JAN-ERIK LANE

GLOBAL WARMING

VOL. 2

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Global Warming

Vol.2

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ISBN: 978-625-8190-28-1 (e-Book)
KSP Books 2022
Global Warming Vol.2
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Dedication

To the memory of

Aaron Wildavsky

University of California Berkeley

Foreword

It is possible to present a brief summary of the subjects that the chapters in this book focus on.

Ch 1. Global warming is the result of an enormous drive for energy during the last 150 years. And demand keeps going up making the COP goals unachievable. I will argue for this inevitability by means of both global and local evidence.

Ch 2. Global warming is the result of an enormous drive for energy during the last 150 years. And demand keeps going up making the COP goals unachievable. Fossils will still dominate with renewables as only increments. Author supports this inevitability argument with data about global trends and local analysis of a few of the heavy emitters of CO2s. Since the demand for energy is still rising, one understands why China and India as well as Brazil and Indonesia renege on the COP ambitions. In fact, all states in the COP club renege somehow, because the demand for energy is overwhelming. Despite this several countries face today energy shortage.

Ch 3. Human beings have existed as modern homo sapiens for some 100 000 years, recent DNA research informs. And this race has grown to a staggering 8 billion almost, dominant over all other living species and subjugating the other human races.

The 21th century will end the fantastic story about Cro-Magnons as planet Earth no longer will support advanced forms of life, I.e. low temperature, supply of food, access to drinking water as well as war between or within nations and even civilisations. Only intergovernmental coordination can slow the process of climate change, but the nature of international relations prohibits it.

Ch 4. African nations share a common situation in that they pollute little in terms of CO2s globally speaking, but at the same time global warming may have terrible consequences for the continent, set to face a sharp population increase. They have now access to few energy resources, which is conducive to their poverty. New renewables belong to the future (solar, wind, geo-thermal), whereas old renewables – wood coal – are a thing of the past. The coal or oil and gas dependent giants must start energy transformation, as must the many countries relying upon traditional biomass. The use of wood coal is simply too large for the survival of the African forest. Under the COP21, African countries have right to financial assistance, especially for more electricity to connect its rural and also many urban people to heating, air-conditioning and the electronic high ways. Without the COP21 promises, decarbonisation will be impossible in Africa, and thus its large need for more energy will lead to more CO2:s.

Ch 5. International political coordination in the UNFCCC or G20 runs with a basic insufficiency , making it too weak to respond to the climate change challenge that could bring about a worst case scenario for mankind. Scholars have shown that the UN climate decision-making is manipulated by self-interests from the major powers (Conca, 2015; Vogler, 2016). The Sachs' ideas (2015) of using climate change policy-making to solve other problems like poverty, global redistribution of wealth and stopping general environment degradation make matters just more complicated, resulting in massive transaction costs and likely policy failures. The likelihood of disaster is on the increase, which is why solar energy parks must both replace lots of fossil fuel and wood coal energy as well as provide for the planned strong increased demand for energy.

Ch 6. One may introduce a concept of Hawking irreversibility as the point where temperature has risen so much that the global warming consequences threaten the survival of mankind. The recent news out of China that its CO2s are increasing again makes this term highly policy relevant. Moreover, the methane emissions have started to augment, which also calls up Hawking irreversibility. The drive behind these dire developments is the endlesszest for affluence and wealth, fueled by ever larger energy consumption. Asian miracle economies should take this warming seriously and srart the implementatuion os COP21 Treaty.

Ch 7. The global warming problematic is in reality decided not by the UNFCCC or IPCC with its mastodon meetings. The decisive players are the states of the following BIG polluters of CO2: China, India, Indonesia, Brazil, Russia Mexico, South Korea, Canada, Australia and the US, despite the fact that its present government already has defected from the common pool regime, set up in Paris 2017, These countries together with international shipping and aviation are putting out more than 50% of the CO2s. However, they are little interested, because they emphasize the policy-making of socioeconomic development, either economic growth with rich countries or the "catch-up" strategy with poor or emerging economies. Resilience will decide which countries can support the consequences of climate change.

Ch 8. The upcoming COP23 at Bonn of the UN and its UNFCCC must outline how its COP21 objectives are to be promoted by means of concrete international and national management. Only a massive replacement of fossil fuels and wood coal by solar power parks, can wind power and atomic power save mankind from the grave threats of global warming. This paper presents a tentative estimation of what is involved with regard to the fulfilment of COP21's GOAL II—decarbonisation to 30-40 per cent of 2005 level of emissions.

Ch 9. Well-known professor Johan Rockström at Stockholm University claims that we are in control of things, now that the Earth Sciences have proven the biological limits of our existing civilisations. But we do not know or have not begun the necessary large global adjustments towards a sustainable Planet Earth. The failure of the UN COP framework is blatant stating the ends but not the means of reducing significantly CO_2 emissions. All major countries plan for much more energy in coming decades treating renewable energy sources as merely compliment to fossil fuels, not substitutes. To accomplish the Paris Accord objevties (COP 21), coal power should be phased out.

Ch 10. The opinion on global warming is sharply divided. On the one hand, we have the climate change DENYERS with different arguments for their position. On the other hand, there are the climate change AFFIRMERS, also suggesting a variety of arguments to support their case. Both fact and value figure in the psychology of climate change.

J.E. Lane
Switzerland
September 15, 2022

Contents

1 Global warming and energy: Hawking's inevitable scenario

Introduction

The energy profile in Figure 1 indicates two of the fundamental facts for early 21th century, namely: enormous growth in energy consumption and almost 90 reliance on fossils that result in CO_2s, the predicament of heating Earth. Figure 1 shows the major kinds of energy today.

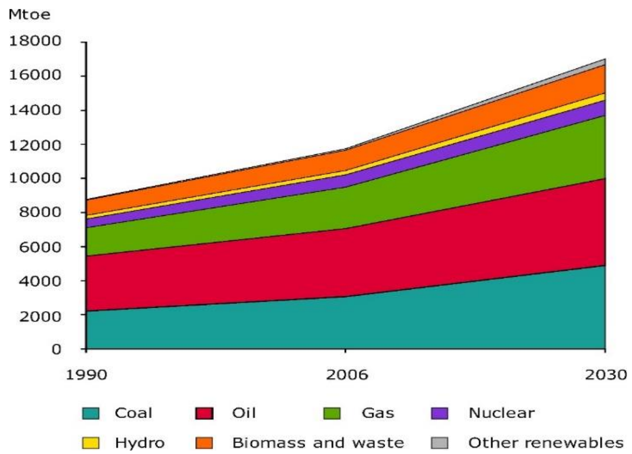

Figure 1. *Energy Consumption by Source (EEA, 2012)*

The energy profile in Figure 1 indicates two of the fundamental facts for early 21th century, namely: enormous growth in energy consumption and almost 90 reliance on fossils that result in CO2s, the predicament of heating Earth.

Humans and energy

Energy is so essential to humans. All need its functions, and current total consumption of energy is roughly 70 Gigajoules per capita. Yet, the differences in per capita energy access are enormous.

Table 1. *Per Capita Energy Consumption (giga joules per year) (BP, 2021)*

	2010	2019
Africa	15,4	15,2
Asia Pacific	50,7	60,9
Australia	240,5	233,2
Brazil	56	58,9
China	76,2	99,1
Germany	169,6	156,3
India	18,2	24,8
Japan	164,2	144,8
Middle East	135,3	146,2
Russia	195,1	204,9
South Korea	218,3	239,1
Sweden	229,8	223,4
United States	300,7	288,4

A human needs about 10 mega joules per day to survive healthy, or 3,8 GJ annually.

Coal power

COP22 tried to ban coal as energy source by 2030 against China and India's objections and ultimately veto. However, burnings of wood and charcoal without replanting give more CO2 emissions.

Countries that produce oil and gas for export have large CO2s. Per capita emissions are highest in Qatar (Figure 2).

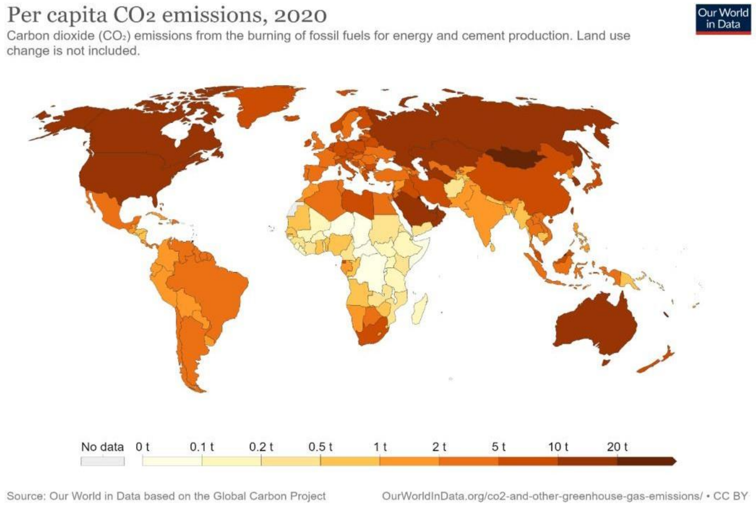

Figure 2. *Per Capita CO2 Emissions 2020 (Our World in Data, 2021)*

We have to look at China, United States and Russia to find huge total emissions. All suffer badly from environmental impact of fossil extraction.

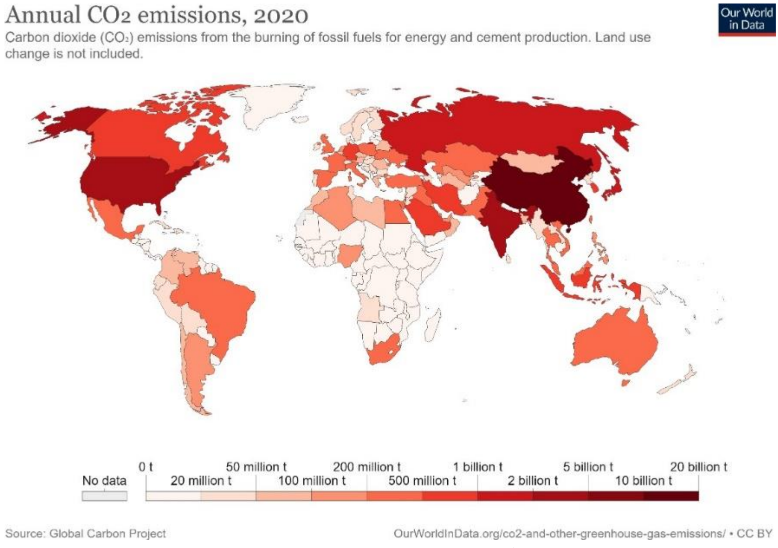

Figure 3. *Total Annual CO2 Emissions 2020 (Our World in Data, 2017)*

Fossils and development China and India

China and India

The energy situation in the most populous countries in the world is of great concern. It is not only that coal power makes up about half of total energy consumed – see Figure 4 and Figure 5.

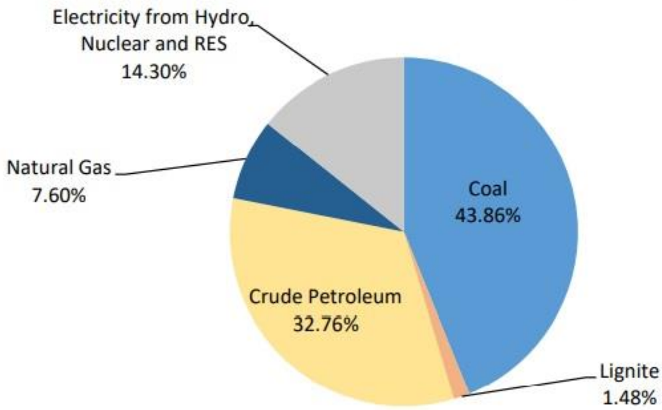

Figure 4. *India Consumption of Energy 2019 (Energy India, 2021)*

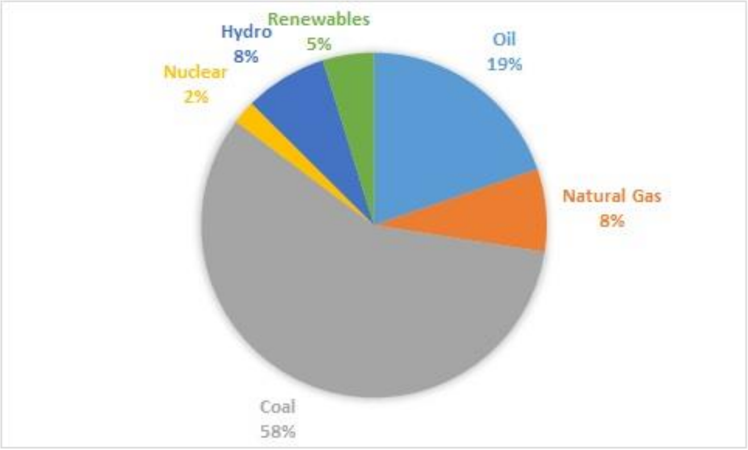

Figure 5. *China Consumption of Energy 2019 (BP, 2021)*

Although both countries have access to renewable power sources, coal and other fossil fuels dominate. In addition, the electric power in India and China is overwhelmingly produced by coal – see Figure 6 and Figure 7.

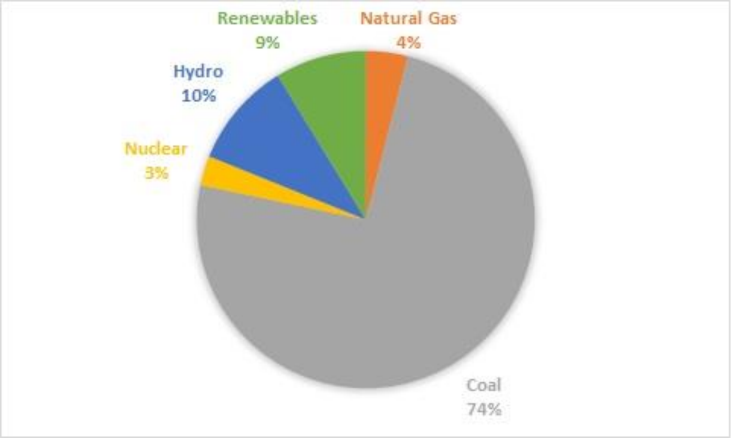

Figure 6. *Electricity Production in India 2019 (BP, 2021)*

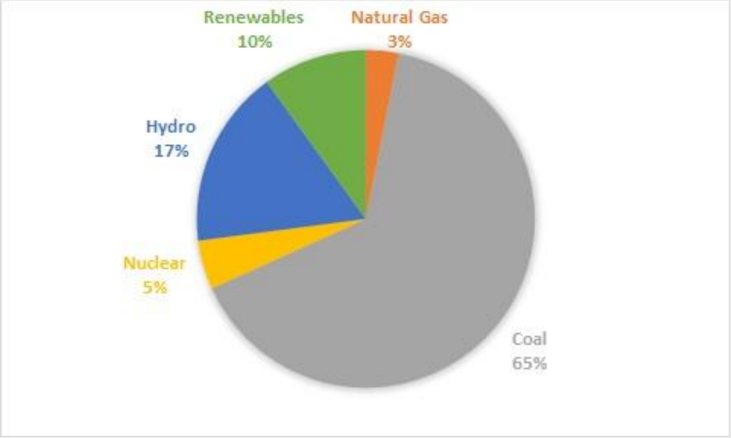

Figure 7. *Electricity Production in China 2019 (BP, 2021)*

Both countries face enormous challenges:

1) Retrieve electricity from non fossils;
2) Replace fossil fuel power with electricity;
3) Increase total power supply considerably.

China says it can accomplish all these goals by 2050, whereas India wants a delay until 2060.

Qatar and Russia

Oil producing nations like Qatar and Russia and Nigeria are all heavily dependent on fossil fuels.

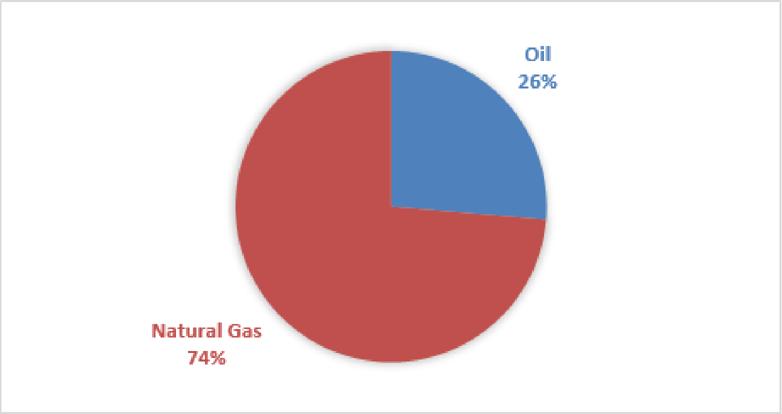

Figure 8. *Primary Energy Consumption for Qatar 2020 (BP, 2021)*

Qatar displays conspicuous consumption of energy, as it simply has too much. Besides exports Qatar offers its small population free electricity and water from desalination plants. These inefficiencies lead to CO_2 emissions but the COP does nothing.

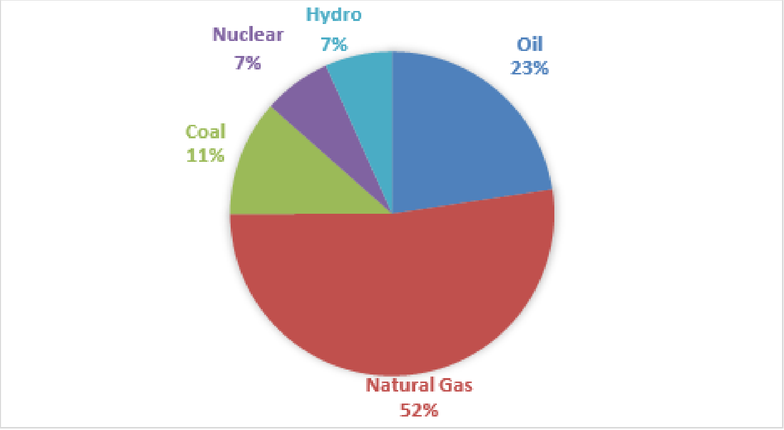

Figure 9. *Primary Energy Consumption for Russia 2020 (BP, 2021)*

The energy - ecology predicament in Russia is more subject of close monitoring and debate. Typical of the USSR was disrespect for the environment. Today Russia bets heavily upon fossils while its tundra softens releasing methane. Energy resources are most plentiful but their extraction has not generated as much citizen affluence as military power. Like Qatar, Russia prefers to rely upon its fossils, especially natural gas. The Russian government promises carbon neutrality by 2060, which is too late for the COP. How will Russia protect its Boreal forest?

Commons' tragedies: Brazil and Indonesia

Global warming is attended by a whole set of commons deteriorations linked somehow to each other. There are two countries in particular that worsen the climate and ecology of Earth. First, Brazil and Indonesia have not protected the rainforests that are the lungs of Earth. Second, both resort to massive employment of coal and other fossils despite hydropower. Figures 10 and 11 display their fossil dependence.

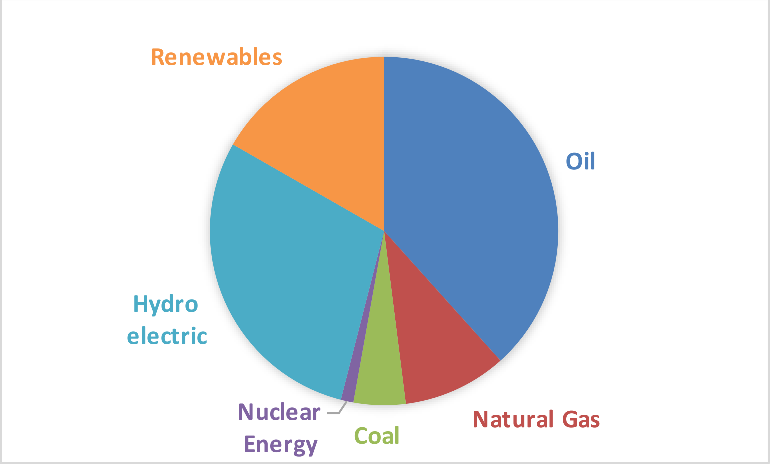

Figure 10. *Primary Energy Consumption Brazil 2020 (BP, 2021)*

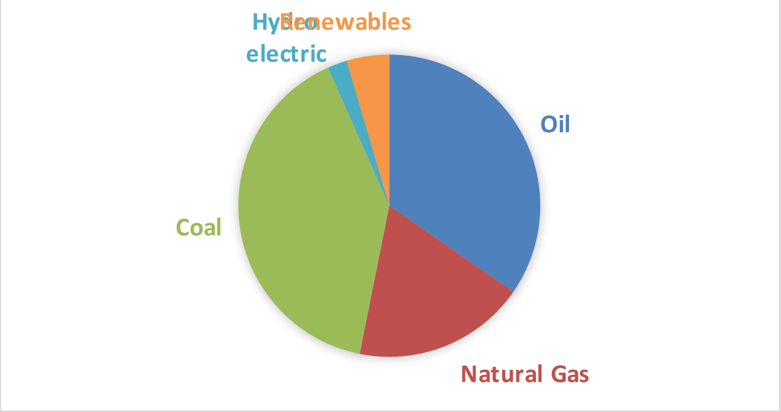

Figure 11. *Primary Energy Consumption Indonesia 2020 (BP, 2021)*

CO2s

The amount of CO2s in the atmosphere depends upon emissions of greenhouse gases and these depend upon the size and economic development of the country. Table 2 defines the 20 biggest emitters of CO2.

Table 4. *CO2 Share of World Emissions by Country 2016 (Worldometers, 2021)*

Country	Share of World emissions
China	29.18%
United States	14.02%
India	7.09%
Russia	4.65%
Japan	3.47%
Germany	2.17%
Canada	1.89%
Iran	1.80%
South Korea	1.69%
Indonesia	1.48%
Saudi Arabia	1.45%
Brazil	1.29%
Mexico	1.23%
Australia	1.16%
South Africa	1.09%
Turkey	1.03%
United Kingdom	1.03%
Italy	1.00%
France	0.93%
Poland	0.83%

The Keeling curve has increased by 2 percent per year since global warming was diagnosed by researchers at the NASA Goddard Space Center in 1988 (Hansen *et al.*, 1988), driven by CO_2 emissions. The amount of greenhouse gases has augmented sharply, driven by energy increases. The latter will not decrease. On the contrary, both greenhouse gases and energy consumption is up 2021 from 2020. Here is the crux of the matter. When global emissions go up 1%, the Keeling curve goes up 2%, It is all about energy. The demand for energy goes up year after year. Since 1990 the increase is 0,8 per cent, as illustrated in Figure 12.

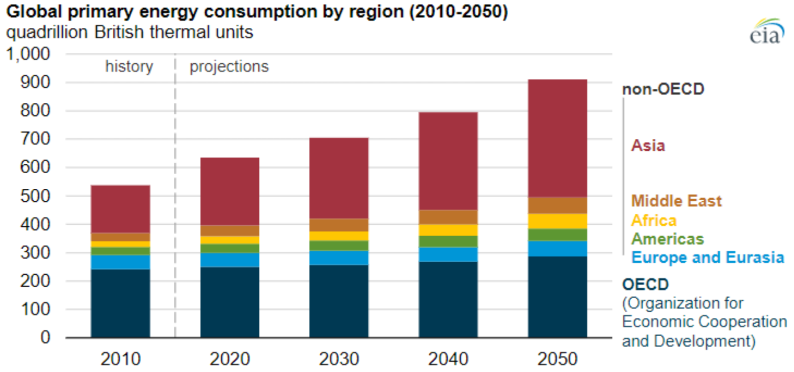

Figure 9. *Projected Energy Demand 2020-2050 (EIA, 2021)*

Conclusion

Since the demand for energy is still rising one understands why China and India as well as Qatar and Russia renege on the COP ambitions. In fact, all states in the COP club renege somehow because the demand for energy is overwhelming. Hawking was right stating large unavoidable climate change.

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2 Ecology and demand for energy

Introduction

Global warming is the result of an enormous drive for energy during the last 150 years –see Figure 1. And demand keeps going up making the COP goals unachievable. Fossils will still dominate with renewables as only increments. Figure 1 shows the major kinds of energy today as well as the global trend.

The global energy profile in Figure 1 indicates two of the fundamental facts for early 21th century, namely: enormous growth in energy consumption and an almost 90 reliance on fossils that result in CO2s i.e. the predicament of a heating Earth.

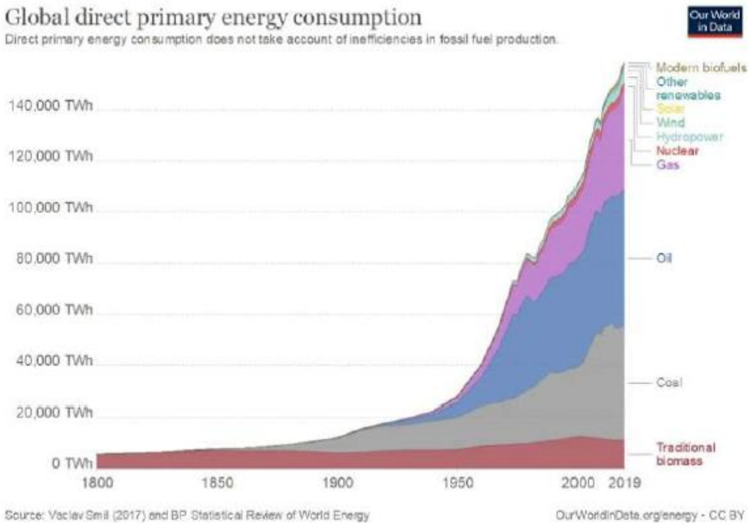

Figure 1. *Energy consumption by source (Our World in Data, 2017)*

Capacity to do work

Energy is so essential to humans and needed for its functions. Today total consumption of energy is roughly 70 Gigajoules per capita. Yet, the differences in per capita energy Access are enormous – look at the following country numbers in Table 1.

Table 1. *Per capita energy consumption (giga joules per year) (BP, 2021).*

	2010	2019
Africa	15,4	15,2
Asia Pacific	50,7	60,9
Australia	240,5	233,2
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United States	300,7	288,4

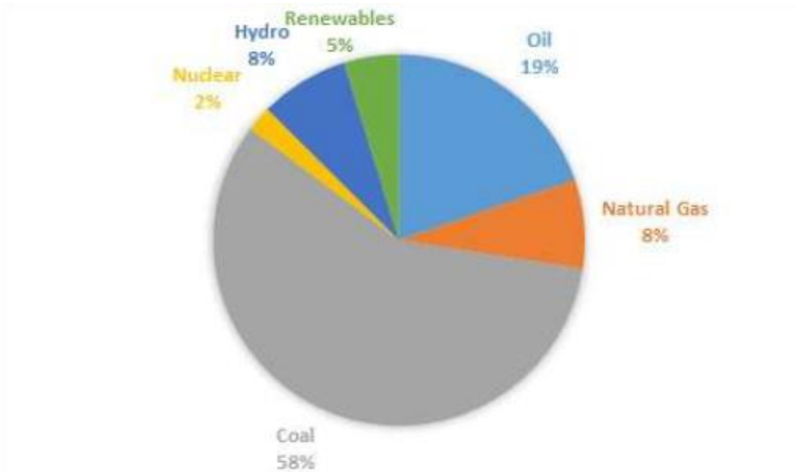
A human needs about 10 mega joules per day to survive healthy, or 3,8 GJ annually.

Coal power

The COP at *Glasgow* concentrated on phasing out *stone* coal poeer by 2030. Alas, coal figures too prominently ìn the *energy profile* of the huge polluters.

China and India

The energy situation in the most populous countries in the world is of great concern. It is not only that coal power makes up about half of total energy consumed – see Figure 2 and Figure 3.



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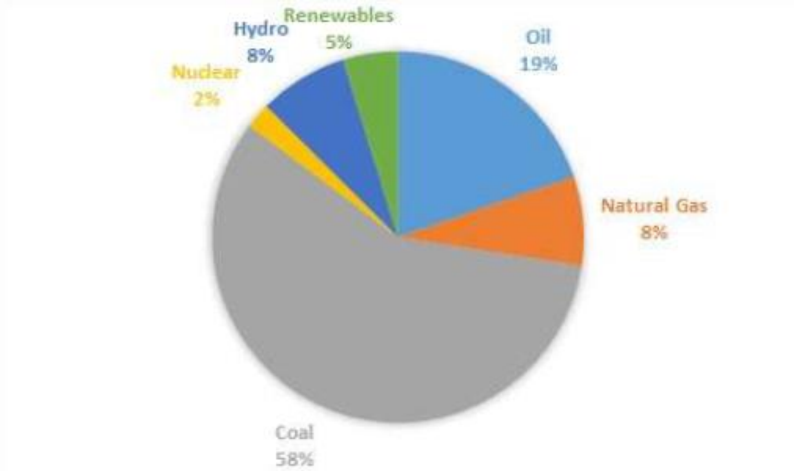

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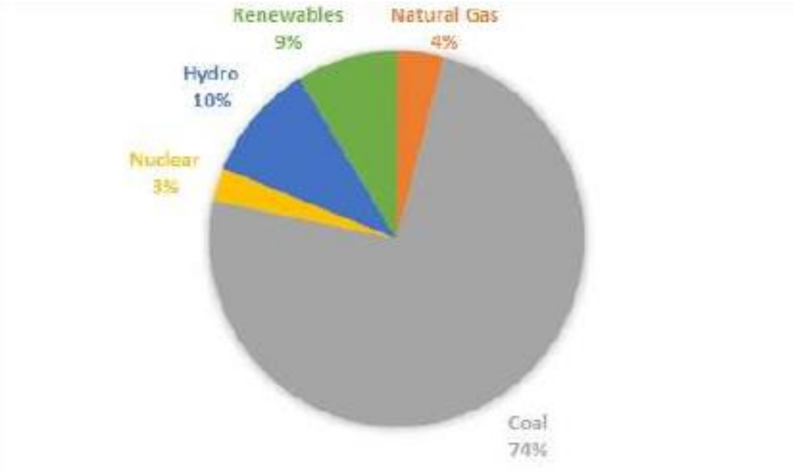

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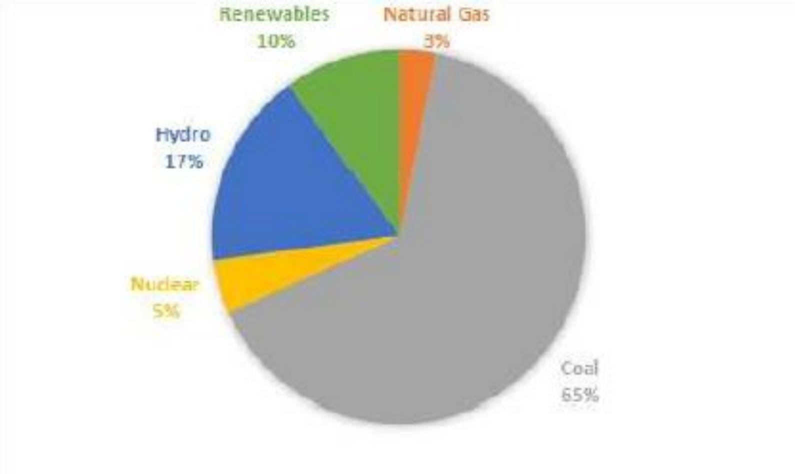

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Figures 6 and 7 display their fossil dependence.

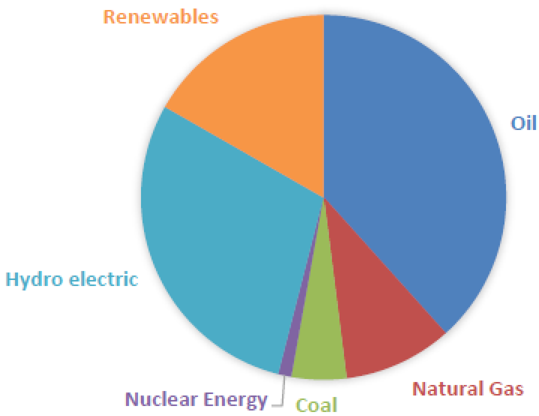

Figure 6. *Primary Energy Consumption Brazil 2020 (BP, 2021)*

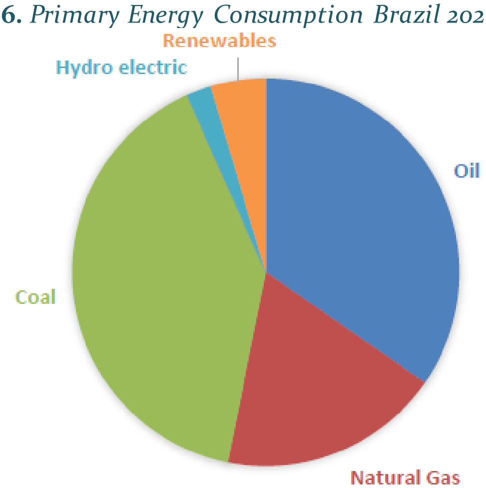

Figure 7. *Primary energy consumption Indonesia*

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The demand for energy goes up year after year. Since 1990 the increase is 0,8 per cent. Figure 8 shows some estimates of future energy.

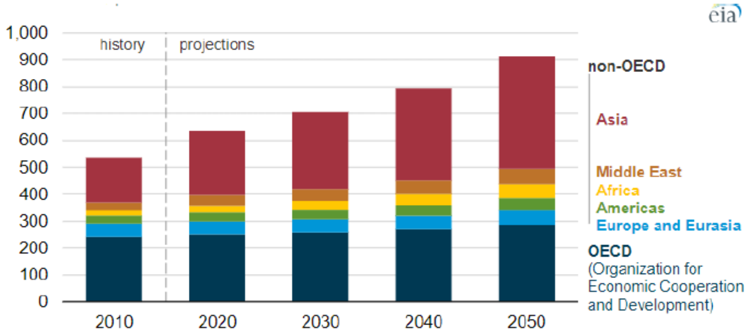

Figure 8. *Projected Energy demand 2020-2050 (EIA, 2021)*

Conclusion

Fossils play such a dominant role for the supply of energy that the use of renewables will be marginal among the big emitters of CO_2 – this analysis shows. Since the demand for energy is still rising, one understands why China and India as well as Brazil and Indonesia renege on the COP ambitions. In fact, all states in the COP club renege somehow, because the demand for energy is overwhelming, I would say. Despite this several countries face today energy shortage.

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3 Intergovernmental coordination without the big polluters

Introduction

Country differences in government response to Nature's challenges to mankind differ. What is extremely important is that policies do not aggravate the situation for humanity. However, some governments fuel chaos in the fight against the COVID. How about global policies towards climate changes? Could intergovernmental coordination work? Mankind is ravaged by a corona virus – COVID weakening social systems and states. COVId-19 has caused chaos in several countries - see Table 1

Table 1. *Outcomes of COVID as of July 18, 2020 (Worldometers)*

Country	[1] Cases	Total Deaths	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop
USA	3,775,280	142,127	11,403	429	46,634,931	140,852
Russia	765,437	12,247	5,245	84	24,676,930	169,092
Spain	307,335	28,420	6,573	608	6,026,446	128,892
UK	294,066	45,273	4,331	667	13,112,764	193,111
Italy	243,967	35,028	4,035	579	6,154,259	101,795
Germany	202,416	9,162	2,416	109	6,884,614	82,159
France	174,674	30,152	2,676	462	2,618,722	40,115
China	83,644	4,634	58	3	90,410,000	62,814

Sweden	77,281	5,619	7,650	556	681,820	67,492
S. Korea	13,711	294	267	6	1,460,204	28,480
Denmark	13,173	611	2,274	105	1,306,743	225,566
Australia	11,441	118	448	5	3,413,831	133,809

Some numbers are shocking. The lack of a proper uniform response is significant, and it could come from intergovernmental *coordination*. The policy guidelines of the WHO were neglected by the worst-off countries. At the same time, biologists and Earth Scientists emphasize that global warming is spinning out of control, fueled by the set of tipping points.

International anarchy

Anarchism as political theory is paradoxical. On the hand, it has few adherents when it is a matter of the domestic polity – although supand ported by none less than Prudhoun, Bakunin, Tolstoy, Krapotkin and Chomsky. On the other hand, it is the prevailing doctrine about international relations. Here it is called *realism,* coming in different versions, more rational or more aggressive. The chief theoretician is Hans Morgenthau. Realism in international theory implies that governmens operatör in än international *system* so as to maximise the interests oftast the system (Bull 1977; Waltz 2008). Hobbes rejected domestic anarchism but endorsed the international anarchy.

However, the opposite approach to international relatìöns underlines ìnstìtutions that restrain States to honour agreements and cooperate peacefully. Here, we have the theory of normativity. It has grown in relevance since World War War two. But we are far from a world federation with Kant or Humanity's Law (Teitel). Jurists have outlined global constitutionalism with the hope of *peace through law* as Kelsen argued.

Intergovernmental coordination is slow and cumbersome. Transaction costs tend to skyrocket. But it is sometimes successful like global economic governance by the WB, IMF and the WHO. Moreover, international governance succeed in resolving the ozone layer problem, at least temporarily. Why, then, does not climate change policies work? Because the *Big* polluters stand by the sidelines watching only what happens at the UN mega reunion.

Lack of normativity globally

To understand the pollution of Earth by greenhouse gases one must identity the major polluters. The governments of the nations of the world have delayed action on climate change for more than 30 years. The next IPCC conference has been postponed until late 2021. What interests do governments pursue in climate change policy making?

First, one needs to focus on which states are responsible for the most emissions. Tables 2-4 present the 10 biggest polluters of CO_2, CH_4, and N_2O, respectively, the "Mega Polluters" .

Table 2. *World leading emitters of CO_2 (Burton)*

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 3. *Leading Emitters of CH_4 (Burton)*

Country	Emissions / gt CO_2 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	58.11

Table 4. *Leading Emitters of N2O (EDGAR)*

Country	Emissions / mt CO_2 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 zealously at zero emissions don't matterq at all.

The costs of CO_2 reduction

CO_2 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 total replacement of coal-fired electricity by solar energy. Table 5 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 5. *Number of Bhadla Solar Park plants required to replace coal power by country (Global Energy Monitor)*

Country	Number of plants
China	475
India	100
Japan	28
South Korea	18
Americas	
United States	106
Colombia	1
Europe	
Germany	32
Russia	30

Africa	
South Africa	14

Only if the governments of states were conducting their businesses with *normativity* would they honour commitments in an ocean common pool regime like the Paris Agreement 2015. Yet, we live on Morgenthau's planet where states interact in international anarchy. Who can convince the above governments to dismantle coal power plants?

Morgenthau formulated the theory that states pursue egoism like individuals, always being prepared to defend their interests against any threat. The International *system* Is a Hobbesian djungel with little normativity, which is why intergenerational coordination fails on environmental issues.

Problematics of environmental coordination

1) Information: people still ask the question that Wildavsky (1997) raised posthumously: is it really true? Global warming is a theory and the evidence can never become 100 percent. Uncertainty concerns: a) what temperatures can humans support, and b) how fast will temperatures go up? The amount of CO_2 is steady on the Keeling scale due to COVID, but CH_4 may rise now as the permafrost thaws—how dangerous? Deluteness and intermittency may lead government to distrust renewable power and look for e.g. thorium power.

2) Incentives: the basic logic of the PD model applies also when we have an oceanic game with some 200 players or governments. The Nash solution still holds: defection for any finite repetition of the game. This is the free rider strategy to externality—Stern says global warming is the largest ever. What complicates intergovernmental coordination is that poor countries want the OECD's to foot the costs for energy transition, obliquely promised in Paris 2015.

The more the EU diminishes pollution, the longer the BIG POLLUTERS simply roll their thumbs.

3) Strategy: delay. Since energy transformation is costly and uncertain, the best is marginal changes. Technology advances rapidly—why bet on an inferior technique? Tomorrow superior

solutions arrive—just wait! How about gigantic carbon capture with fusion energy?

4) Needs: energy demand has risen enormously since 1960 and is predicted to double up to 2050. More and more states will turn to renewable, but they will not reduce fossils significantly. At the end of the day, Superpowers need energy for military might and poor states need energy for development. All the energy agencies predict rising energy demand with stable fossils. If all cars become EV, where is all the electricity to from? Maybe dams dry up?

5) Tactics: pretending. Given the popular anxiety for Armageddon as climate change and species' extinction, the big polluters take only limited initiatives or build Potemkin villages.

Thus, the EU promises carbon neutrality by 2050. At the same time, it allows Germany and Eastern Europe to burn massive amounts of dirty coal beyond 2030. Sweden imports biotrash to burn for heat and electricity. Similarly, pellets are cut in the US to be burned in Western Europe. China closes some coal plants and rebuilds a few elsewhere, sometimes abroad. India aims to use coal power for electricity to 300 million poorest. And the US hopes that fracking will make them the number one oil exporter.

Conclusion

Foreign policy is driven by expectations. As long as the big polluters expect few changes in the short run, they pay lip service to the theory of global warming (Schneider, 1989; Stern, 2006). Government expectations are not always rational, even though continuously updated legally or illegally—Brazil for instance.

Examination of COVID policy in the US leads one to observe CHAOS. The same observations apply to global climate change policy. The most likely scenario is that the Big Polluters—also BIG POWERS—recognize too late Hawking's irreversibility, provoking chaos, migrations as well as confrontation in war. A world based on opinion juries would be better than realpolitik.

The roles of China and India appear in a crystal clear manner in the above Tables. Yet, arguments for their extreme pollution quantities are widely different.

On the one hand, Indian governments refer to dismal poverty of the giant country with its millions of homeless and illiterate claiming that only coal power can bring electricity to all—unless the rich countries assist financially as they promised in Paris 2015. Confronted by an explosive growth in population, India is running out of options. Nuclear energy is too costly, hydraulic power too uncertain with rivers drying up. Solar power would require much land space and foreign investment. Besides communication in India depends upon fossil fuels, charcoal is used in poor families.

On the other hand, China has huge pollution for a difference reason, namely to become a Superpower like the USA and the EU. Having reduced poverty very significantly, China now has set its goals much higher—to become a global leader. This will require enormous amounts of energy which is why China now promises carbon neutrality first by 2060—too late compared to the EU and California for Instance. See Figure 1.

The plan is to retain fossil fuel but increase renewables and nuclear energy meaning that pollution will not decrease markedly. China promises several countries generously to help with nor their economies, but continues with coal power at home.

According to the Dean of the Lee Kuan Yew School at Singapore the West should accept China's rise to NUMBER ONE (Mahbubani, 2018). No—for several reasons, one of which is environmentalism.

Speaking of global warming responsibility, it makes no sense to speak of history and the early use of fossils by the West. Nor is it relevant to refer to pollution per capita i.e. the GULF. Total GHC emissions must down NOW.

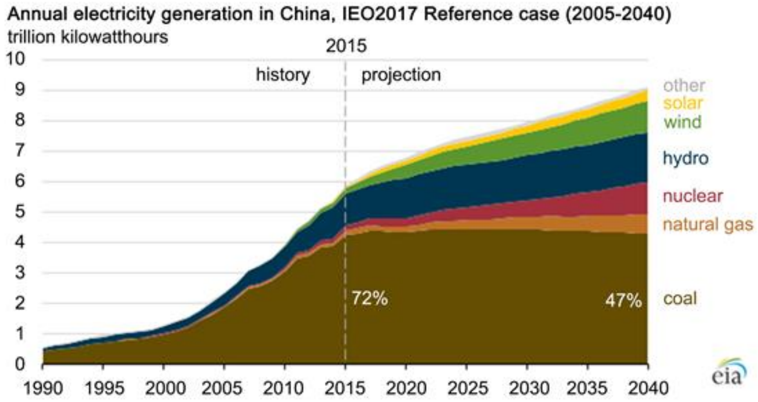

Figure 1. *Projected China electricity generation by source (EIA).*
Source: *U.S. Energy Information Administration (EIA, 2017). International Energy Outlook 2017.*

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4 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 CO_2: 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 CO_2:s will not renege. And then we have the danger of the new methane emissions.

In this paper, I will render a short overview of the energy-emissions 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.

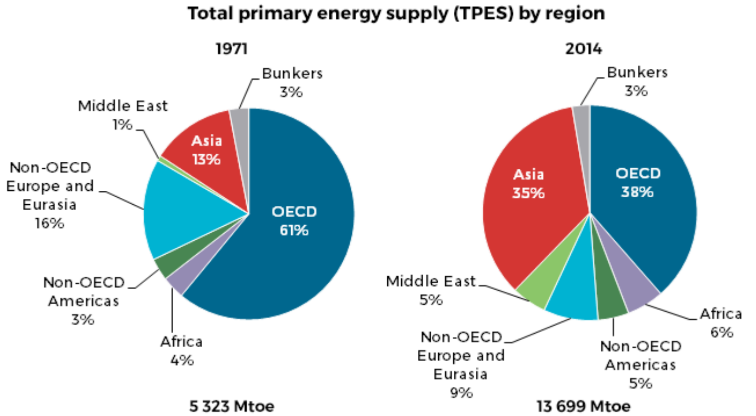

Figure 1. *Global energy*
Source: [Retrieved from].

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.

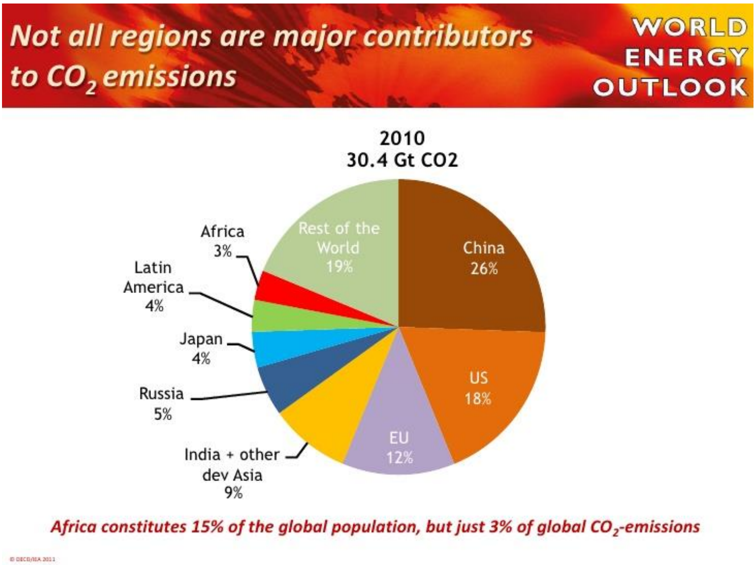

Figure 2. *Global emissions of CO2*
Source: [Retrieved from].

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?

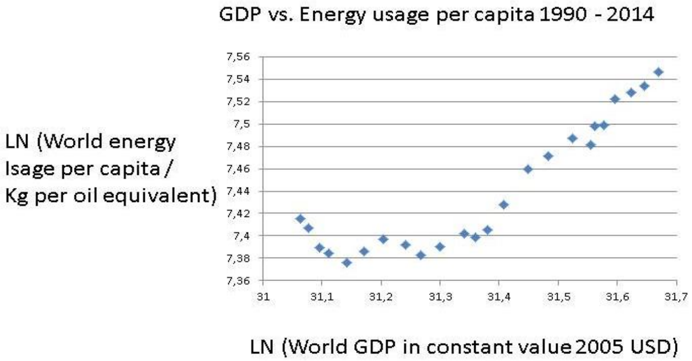

Figure 3. *GDP against energy per person (all countries)*

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 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.

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.

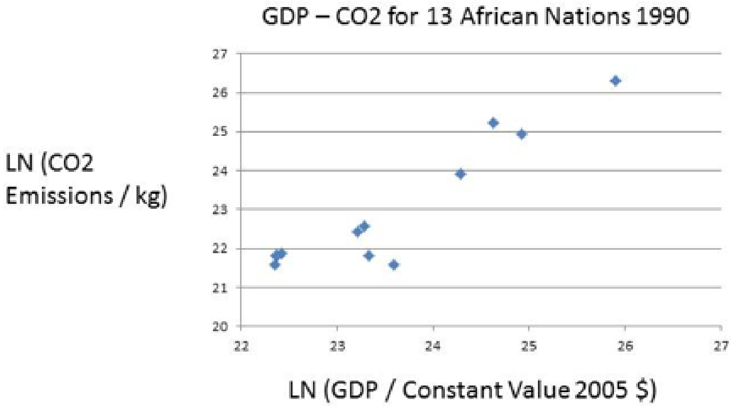

Figure 4. GDP-CO2 link in 1990: y = 1,3354x; R^2 = 0,87

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).

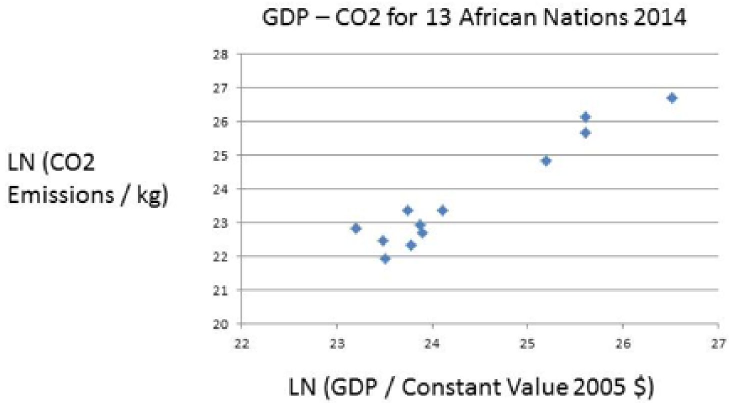

Figure 5. *GDP-CO2 link 2014: y = 1,4684x;* $R^2 = 0{,}93$

Solar power: Estimation of governments' obligations

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 CO_2 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	8	50
Egypt	None	0	80
Senegal	5 – 21	0,3	3
Ivory Coast	28-36	2	3
Ghana	15 – 45	1	3
Angola	35 – 50	6	7
Kenya	30	3	4
Botswana	17	1	2
Zambia	25 – 47	0,7	1
South Africa	None	0	190

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 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 energy-emission 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 shanti-towns, but with what energy source? Figure 6 substantiates the basic point that economic development needs lots of energy all the time.

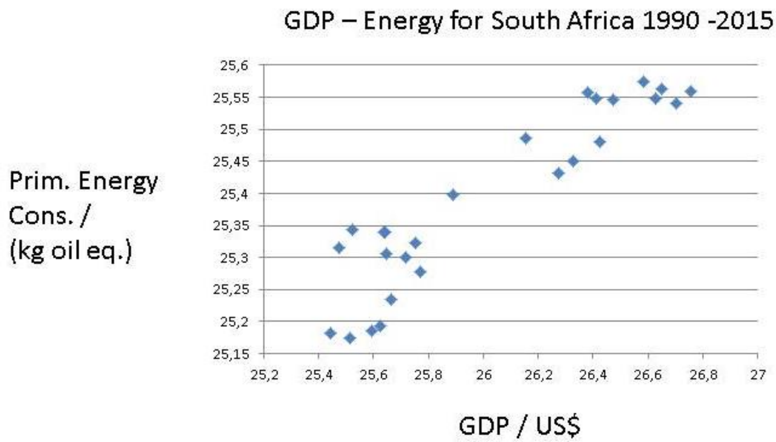

Figure 6. *GDP and energy in RSA : y = 0,2814x; R^2 = 0,8597*

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.

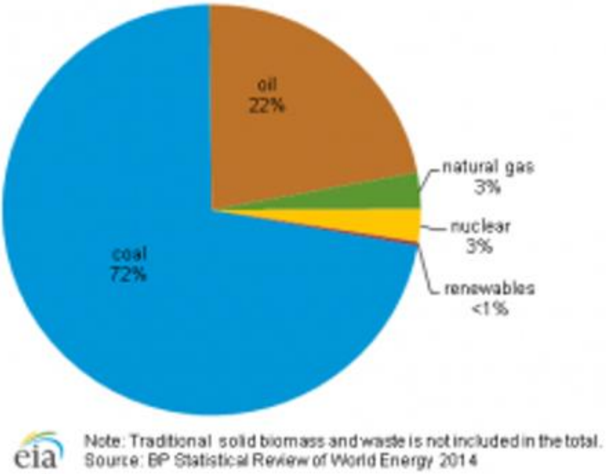

Figure 7. *Energy consumption in RSA*

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.

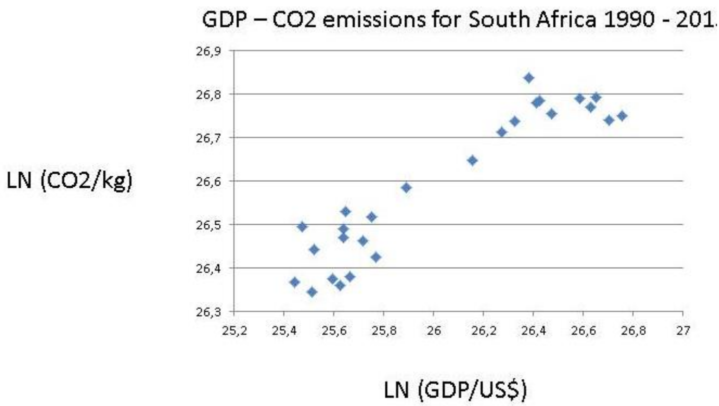

Figure 8. *GDP and emissions 1990-2015: $y = 0{,}3492x$; $R^2 = 0{,}8729$*

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 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.

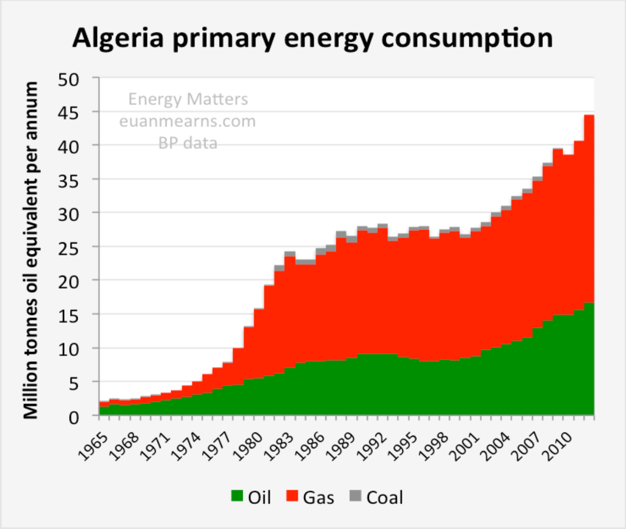

Figure 9. Energy mix in Algeria
Source: [Retrieved from].

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 CO_2 emissions from the COP21. Emissions have thus far followed the economic progress very closely– see Figure 10.

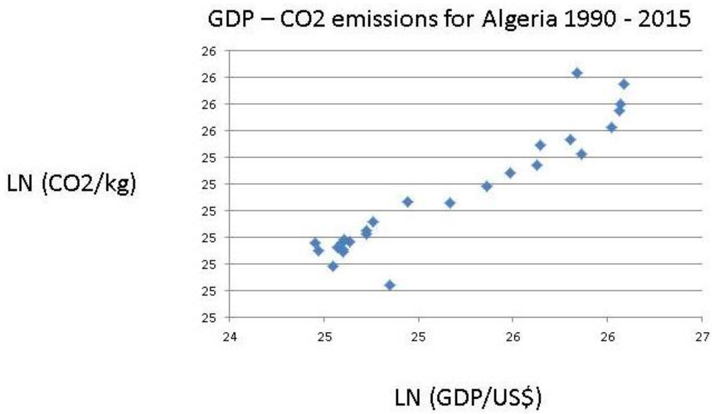

Figure 10. *GDP-CO2 in Algeria: y = 0,81x; R^2 = 0,93*

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.

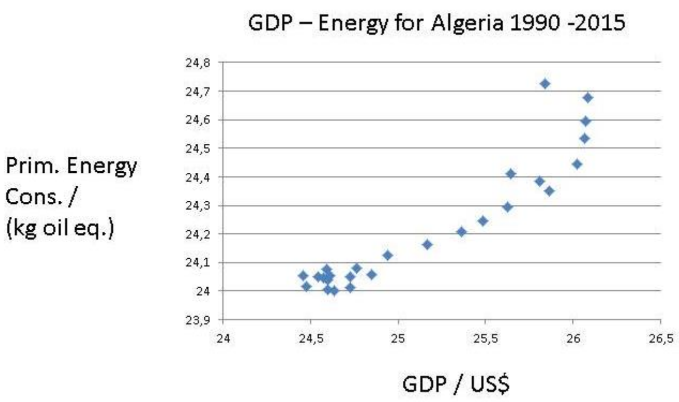

Figure 11. GDP and energy: y = 0,3481x; R^2 = 0,8702

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.

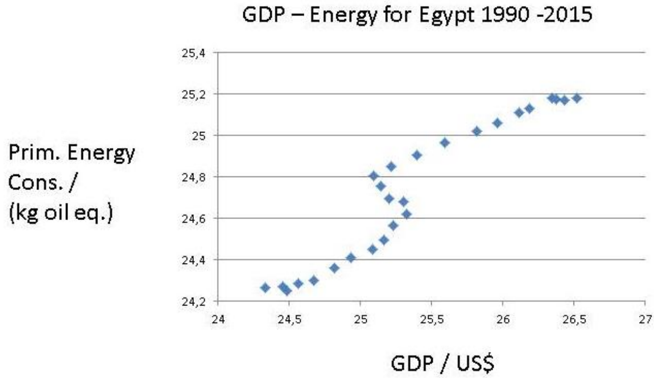

Figure 12. Energy and GDP in Egypt: y = 0,4881x; R^2 = 0,9069

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.

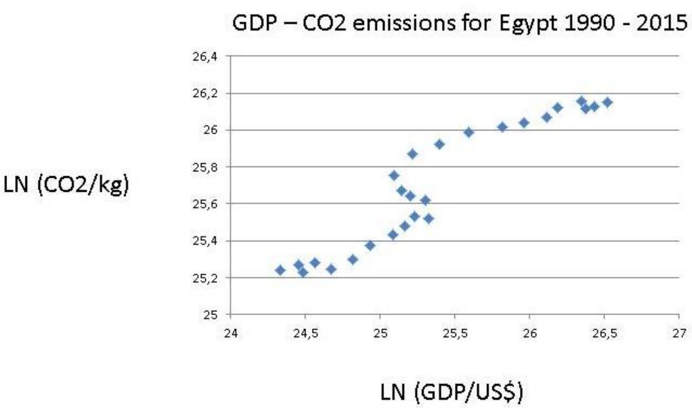

Figure 13. *GDP-CO2 for Egypt: y = 1,02x; R^2 = 0,99*

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 CO_2 emissions (Figure 14).

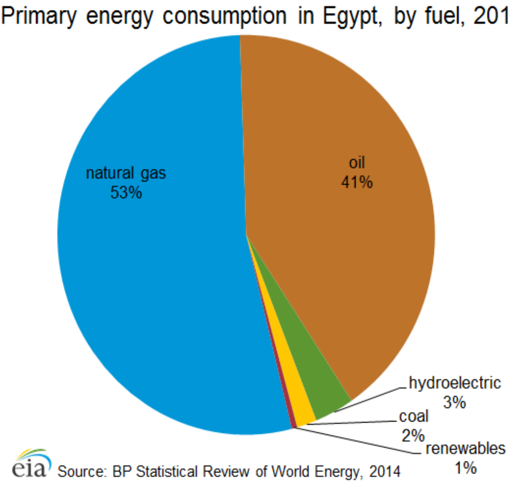

Figure 14. *Egypt's energy mix*

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 CO_2 emissions that follow economic development, as usual – see Figure 15.

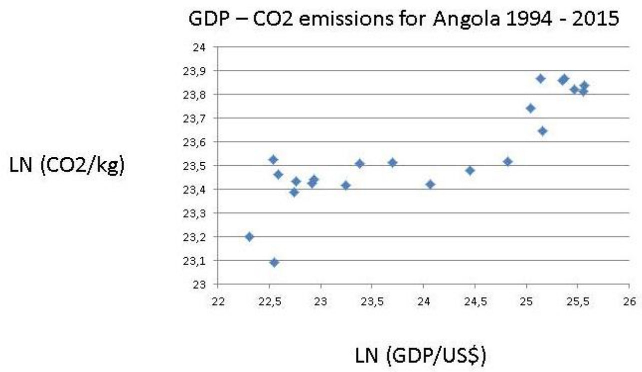

Figure 15. *GDP and CO2:s for Angola: y = 0,1576x; R^2 = 0,7532*

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).

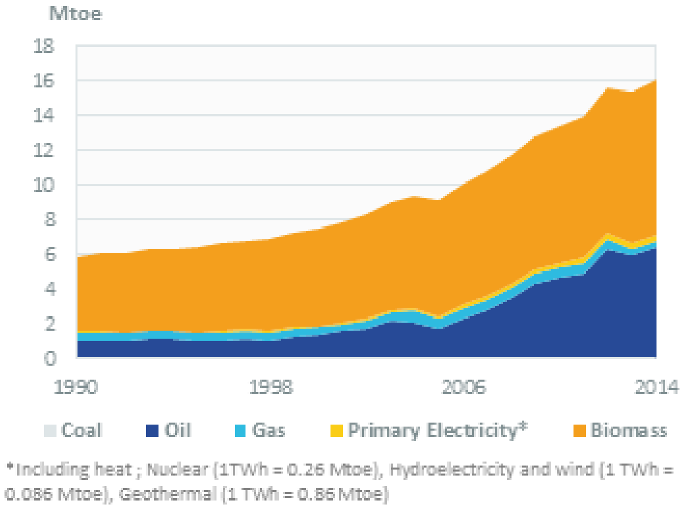

Figure 16. *Angola's energy mix*

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 CO_2:s. This, Nigeria pollutes much totally, although not per capita. Figure 17 shows a somewhat erratic trend that is upward

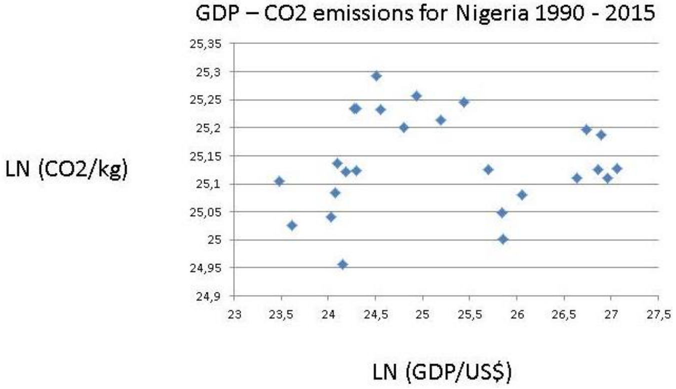

Figure 17. Nigeria: GDP-CO_2 link: y = 0,0032x; R^2 = 0,0018

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

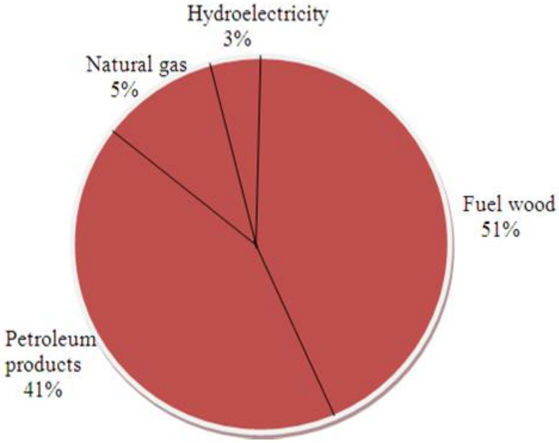

Figure 18. *Nigeria's energy consumption*

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).

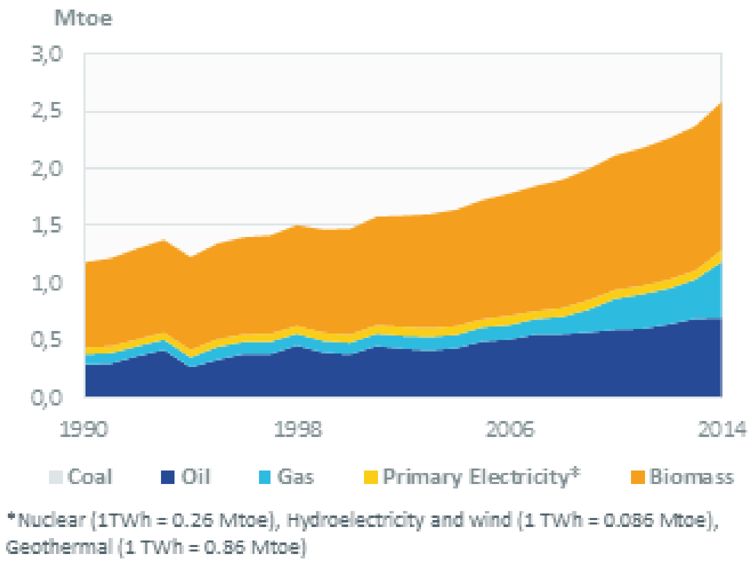

Figure 19. Energy consumption in Gabon
Source: [Retrieved from]. update 2015.

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.

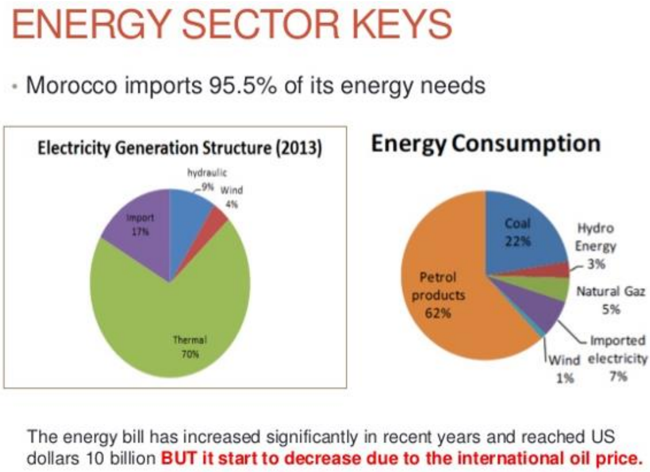

Figure 20. *Energy mix in Morocco*
Source: [Retrieved from].

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.

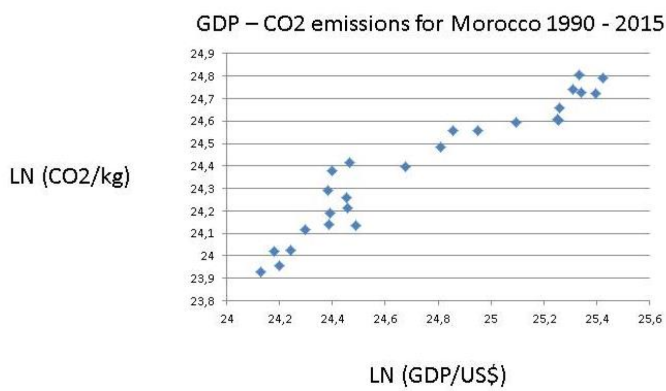

Figure 21. *GDP and emissions in Morocco: $y = 0{,}5846x$; $R^2 = 0{,}9124$*

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.

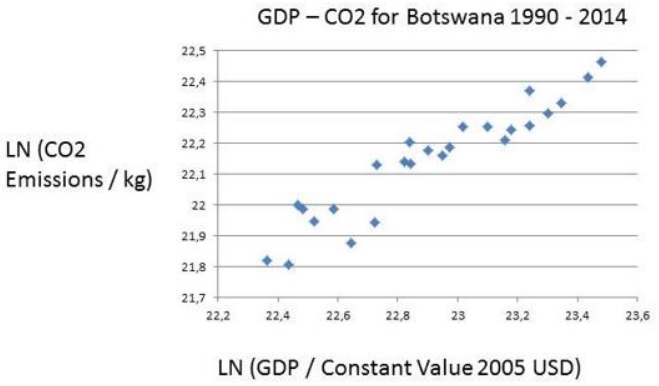

Figure 22. Botswana: GDP-CO2: $y = 0{,}51x$; $R^2 = 0{,}89$

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

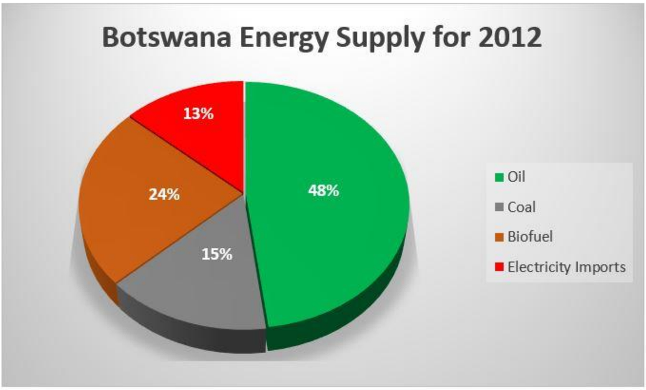

Figure 23. *Energy consumption in Botswana*

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 4).

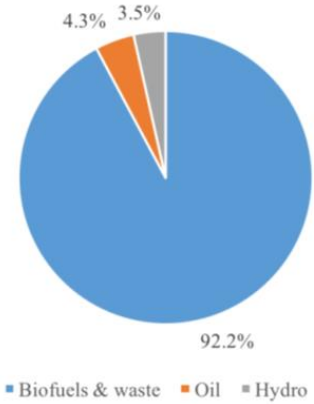

Figure 24. Dr Kongo's energy mix
Source: Democratic Republic of Congo - Energy Outlook, Kungliga Tekniska Hoegskolan

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.

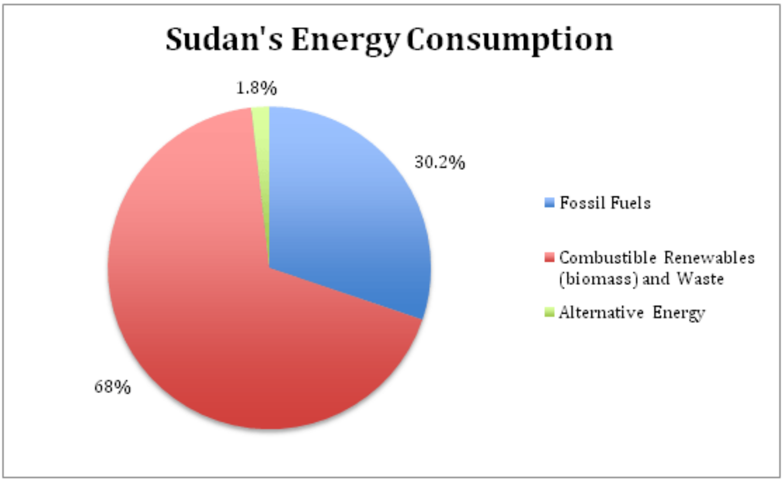

Figure 25. *Sudan's energy mix*
Source: [Retrieved from].

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.

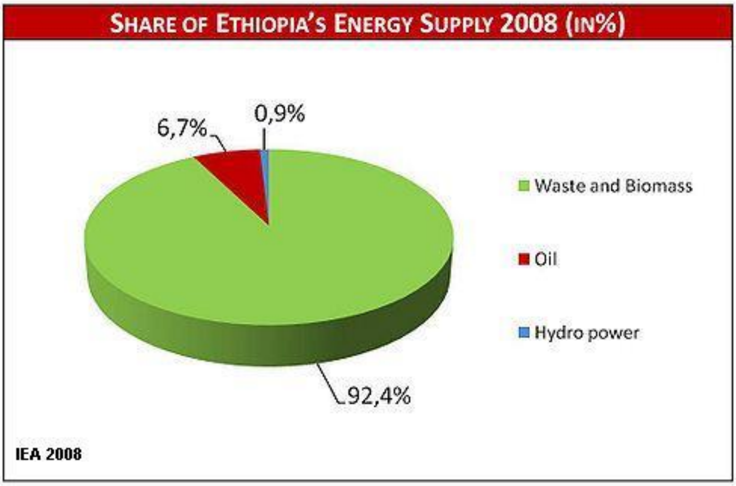

Figure 26. *Ethiopia's energy mix*

Are there any advantages with such a skewed energy mix? No, because even mainly rural Ethiopia delivers with lots of CO2: - see Figure 27.

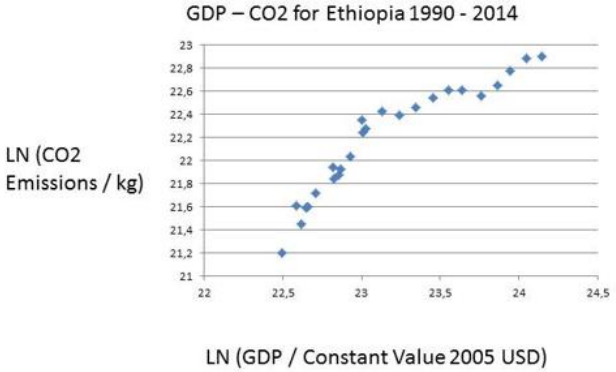

Figure 27. *Ethiopia: GDP and CO2: $y = 0{,}90x$; $R^2 = 0{,}88$*

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 CO_2: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-CO_2 picture for the last two decades, when things have gone well and peacefully.

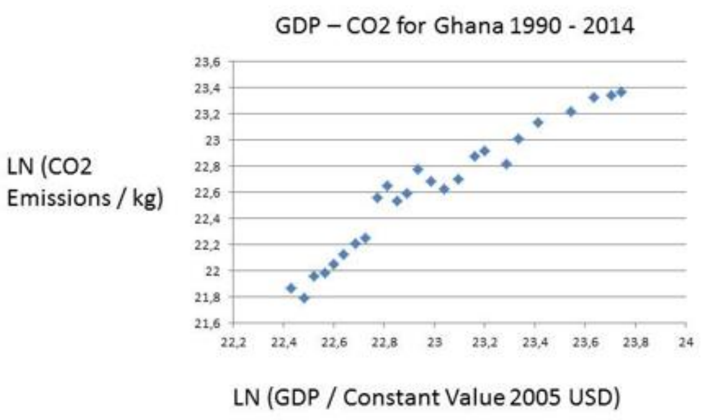

Figure 28. Ghana: GDP-CO_2: $y = 1{,}17x$; $R^2 = 0{,}94$

There is a very strong connection between GDP and CO_2 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.

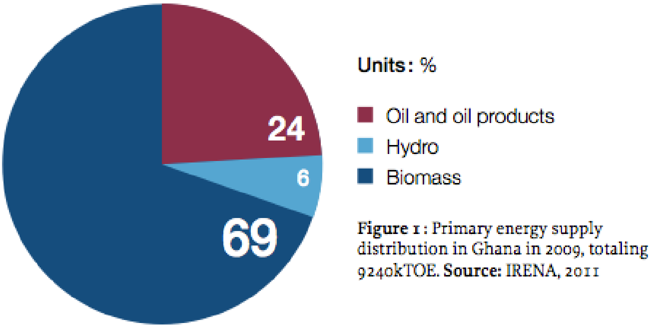

Figure 29. *Ghana's energy mix*
Source: [Retrieved from].

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.

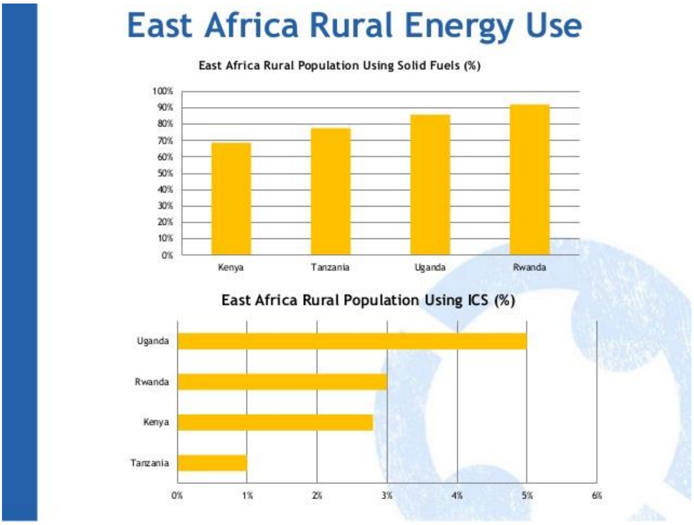

Figure 30. *Energy mix in rural East Africa*

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.

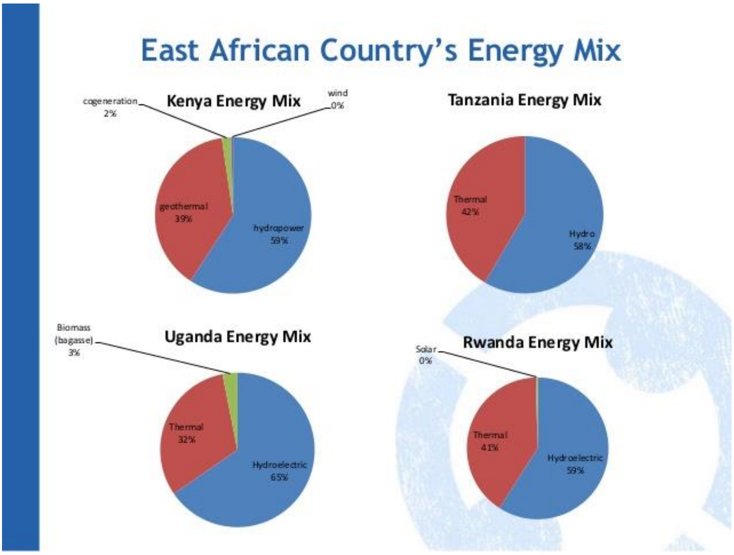

Figure 31. *Hydro power in East Africa*

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.

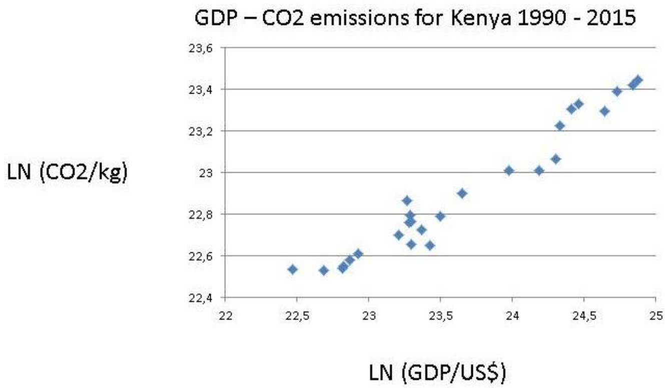

Figure 32. *GDP - emissions for Kenya: y = 0,4154x; R^2 = 0,9501*

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 CO_2 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 *UN 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. Source: [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 CO_2 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 CO_2s, 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 CO_2: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 CO_2: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 & *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) k_1= 0,68, k_2=0,85, k_3=0,95, k_4=0,25; R^2 = 0.885.

Note: LN CO_2 = k_1*LN (GDP/Capita) +k_2*(dummy for Energy Intensity) + k_3*(LN Population) + k_4*(dummy for Fossil Fuels/all) Dummy for fossils 1 if more than 80 % fossil fuels; k_4 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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5 The politics of climate change coordination: The COP21 goals I, II, III

Introduction

The UNFCCC holds a new meeting this fall in Bonn with host country Fiji—the COP23. It has to find a way forward towards the implementation of the COP21 Treaty, although there is already one defection. The islands of Fiji fear of course the sea level rise attending global warming, as there is now a set of islands be- coming inhabitable in the Pacific Ocean, e.g. Tuvalu. But the dangers involved in the global warming process concern all countries on the globe in various forms of risks, immense one in reality.

Political scientist Herman Kahn showed in 1962 by Thinking of the Unthink-able that one can scientifically theorize future scenarios with the inter alia one terrible outcome, namely the elimination of the human species. Nuclear deter- rent has proved effective against this result, with the possible exception of North Korea (Kahn, 1962). But its leader knows that if the country hurts surrounding nations, it will suffer a terrible punishment. Global warming is different, as there is no efficient halting process in place.

Global warming theory (GWT) has come of age. It entails the possibility of a process of continuous warming of the globe until irreversibility is arrived at. Then, humanity is finished forever, as Mother Earth enters a new stage in its giant evolutionary path over hundreds of millions of years. What must be done by international coordination is to set up and operate a common pool regime (CPR) that is capable to halt this climate change process in the 21st century, and maybe reverse it. Is the UNFCCC framework this CPR? I doubt that.

Outline of the theory of global warming (GWT)

One may distinguish between two parts in GWT, one much developed set of hypotheses bout the natural sciences' contribution to understanding climate change, and one less developed set of hypotheses about the difficulties in engaging in collective action, like the common pool regime (CPR) for decarbonisation. The most ominous warning about the dangers of climate change came very re- cently from world star physicist Stephen Hawking.

Natural sciences

The first steps towards GWT were developed by Swedish chemist Arrhenius around 1895, suggesting that a doubling of CO_2 ppm could result negatively in a 5 degree Celcius increase in global average temperature (Arrhenius, 1961). It was an exaggerated calculation for 1900, but now it would not too far off the worst scenario for the 21st century, according to UN expertise. A positive anticipation of the global warming mechanism was done by famous mathematician Joseph Fourier in the early 19th century, arguing that with the CO_2 layer the Earth would be too cold!

When Stephen Schneider published Global Warming in 1989 and propagated his views in Climate Change journal, GWT started to receive wide attention, no doubt strengthened by the work of C. D. Keeling in measuring CO_2 ppm global- ly. Moreover, techniques for viewing the CO_2

layer were developed, increasing the attention to climate change. The UN reacted with creating a few bodies to look into the changes going on, one of which was the COP framework, or UNFCCC.

In the 1990s, economists jumped in besides the natural scientists, worried about the future costs of this transformation of the atmosphere. On the one hand, Kaya and associates (1998) presented a model that explained CO_2:s with energy and energy intensity of GDP. On the other hand, Stern (2007) called global warming the largest externality in human history, calling for international governance in order to stem the growth of greenhouse gases. Stern outlined a number of activities aimed at reducing CO_2 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 up to date, Stern (2015) later asked: "What are we waiting for?"

All theories need severe tests and empirical corroboration (Popper, 1962). When the polar ice mountains began to collapse, it seemed decisive evidence for the global warming theory. Other important test implications like glacier retreats everywhere, ocean warming and acidification as well as desertification in Africa also gave support for global warming theory. Denials of climate change appear more and more unfounded, although it is true that more of CO_2 may benefit some fauna or environment niches.

Political and social sciences

The part of GWT analyzing the coordination efforts within the UNFCCC as well as the different country responses to climate change is far less developed than the natural sciences' part. One finds practically nothing in the UNFCCC documents about the principal problems in large scale international governance, like e.g. defection. One may speak of two currents of social science theory thatare highly relevant for GWT:

1) *Implementation theory*: In the discipline of public

administration and policy-making, some ideas about the so-called "implementation gap"—*Wildavsky's hiatus*—are highly relevant to the COP21 project (Pressman & Wildavsky, 1973, 1984). The COP21 has three main objectives: halt CO_2 increases by 2018-2020 (GOAL I), decrease CO_2 emissions considerable by 2030 (GOAL II) and achieve full decarbonistion by 2070-80 (GOAL III).

Interestingly, Wildavsky (1997) himself completely rejected GWT—"the mother of environment scares". He was influenced by economist Simon, who rejected environmentalism in general (Simon, 2002), arguing that the normal price system did not indicate that natural resources were running out or becom-ing scarce.

But how are the COP21 GOALS to be implemented? No one knows, because COP21 has neglected what will happen after the major policy decision. The COP21 project outlines many years of policy implementation to reach decarbo-nisation, but which are the policy tools and the global funding—SUPER Fund?

2) *Game theory*: A common pool regime, or CPR is vulnerable to the strategy of reneging, as analyzed theoretically in the discipline of game theory. The rele-vant game for the CPR is the PD game, where the sub game perfect Nash equi-librium is defection in a finite version of this game (Dutta, 1999). This is notrecognized by Ostrom (1990) in her too optimistic view about the viability of CPR: s. It is definitely not the case that Ostrom has overcome Hobbes ("And Covenants, without the Sword, are but Words, and of no strength to secure a man at all."), as one commentator naively declared when she was awarded both the Nobel prize and the Johan Skytte prize (B. Rothstein' website 2014).

The COP21 project houses lots of reneging opportunities of various sorts, which will become clear as this CPR project moves forward. One major partner has already defected, which may trigger other governments to renege. The only way to control defection in this global CPR is to employ selective incentives, which is what the planned Super Fund could offer, if at all workable.

The problematic of global warming: Anthropogenic need of energy

To have a firm foundation for understanding the immense increase in CO_2 emissions the last two decades, we resort to the Kaya model, linking CO_2: s with energy and affluence (Kaya & Yokoburi, 1997). In theories of climate change, the focus is upon so-called anthropogenic causes of global warming through the re- lease 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 CO_2: s over time (longitudinally) and its variation among countries (cross-sectionally). As a matter of fact, CO_2: s has very strong mundane conditions in human needs and social system prerequisites. Besides the breading of living species, like Homo sa- piens for instance, energy consumption plays a major role. As energy is the ca- pacity 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. Thus, we have this equation format: (E1) Multiple Regression:

$$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + \ldots b_t X_t + u$$

Thus using the Kaya model for empirical research on global warming, the fol- lowing anthropogenic conditions would affect positively carbon emissions: (E2) CO_2: s = F(GDP/capita, Population, Energy intensity, Carbon intensity), in a stochastic form with a residual variance, all to be estimated on data from some 59 countries. I make an empirical estimation of this probabilistic Kaya model-the cross-sectional test for 2014: (E3) k1 = 0.68, k2 = 0.85, k3 = 0.95, k4 = 0.25; R2 = 0.895. Note: LN CO_2 = k1 * LN(GDP/Capita) + k2 * (dummy for Energy Intensity) + k3 * (LN Population) + k4 * (dummy for Fossil Fuels/all) Dummy for fossils 1 if more than 80 % fossil fuels; k4 not significantly proven to be non- zero, all others are. (N = 59).

The findings show that total CO_2: s go with larger total GDP. First, we see that CO2 emissions are closely connected with energy consumption, globally speak- ing. And the projections for future energy augmentation in the 21st century are enormous (EIA, BP, IEA). Figure 1 shows how things have developed since 1990.

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. Decar- bonisation is the promise to undo these dismal links by making GDP and energy consumption rely upon carbon neutral energy resources, like modern rene- wables and atomic energy.

Thus, we arrive at the energy-emissions conundrum: GDP growth being un- stoppable requires massive amounts of energy that results in GHC: s or CO_2: s. The only way out of this dilemma is that renewables become so large and effec- tive in a short period of time decarbonisation becomes feasible or likely, not merely desirable. All forms of energy be measured, and these measures are translatable into each other—a major scientific achievement. One may employ some standard sources on energy consumption and what is immediately obvious is the immensely huge numbers involved—see Table 1.

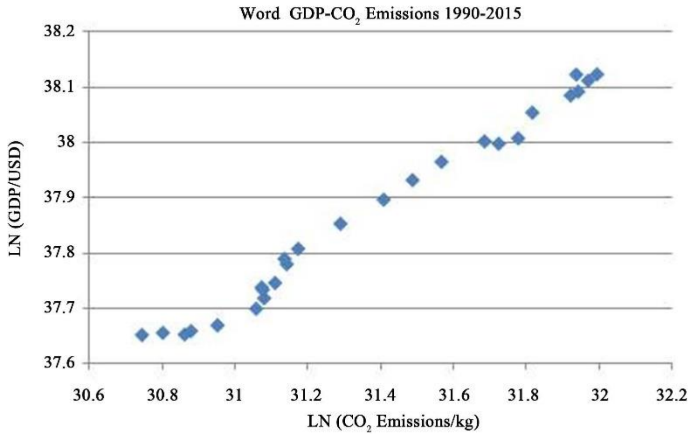

Figure 1. *Global GDP-CO_2 link: $y = 0.4092x + 25.03$, $R^2 = 0.987$ (N = 26).*

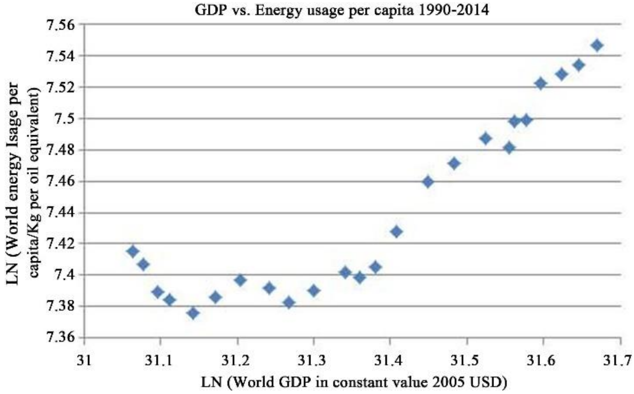

Figure 2. *GDP against energy per person (N = 59). Sources: CO_2 emission reduction with solar* [Retrieved from]. World Bank national accounts data—data.worldbank.org, OECD national accounts datafiles, World Resources Institute CAIT Climate Data Explorer—cait.wri.org, EU Joint Research Centre Emission Database for Global Atmospheric Research— [Retrieved from], UN framework convention on climate change [Retrieved from]. International Energy Agency, Paris. Energy Information Administration, Washington,DC. BP Energy Outlook 2016. EU Emissions Database for Global Research EDGAR,[Retrieved from]. World Bank Data Indicators, data.worldbank.org, BritishPetroleum Statistical Review of World Energy 2016.

It is true that a lot is happening with energy and emissions, but one tends to report only the positive news about coal reduction, more efficiency in energy consumption, new solar and wind plants. Sad to say, one bypasses the constantly increasing need for energy, the augmentation of air transportation, more cars

Table 1. *Energy consumption 2015 (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	13147.3	100.0

Source: BP Statistical Review of World Energy 2016 and bigger engines, and first and foremost more human beings! The COP21 call for decarbonisation entails a sharp reduction of fossil fuels up until 2030 in or-der to stabilize climate change, involving a 30 - 40 decrease in CO_2 emissions, measured against the 2005 level of emissions.

Solar power plants: Global estimation of governmentd' *Obligations*

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 2, 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 CO_2 emissions?

If countries rely to some extent upon wind or geo-thermal power or atomic power, the number in Table 2 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 colossal 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 tonuclear 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. Geo-thermal power comes from volcanic power and sites.

Let us look at the American scene in Table 3.

It has been researched has much a climate of Canadian type impacts upon so- lar power efficiency. In any case, Canada will need backs ups for its many solar

Table 2. *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	CO_2 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
Canada	30	230	300
Mexico	25	120	200
Australia	26 – 28	130	190
Russia	None[iii]	0	940
World	N/A	N/A	16,000

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. [Retrieved from] 2016 forthcomin CO_2 Emission Reduction with Solar, [Retrieved from].

Table 3. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: Ameri- can scene (Note: Average of 250 - 300 days of sunshine per year was used for Canada, 300- 350 for the others).*

Nation	CO_2 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[ii]	0	80
Peru	None[ii]	0	15
Uruguay	None[ii]	0	3
Chile	35	25	30

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

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 power without problems when helped financially.

Table 5 shows the number of huge solar parks necessary for a few Asian countries. 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 assistance, like giant India (Ramesh, 2015).

Table 4. *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	CO_2 reduction pledge/% of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40% reduction
Algeria	7 - 22[iv]	8	50
Egypt	None[ii]	0	80
Senegal	5 – 21	0.3	3
Ivory Coast	28-36[iv]	2	3
Ghana	15 - 45[iv]	1	3
Angola	35 - 50[iv]	6	7

Table 5. *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	CO_2 reduction pledge/% of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40% reduction
Saudi Arabia	None[ii]		0150
Iran	4 - 12[iv]		22220
Kazakhstan	None[ii]		0100

Turkey	21	60120
Thailand	20 - 25[iv]	50110
Malaysia	None[ii]	080
Pakistan	None[ii]	060
Bangladesh	3.45	218

Finally, we come to the European scene, where also great investments are needed, especially as nuclear power is reduced significantly and electrical carswill replace petrol ones, to a large extent (Table 6).

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

As the Keeling curve continues its relentless rise (Earth CO_2), we must take Hawkins warning about irreversibility seriously. Moving now and up to 2030, according 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 CO_2 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 of the promised Super Fund. No time for politicking in the UN any longer (Conca, 2015; Vogler, 2016).

Conclusion: Stephen Hawking's irreversibility warning

The governments of the countries in the world struggle with climate change and its threatening consequences for mankind chiefly by means of the UN mechan- ism UNFCCC. The upcoming COP23 global meeting, hosted by Fiji must out- line how its three 2015 Paris COP21 objectives are to be promoted and imple- mented by clearly stated means or tools/tasks for international political gover- nance and national political management. It seems now that only a massive replacement of fossil fuels and wood coal by solar and/or wind power can save mankind from the threat of global warming. How will the governments go about this formidable challenge, relying upon powerful market incentives for the de- mand and supply of solar energy (Barry, 1982; Hayek, 1991)?

Sooner or later, as global warming continues, outcomes like the following arrive, here with a few examples of already occurring disasters:

Table 6. *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	CO_2 reduction pledge/% of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40% reduction
Germany	49V	550	450
France	37V	210	220
Italy	35V	230	270
Sweden	42V	30	30

a) Huge land losses along the costs (Bangladesh, Vietnam);
b) Too high temperatures for men and women to work outside with constant need of air conditioning increasing climate change (Middle East, South EastAsia);
c) Food production decline (Africa);
d) Fish harvest decrease (Pacific Ocean, Atlantic, Indian Ocean);
e) Droughts and starvation (Africa);
f) Lack of fresh water supply (India, Africa, USA);
g) Drying up of rivers, affecting electricity supply (South America, India);
h) Ocean acidification and species extinction (Australia, East Africa);
i) Highly volatile climate with tremendous damages from flooding and stormsor hurricanes and tornados (Pakistan, Sri Lanka, Bangladesh, Thailand, etc.);
j) Extremely violent forest fires (Portugal, US, Canada, Indonesia).

This list is far from the complete or exhaustive. One could even mention worse outcomes, like the transformations of warm and cold currents in the oceans (Gulf Stream, North Atlantic Stream).

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6 Asian miracles and climate change

Introduction

Climate scientists warn, already before the implementation of the UNFCCC Agreement from Paris 2015 that the decarbonisation plan decided in global governance will not be enough to stabilize temperature at + 2 Celsius, at most. Global average temperature will most probably be larger than the COP21 objective. 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 definitively recommends a combination of national and international policy-making to halt temperature rise, despite the fact that the US government is negative. It renders an impressive list of climate change impacts upon the US territory and points decisively at human causes. We must then ask: Can decarbonisation policies be implemented or managed? The COP23 by the UNFCCC reflects upon the very same problem.

The Asia-Pacific region has taken over economic leadership from the Atlantic region. Some 60 per cent of global GDP comes from the APEC countries. And the Asian members plus India plan large increases in energy consumption up to 2040, but they show little interest in the greenhouse emission problematic, at least not in real action.

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);
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 beimplemented? Will the Asian miracle economies implement them?

Present global predicament

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, etc. The UNFCCC has focused on h lting CO2s and decreasing them in a gigantic decarbonisation policy globally in this century.

Since 1970, global energy consumption has more than tripped. And the share of Asia has incr ased 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 (Figure 1)

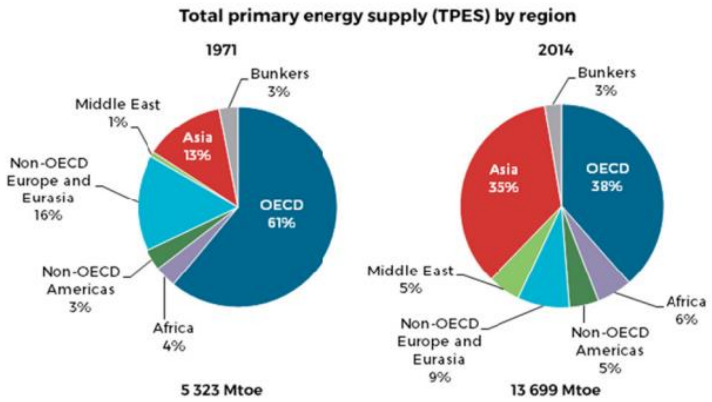

Figure 1. *Global energy*

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 c rbon 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, 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 pushed 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.

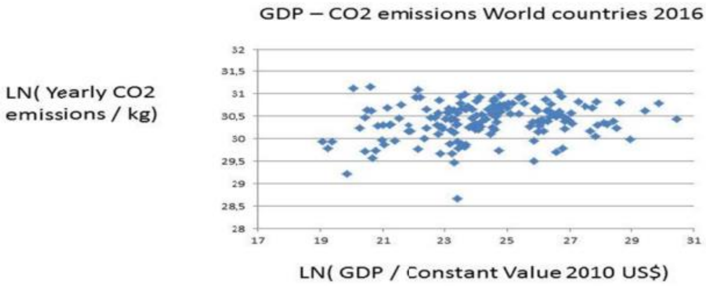

Figure 2. *GDP-COP for all countries*

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 (Rostov, 1960; Barro, 1991; Barro, & Sala-i-Martin, 1992, 1995).

Co2 Emissions in Asian Miracles

Below we look at the GDP and CO2 links in a few major Asian economies.

Catch-Up Strategy: 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 3.

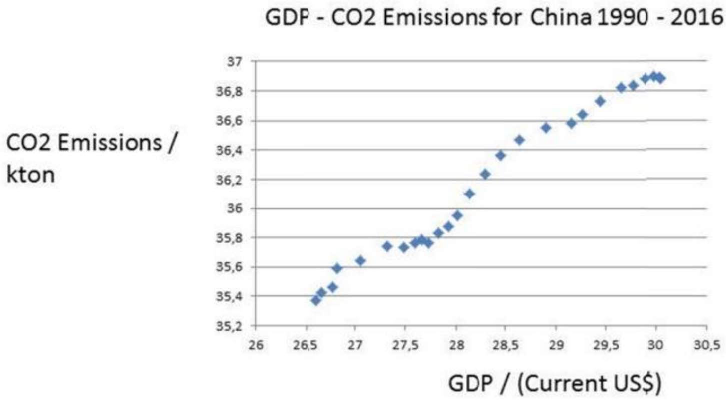

Figure 3. *China: GDP and CO2s: y = 0,46x, R^2 = 0,98*

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

India: Take-Off Strategy

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 4.

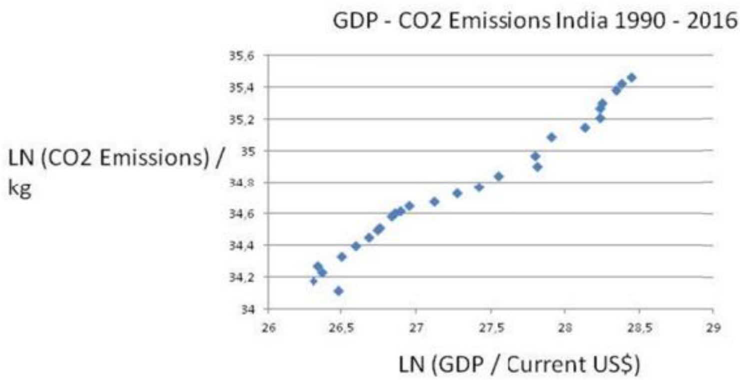

Figure 4. *INDIA: GDP and CO_2*

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, fa ilies

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.

South Korea: Mature Economy on Imported Energy

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 5, huge CO_2 emissions.

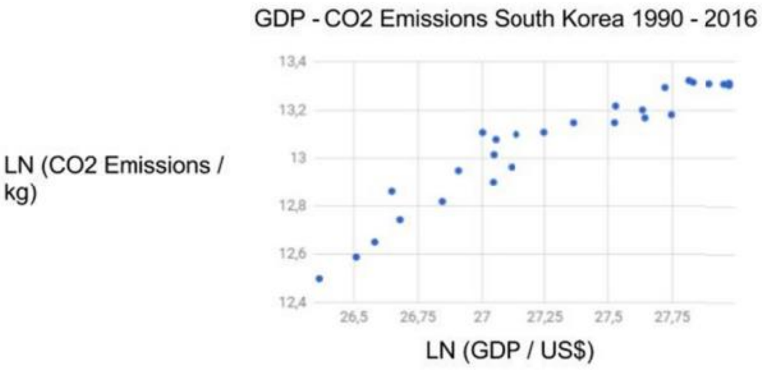

Figure 5. *South Korea*

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 upon natural gas, imported mainly from Australia and Indo esia. But it will still result in CO_2 emissions higher than GOAL II in CO21.

Iran: Sleeping Giant

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 CO_2s are high for Iran – Figure 6.

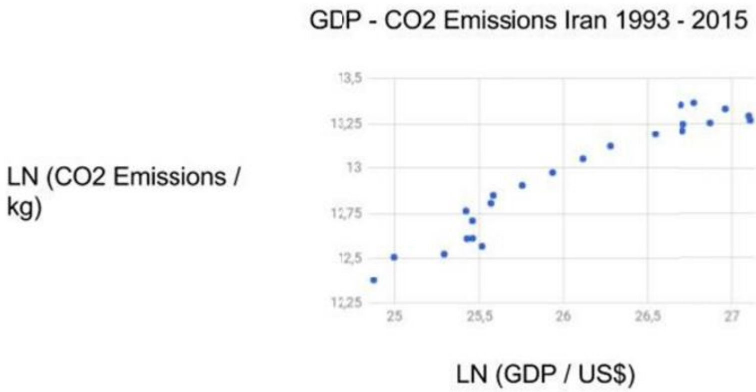

Figure 6. *Iran*

Iran will have to renege on COP21 objectives, unless receiving support from outside. The solution is app rent: solar power parks.

To Sum Up: The Asia-Pacific region has become dominant in the world economy. This has made Asian countries vulnerable to the threat of global warming from the emissions of GHGs. Asian economies produce a lot of CO2s, which is why they must be active in the UN global decarbonisation plan: COP21 Treaty. The ADB solution of carbon sequestration is not in the cards of the UNFCCC.

Evolving methane threat

We employ the general formula: $dT = \lambda * dF$, where 'dT' is the change in the Earth's average surface temperature, 'λ' is the climate sensitivity, usually with degrees Celsius per Watts per square meter (C/ [W/m2]), and 'dF' is the radiative forcing. To get the calculations going, we start from lambda between 0.54 and 1.2, but let's take the average = 0.87. Thus, we have the formula (Myhre el al, 1998): Formula: (1) $0.87 \times 5.35 \times \ln(C/280)$.

Figure 7 shows how CO2 emissions may raise temperature to 4-5 degrees:

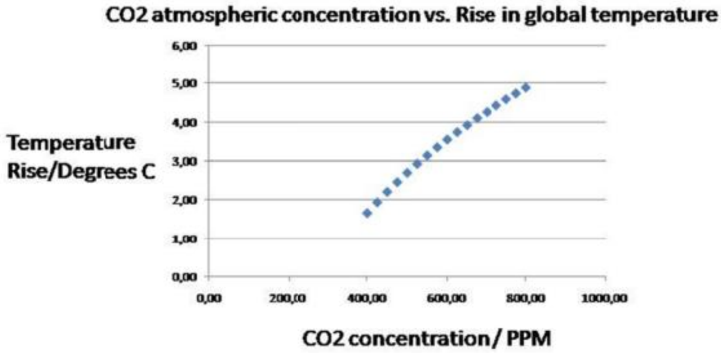

Figure 7. *CO2s and temperature rise in Celsius*

There are several greenhouse gases, but the two biggest are the CO2s and methane. The UNFCCC has concentrated upon halting and reducing carbon dioxide, but now we are about to face a methane threat. We shall use the methane concentration curve from mid-2013 to beginning of 2017 issued by NOAA ESRL [Retrieved from], gently suggested by Dlugokencky and Kuniyuki. Why mid 2013? Because it is the last maximum of the second derivative before 2017. Since then, the curve is approximately linear, and we will derive its equation hereunder.

Why should we start with a linear approximation, the simplest approximation that can be found? Because it is a mean between two extreme scenarios:

1) Another plateau like during the years 1999-2006 (probably due to an enhancement in methane transport insulation in ex-USSR after 1991, Pearce), unlikely for the following reasons. Any decrease in me hane 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 devel ping countries and the temperature increasing the metabolism of microbes in rice agriculture.

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

c) Fossil fuel production and use doesn't diminish yet, and was underestimated by industry (Fred Pearce, [Retrieved from]).

d) Biomass burning doesn't diminish yet, therefore 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

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

We will derive examples of future increase in methane concentration due to such a positive feedback, in addition to a linear approximation. For this, we will not simulate differential equations, which would be the best option, but simulate the hypothetical solution of a transition (bifurcation) between 2 steady-states, with a S-shaped function (which approximate the bifurcation between 2 steady-states) multiplied (to have continuity) by the linear approximation. We shall approximate the S-shape curve by an transitory (5 years) exponential curve in continuity with the linear approximation.

The present (November 2017) quasi-linear curve starts mid 2013 (2013.5) and its ordinate is approximately 1813 ppb. We will use as a last value at start of 2017 (2017), and the function is approximately 1846 ppb. a straightforward calculation gives the slope: it is approximately 10 ppb/year. Therefore the equation for the future curve if there is no vicious circle (positive feedback) is: (2) $y = 10\,(t - 2013.5) + 1813$, where t is the time when one wants to know the CH_4 concentration, and y is the future CH_4 concentration in ppb. From this equation, one can estimate the approximate the temperature rise due by methane, by applying to y the formula (1), and multiply it by 25. It will be valid for close future, but will probably be underestimated for farther future, where it will probably closer to an exponential.

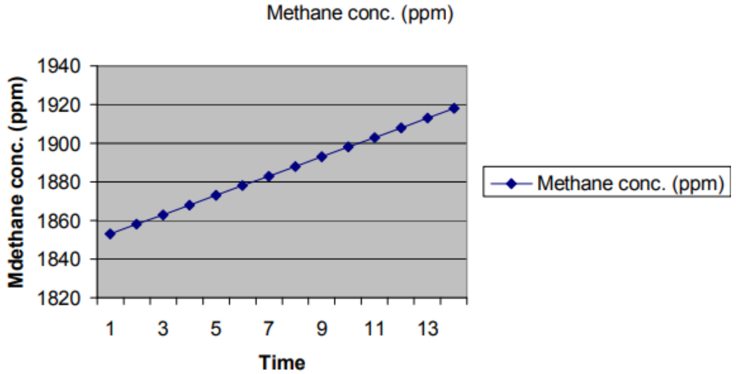

Figure 1. *Projected increase in methane*

Management Strategies for decarbonisation

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, 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 CO_2 emissions? Table 1 has the answer.

Table 1. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II:*

(Note: Average of 250 - 300 days of sunshine used for all entries except Australia, Indonesia, and Mexico, where 300 - 350 was used).

India	None (Note 2)	0	600
Japan	26	460	700
South Korea	37	260	280
Philippines	70	70	40
Turkey	21	60	120
Indonesia	29	120	170
Saudi Arabia	none (Note 2)	0	150
Iran	4 – 12 (Note 4)	22	220
Kazakhstan	none (Note 2)	0	100
Turkey	21	60	120
Thailand	20 – 25 (Note 4)	50	110
Malaysia	none (Note 2)	0	80
Pakistan	none (Note 2)	0	60
Bangladesh	3,45	2	18
Australia	26 – 28	130	190
World	N/A	N/A	16000

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

Conclusion

We are not yet at the point of Hawking irreversibility, meaning there are still a few degrees of freedom for government policy-making and international governance. The plans of the UNFCCC must be implemented by all nations: Goal I: halting CO_2 growth, Goal II: reducing CO_2s until 2030 and Goal III: near complete decarbonisation by 2075.

The Asian economic miracle can run into mega pollution from GHGs. I would undo the immense advances the recent decades. Solar panel parks is the reply, and not carbon capture.

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7 Socio-economic determinism and climate change

Introduction

Just before the start of the UN global environment reunion COP23 (6-13 November 2017) in Bonn, the study Climate Science Special Report: Fourth National Climate Assessment (USGCRP, 2017): was published in Washington, enquiring into the global warming consequences for especially the US but also the world. It recommends a combination of national and international policy-making to halt temperature rise, despite the fact that the US government is negative. We must then ask: Can decarbonisation policies be implemented or managed? I will suggest: NO.

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) Halting the rise if CO2s by 2020 (GOAL I);
ii) Reducing the CO2s by 30-40% by 2030 (GOAL II);
iii) Complete 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. Some countries have lately had stalling or even decreasing CO2s, but many other still face an upward sloping curve.

Global predicament: Energy-environment conundrum

The greenhouse gases (GHG) have strong anthropogenic sources, being linked with socio-economic development or economic growth via the consumption of energy generally, especially the burning of fossil fuels, use of cement and emission of methane from landfills, cows, microbes, etc. The UNFCCC has focused on halting CO2s and decreasing them in a gigantic decarbonisation policy globally in this century. CO2 emissions are closely connected with energy consumption, globally speaking. Projections for future energy augmentation in the 21st century are enormous, especially for Asia (EIA, BP, and IEA). Figure 1 displays developments since 1990.

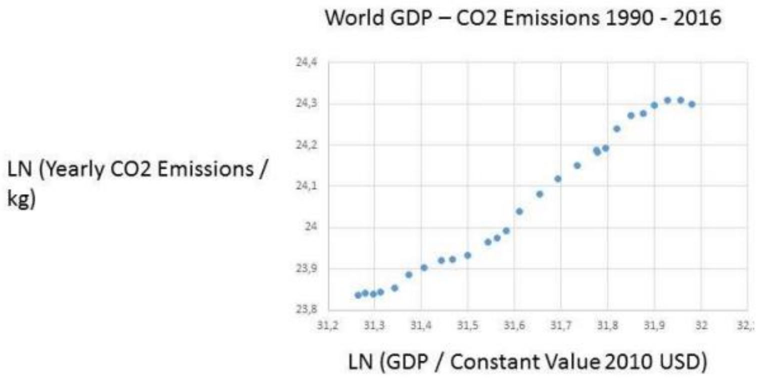

Figure 1. *Global GDP-CO2 link: $y = 0{,}75x$; $R^2 = 0{,}98$*
Source: See references

There has been a widespread hope that the augmentation of CO2s would "stall", but now China reports ominously that its CO2s are set to increase again. Thus, Figure 1 may lead to the planet not fulfilling GOAL I in 2020.

Burning fossil fuels is today essential for affluence and wealth, being vital to poor and rich countries. If energy consumption is reduced, we will have economic recession and mass poverty as well as of course unemployment writ large with 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
Hydroelectiric	892,9	6,8
Others	364,9	2,8
Nuclear power	583,1	4,4
Total	13147,3	100,0

Source: BP Statistical Review of World Energy 2016

Table 1 holds the answer to why GHG emissions have become the global headache number 1. Energy for humans and their social systems come to an average of 90% from burning fossil fuels: stone and wood coal, oil and gas. And people do that all over the world, though to very different degrees from 100% to less than 50% of all energy consumption, because it is necessary for affluence and survival.

GHGs and methane

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. They are now stalling in some countries but far from all, not increasing any longer globally.

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. Consider further the immense CO2s from global transportations, which still increases with all the new flights and airports. CO_2s are augmenting in for instance India, Indonesia, South Korea, Saudi Arabia, Brazil, Kazakhstan, etc. But why bypass methane? The UNFCCC has concentrated upon halting and reducing carbon dioxide, but now we are about to face a methane threat

Methane emissions are now becoming more frequent and important for global warming. Thus, we have several greenhouse gases, but the two biggest are the CO_2s and methane. Finally, we have the Nitrous Oxide and very small amounts of F-gases. Methane and F-gases are more powerful in preventing sun radiation to exit the Planet, but they arenot as long lasting as the CO_2s. The oceans swallow much CO_2s, but this leads to acidification.

One may predict that 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 (see papers by Lane & Dieterlen 2017).

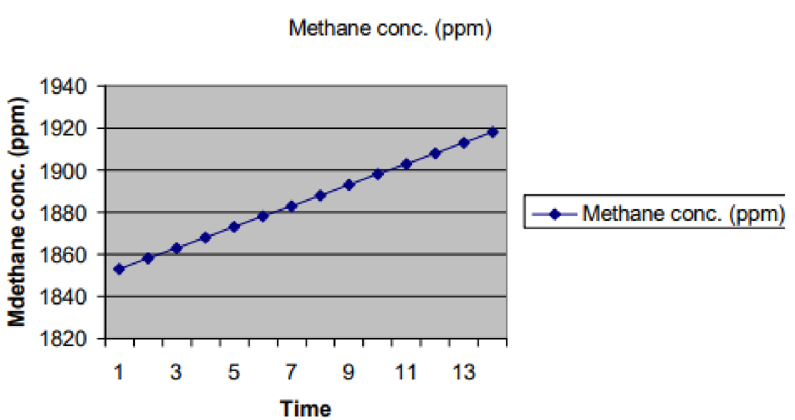

Figure 2. *Methane emissions in Dieterlen's projection*

With methane emissions rising, it is all the more urgent to not only halt bot considerably reduce CO_2 emissions. Can all nations do it? Probably not. Any decrease in methane concentration is improbable,

i) Agriculture emissions increase with the increase of population, the increase in meat diet in developing countriesand the temperature increasing the metabolism of microbes in rice agriculture;

ii) Wetlands emissions do not diminish with the microbial chemical activity on increase with temperature rise;

iii) Fossil fuel production and use do not diminish;

iv) Forests diminish in the tropics, resulting in a decrease in animal, vegetal and cultural (Indigenous People) assets;

v) Melting permafrost releases methane from land and see.

Thirst for energy: More efficiency and renewables!

GDP increases with the augmentation of energy per capita. Decarbonisation is the promise to undo these dismal links by making GDP and energy consumption rely upon carbon neutral energy resources, like modern renewables and atomic energy can this promise be kept or fulfilled? Figure 4 shows the almost iron law type link.

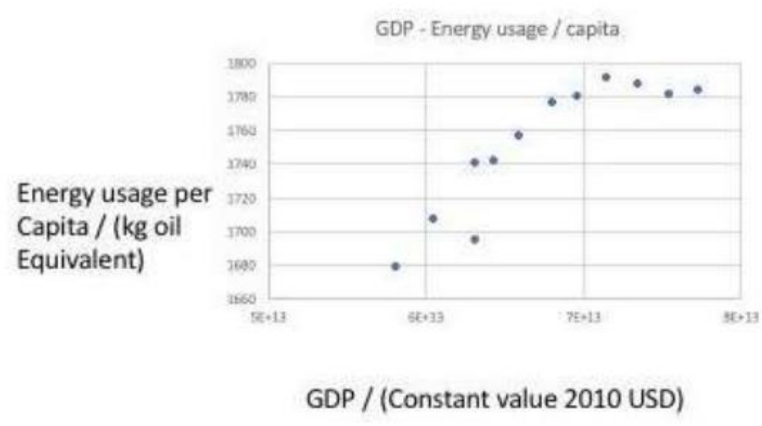

Figure 4. *GDP against energy per person, 2005-2016*
Source: World Bank Data Indicators, data.worldbank.org; BP Statistical Review of World Energy 2017

COP21 member country faces the dilemma in Figure 5: more energy gives higher economic growth but also more CO2s. If countries continue to prioritize fossil fuels induced socio-economic development, they will bring about the Hawking irreversibility.

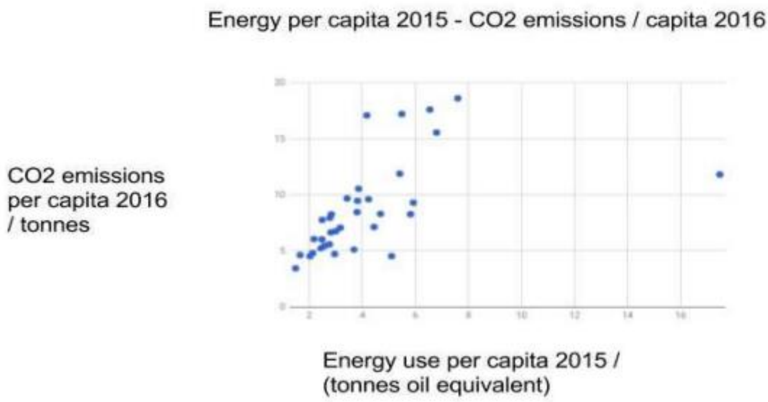

Figure 5. *Energy and CO_2s per capita*
Sources: EU CO_2 Database EDGAR: Co_2 and GHG, [Retrieved from]; World Bank Data indicators, [Retrieved from].

For saving the Planet and maintaining socio-economic development against poverty as well as economic growth for fullemployment, the economies of the world must become much better at energy efficiency. And they must turn massively torenewable energy sources now.

Kuznets' curve for GDP and GHC? No

In the general debate about environmentalism, the pro-economic growth argument states that increasing affluence will take care of the environmental problematic by itself: more wealth, more care for the environment. But Figure 6 shows that there is no Kuznets' curve (first rising with GDP, then descending with GDP) for CO_2: richer countries emit more CO_2 than poor ones. International aviation is a very major source of CO_2 emissions, and it is booming with augmenting GDP everywhere.

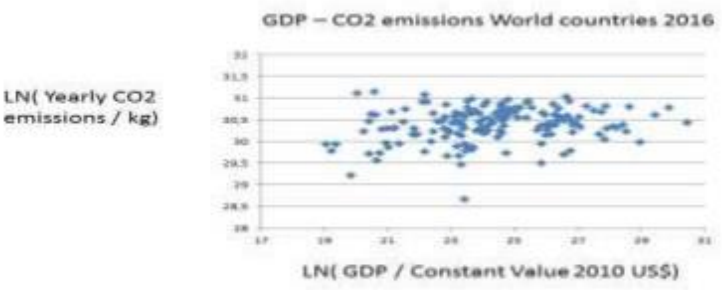

Figure 6. *No Kuznets'curve: GDP-CO2s*

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 by 2020; convincing a few countries like India and Australia not to build new ones;

2) Replace wood coal with natural gas stoves – small or large scale, stopping deforestation and the use of charcoal in households in poor nations;

3) Massive construction of solar power parks and wind power plants in all countries, as well as stimulate small scale solar power for households;

4) Turn some countries away from massive dam constructions towards solar power parks, like Brazil and India, as the environmental damages are too big and water shortages loom;;

5) Help some countries maintain their huge forests, like Brazil, Indonesia and Russia;

6) Abstain from expensive and unsafe carbon capture or sequestration techniques in favour of electricity: solar power and electrical vehicles.

7) 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 emissions of methane increase, the reduction of CO2s is all the more important.

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. Germany and France should stop dismantling their atomic power stations and concentrate upon eliminating coal at one.

Solarpower parks – A model example

Consider now Table 2, using the giant solar power station in Quarzazate 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 CO_2 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).*

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
Canada	30	230	300
Mexico	25	120	200
Australia	26 – 28	130	190
Russia	none[iii]	0	940
Canada	30	230	300
Mexico	25	120	200
Iran	4 – 12[iv]	22	220
Saudi Arabia	none[ii]	0	150
Turkey	21	60	120
Thailand	20 - 25[iv]	50	110
France	37[v]	210	220
Italy	35[v]	230	270
Germany	49[ix]	550	450
Argentina	none[ii]	0	80
World	N/A	N/A	16000

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

If countries rely much upon water or geo-thermal power or atomic power, the number in Table 2 will be reduced. Table 2 displays the dependency upon fossil fuels that may go over 90%in some countries. Each country energy predicament is both situation dependent and path dependent, reflecting natural resources and past policies/

The key question is: Can so much solar power be constructed in some 10 years? If not, Hawking may be right.

Thus, the COP23 should decide to embark upon an energy transformation of this colossal 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. Geo-thermal power comes from volcanic power and sites.

It has been researched has much a climate of Canadian type impacts upon solar power efficiency. In any case, Canada will need back-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 from the Andes may be expected. Chile can manage their quota, but Argentine needs the Super Fund for sure. Uruguay has the best number globally, relying upon water and biomass.

Conclusion

The COP23 meeting of the UNFCCC resulted in basically NOTHING. It is NATO: no action, talk only. The COP21 Treaty states constitute a common pool club (CPR = common pool regime) where each member country faces the dilemma in Figure 7: more energy gives higher economic growth but also more CO2s. If countries continue to prioritize fossil fuels induced socio-economic development, they will defect in this CPR as in an ocean PD game and bring about Hawking irreversibility.

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 7.

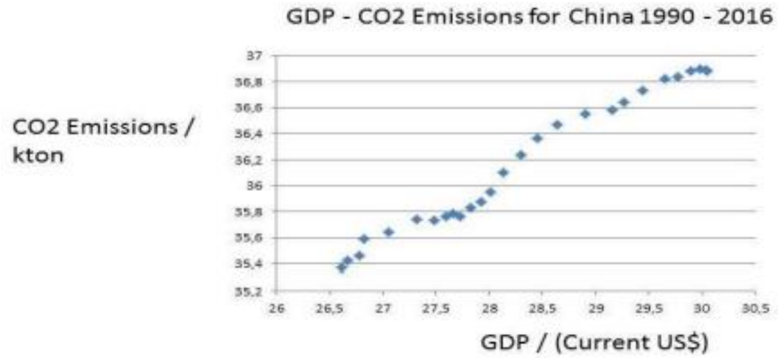

Figure 7. *China: GDP and CO2s: y = 0,46x, R^2 = 0,98*
Sources: Janssens-Maenhout, G., et al., 2017. World Bank Data Indicators, [Retrieved from].

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.

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8 Could it happen: Global warming leads to the extinction of mankind

Introduction

The UNFCCC holds a new meeting this fall in Bonn with host country Fiji—the COP23. It has to find a way forward towards the implementation of the COP21 Treaty, although there is already one defection. The islands of Fiji fear of course the sea level rise attending global warming, as there is now a set of islands becoming inhabitable in the Pacific Ocean, e.g. Tuvalu. But the dangers involved in the global warming process concern all countries on the globe in various forms of risks, immense one in reality.

Herman Kahn showed in 1962 by Thinking about the Unthinkable that one can scientifically theorize future scenarios with the inter alia one terrible outcome, namely the elimination of the human species. Nuclear deterrent has proved effective against this result, with the possible exception of North Korea. But its leader knows that if the country hurts surrounding nations, it will suffer a terrible punishment. Global warming is different, as there is no efficient halting process in place.

Global warming theory (GWT) has come of age. It entails the possibility of a process of continuous warming of the globe until irreversibility is arrived at. Then, humanity is finished forever, as Mother Earth enters a new stage in its giant evolutionary path over hundreds of millions of years. What must be done by international coordination is to set up and operate a common pool regime (CPR) that is capable to halt this climate change process in the 21st century, and maybe reverse it. Is the UNFCCC framework this CPR? The author doubts that.

Overview of GWT: Natural Sciences

One may distinguish between two parts in GWT, one much developed set of hypotheses about the natural sciences' contribution to understanding climate change, and one poorly developed social sciences' set of hypotheses about the difficulties in engaging in collective action, like the COP21 common pool regime (CPR) for decarbonisation.

The first anticipation of the global warming mechanism was done by Frenchman J. Fourier in the early 19th century, but the theory was developed by Swedish chemist Arrhenius around 1895. He calculated that a doubling of CO_2 ppm would be conducive to a five degree increase in global average temperature, which is not too far off the worst scenario for the 21st 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 CO_2 ppm globally. Moreover, techniques for viewing the CO_2 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 atmosphere. On the one hand, Kaya & Yokoburi (1997) presented a model that explained CO_2:s with energy and energy intensity of GDP. On the other hand, Stern (2007) called global warming the largest externality in human history, calling for international governance in order to stem the growth of greenhouse gases. Stern outlines a number of activities aimed at reducing CO_2 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 up to date, Stern (2015) later asked: "What are we waiting for?"

All theories need confirmation. When the polar ice mountains began to collapse, it seemed decisive evidence for the global warming theory. Other important test implications like glacier retreat everywhere, ocean warming and acidification as well as desertification in Africa also gave support for global warming theory. Denials of climate change appear more and more unfounded, although it is true that more of CO_2 may benefit some fauna or environment niches.

Considering the probable damages from global warming, it is astonishing that global warming theory has not been better recognized or even conceptually developed or empirically corroborated. If global warming continues unrestrained, much of Asia will be negatively affected, just as Australia is on the verge of losing its coral reefs. There will be sooner or later:

(a) Great damages to Polar areas and reductions of glaciers;
(b) Huge land losses along the costs;
(c) Too high temperatures for men and women to work outside;
(d) Food production decline;
(e) Fish harvest decrease;
(f) Droughts and starvation;
(g) Lack of fresh water supply;
(h) Drying up of rivers, affecting electricity supply;
(i) Ocean acidification and species extinction;
(j) Highly volatile climate with tremendous damages.

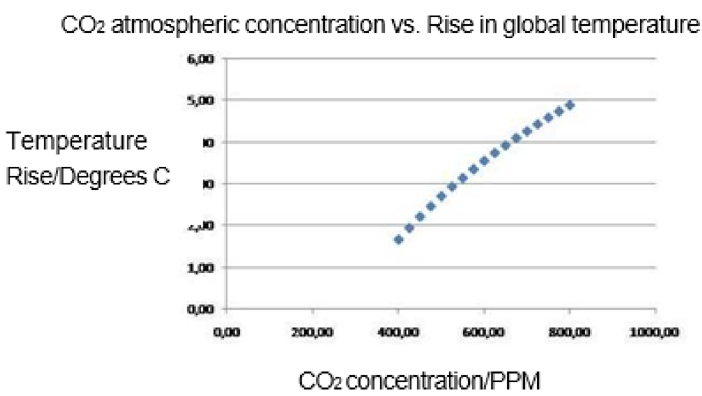
This list is far from complete or exhaustive. One could even mention worse outcomes, like the transformations of warm and cold currents in the oceans. What one may underline is that so far no known negative feedback has been found that could stem global warming naturally. We have only positive feedbacks, meaning outcomes reinforce each other in the same direction. It is far from easy to calculate exactly how increases in greenhouse gases impact upon temperature augmentations. Take the case of CO_2s, where a most complicated mathematical formula is employed:

(1) T = Tc + Tn, where T is temperature, Tc is the cumulative net contribution to temperature from CO_2 and Tn the natural one. "CO_2" refers to all CO_2, there is no distinction between man-made and natural CO_2.

But when it comes to methane, it is not known whether the tundra will melt and release enormous amounts. But methane does not stay in the atmosphere long, like CO_2s. For the other greenhouse gases, there is no similar calculation as for the CO_2s: If humans could eat less meat from cows, it would mean a great improvement, as more than a billion cows emit methane. Food from chicken should replace beef meat and burgers. The general formula reads:

(2) $dT = \lambda * dF$, where dT is the change in the earth's average surface temperature, λ is the climate sensitivity, usually with degrees Celsius per Watts per square meter (°C/[W/m2]), and dF is the radiative forcing.

To get the calculations going, we start from lambda between 0.54 and 1.2, but let's take the average = 0.87. Thus, we have the formula (Myhre, Highwood, Shine, & Stordal, 1998): $0.87 \times 5.35 \times \ln(C/280)$. Figure 1 shows how CO_2 emissions may raise temperature to 4-5 degrees, which would be Hawking's worst case scenario.



When taking into account that global planning speak of a 20-30 percent increase in energy for the coming decades, then one clearly understands the warning of Schneider: the 21st century will be a greenhouse century for mankind as well as Stephen Hoawking's warning about irreversibility.

The methane threat

The global situation with regard to the greenhouse gases appears from Figure 1, where the economic expansion, measured by the GDP, is accompanied by an inexorable growth in GHGs. This trend must be halted and reversed, as otherwise the 21st century will be the greenhouse century of mankind, as Stephen Schneider warned already in 1989.

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. The UNFCCC must start paying more attention to other GHGs than only the CO_2s, but especially methan emissionsthat now increase sharply (Figure 2).

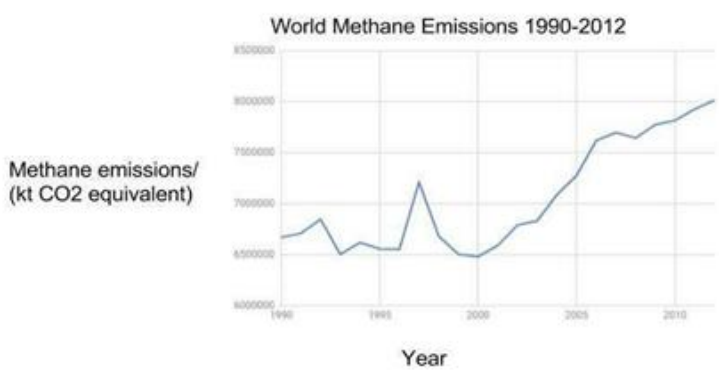


Figure 2. *Methane emissons.*

Social and political sciences

The part of GWT analyzing the coordination efforts within the UNFCCC as well as the different country responses to climate change is far less developed than the natural sciences' part. One finds practically nothing in the UNFCCC documents about the principal problems in large scale international governance, like defection. One may speak of two currents of social science theory that are highly relevant for GWT:

(1) Implementation theory: In the discipline of public administration and policy-making, some ideas about the so-called "implementation gap"—Wildavsky's hiatus—are highly relevant to the COP21 project (Pressman & Wildavsky, 1973; 1984). The COP21 has three main objectives: halt CO_2 increases by 2018-2020 (GOAL I), decrease CO_2 emissions considerable by 2030 (GOAL II), and achieve full decarbonistion by 2070-80 (GOAL III).

But how are they to be implemented? No one knows, because COP21 has neglected what will happen after the major policy decision. The COP21 project outlines many years of policy implementation to reach decarbonisation, but which are the policy tools?

(2) Game theory: A CPR is vulnerable to the strategy of reneging, as analysed theoretically in the discipline of game theory. The relevant game for the CPR is the PD game, where the sub game perfect Nash equilibrium is defection in a finite version of this game (Dutta, 1999). This is not recognized by Elinor Ostrom (1990) in her too optimistic view about the viability of CPR:s. It is definitely not the case that Ostrom has overcome Hobbes, as one commentator naively declared when she was awarded both the Nobel prize and the Johan Skytte prize (Rothstein's website, 2014).

The COP21 project houses lots of reneging opportunities of various sorts, which will become clear as this CPR project moves forward. One major partner has already defected, which may trigger other governments to renege. The only way to control defection in this global CPR is to employ selective incentives, which is what the planned Super Fund could offer, if at all workable.

The Problematic of Global Warming: Anthropogenic Need of Energy To have a firm foundation for understanding the immense increase in CO_2 emissions the last two decades, we resort to the Kaya model, linking CO_2:s with energy and affluence. One basic theoretical effort to model the greenhouse gases, especially CO2:s, in terms of a so-called identity is the deterministic Kaya equation. The Kaya identity, "I = PAT"—model type, describes environmental (I)mpact against the (P)opulation, (A)ffluence and (T)echnology. Technology covers energy use per unit of GDP as well as carbon emissions per unit of energy consumed (Kaya & Yokoburi, 1997).

The Kaya model findings show that total CO2:s go with larger total GDP. 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 3 shows how things have developed since 1990.

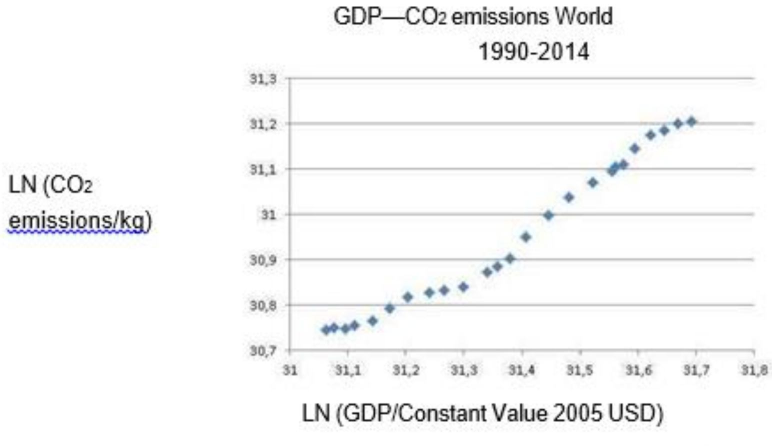


Figure 3. *GDP—CO_2 emissions.*

To make the dilemma of energy versus emissions even worse, we show in Figure 4 that GDP increases with the augmentation of energy per capita. Decarbonisation is the promise to undo these dismal links by making GDP and energy consumption rely upon carbon neutral energy resources, like modern renewables and atomic energy.

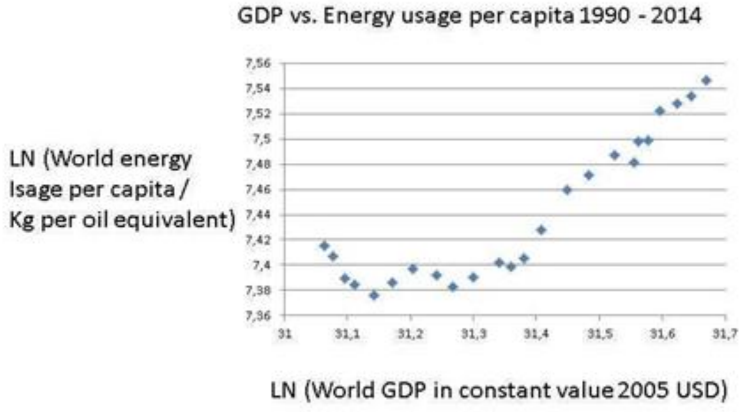


Figure 4. *GDP against energy per person (N = 59).*

Thus, we arrive at the energy-emissions conundrum: GDP growth being unstoppable requires massive amounts of energy that results in GHC:s or CO_2:s. The only way out of this dilemma is that renewables increase so massively and effectively in a short period of time and that decarbonisation becomes feasible and likely, not merely desirable.

Solar power plants

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 close reactors while others construct new and hopefully safer ones. The author here bypasses 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 CO_2 emissions?

Table 1. *Number of Ouarzazate Type Solar Plants for Decarbonisation 2030 in COP21 Treaty (Average of 250-300 Days of Sunshine Used for All Entries Except Australia, Indonesia, and Mexico, Where 300-350 Was Used)*

	% of 2005 emissions	needed (Ouarzazate)	reduction
United States	26-28[1]	2,170	3,100
China	none[2]	0	3,300
EU28	41-42	2,300	2,200
India	none[2]	0	1,700
Japan	26	460	700
Brazil	37	170	190
Indonesia	29	120	170
Canada	30	230	300
Mexico	25	120	190
Australia	26-28	130	190
Russia	none[3]	0	940
World	N/A[4]	N/A	16,200

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. [Retrieved from]; 2016 forthcoming; CO_2 Emission Reduction With Solar [Retrieved from].

Allowing the author to doubt that the UNFCCC or the COP21-22 is aware of the immensity of the task of implementing GOAL II until 2030. Several countries will find even GOAL I hard to fulfill! The COP23 must urgently clarify how such enormous amounts of solar power can be achieved by 2030—plan or spontaneous order? Such an enormous energy transformation can only be made by the use of market initiatives and incentives (Barry, 1982; Hayek, 1991), but governments must put down the rules of the game: subsidies, charges, and taxes?

Dismal science: Rejection of Sachs' moralism

World star economist Sachs (2015) preaches this message, but it is only ethics. Economics is, as Carlyle said, a "dismal science", analyzing the IS and not the OUGHT. And the Malthusian predicament is with us with a vengeance in the form of the energy-emissions conundrums. The author will develop this position by means of some country examples.

Insisting upon the positive nature of economics, "positive" referring to the understanding and prediction of the IS, one cannot but realize that sustainable development theory deals with the OUGHT. The gulf between normative utopia and harsh reality forces one to look for how adherents of sustainable economics get from realities to vision. Take the example of Sachs, stating about SDG (sustainable development goals):

> … the SDGs need the identification of new critical pathways to sustainability. Moving to a low-carbon energy system, for example, will need an intricate global interplay of research and development, public investments in infrastructure (such as high-voltage direct current transmission grids for long-distance power transmission), private investments in renewable power generation, and new strategies for regulation and urban design. The task is phenomenally complex.

But Sachs does not inform us how something so "phenomenally complex" is to come about, going from the IS to the OUGHT. He continues:

> Market-based strategies (such as carbon taxation) can help to simplify the policy challenge by steering private decisions in the right direction, but politics, planning, and complex decision making by many stakeholders will be unavoidable (Sachs, 2012).

Of course, but what is the likelihood that a carbon tax can be put in place (where, how much) as well as how large is the probability that planning works? Only wishful thinking!

Sachs realizes the gap between desirability and feasibility, but he confronts the gap by almost religious beliefs:

> The SDGs will therefore need the unprecedented mobilisation of global knowledge operating across many sectors and regions. Governments, international institutions, private business, academia, and civil society will need to work together to identify the critical pathways to success, in ways that combine technical expertise and democratic representation. Global problem-solving networks for sustainable development—in energy, food, urbanisation, climate

resilience, and other sectors—will therefore become crucial new institutions in the years ahead (Sach, 2012).

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. Their crux of the matter is feasibility: How to promote decarbonisation so that real life results occur? The real obstacles for any decarbonisation project stem from the logic of collective action, if we stick to the social sciences, as ethically neutral and truthfully objective. The energy-emissions conundrum is probably unresolvable until fusion power arrives!

The need for solar power parks is apparent everywhere. Table 2 shows the number of huge solar parks necessary for a few Asian countries. The numbers are staggering, but can be fulfilled, if turned into the number ONE management priority. Some of the poor nations need external financing and technical assistance from the promised Super Fund with the UNFCCC.

Table 2. *Number of Ouarzazate Plants Necessary in 2030 for COP21's GOAL II. Asian Scene (Note: Average of250-300 Days of Sunshine Was Used for Kazakhstan, 300-350 Days of Sunshine per Year for the Others)*

	% of 2005 emissions	needed (Ouarzazate)	reduction
Saudi Arabia	none[ii]	0	150
Iran	4-12[iv]	22	220
Kazakhstan	none[ii]	0	100
Turkey	21	60	120
Thailand	20-25[iv]	50	110
Malaysia	none[ii]	0	80
Pakistan	none[ii]	0	60
Bangladesh	3.45	2	18

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

Let us finally look at the American scene in Table 3.

Table 3. *Number of Ouarzazate Plants Necessary in 2030 for COP21's GOAL II: American Scene (Note: Average of250-300 Days of Sunshine per Year Was Used for Canada, 300-350 for the Others)*

	% of 2005 emissions	needed (Ouarzazate)	reduction
Canada	30	230	300
Mexico	25	120	200
Argentina	none[ii]	0	80
Peru	none[ii]	0	15
Uruguay	none[ii]	0	3
Chile	35	25	30

It has been researched how 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 it will need financing from the Super Fund, promised in COP21 Treaty. In Latin America, solar power in the future, especially as water shortages may be expected. Chile can manage their quota, but Argentine needs the Super Fund for sure.

Conclusion

The entire UNFCCC runs with a basic insufficiency, making it too weak to respond to the climate change challenge that could bring about a worst case scenario for mankind.Scholars have shown that the UN climate decision-making is highly manipulated by self-interests from the major powers (Conca, 2015; Vogler, 2016). The ideas of using climate change policy-making to solve other problems like poverty, global redistribution of wealth and stopping general environment degradation make matters just more complicated, resulting in massive transaction costs.

A strong warning for growing methane emissions will end this paper. Consider Table 4.

Table 4. *GHC Minus CO_2s*

Year	GHG other than CO_2/ton
1990	15.56
1995	15.20
2000	14.74
2005	17.20
2010	17.05
2011	18.47
2012	18.97

Methane is 25 times more powerful as greenhouse gas. When now these emissions increase, global temperature will rise even more and quickly.

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9 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). CO_2 concentration = Energy
3). CO_2 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 CO_2 emissions yearly. Thus, we have:

x=atmosphere concentration CO_2 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 CO_2 leads to increase in global temperature 0,01 degrees CO_2 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 CO_2 daily: 28/12 at 412 ppm and 408 one year ago (CO_2).

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 socio-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.

Solar power

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Table 1. *Number of Bhadla Solar Park plants required to replace coal power by country (Global Energy Monitor). Country Number of solar plants*

Country	Number of plants
Asia	
China	475
India	100
Japan	28
South Korea	18
Turkey	9
Americans	
United States	106
Colombia	1
Europe	
Germany	32
Russia	30
Africa	
South Africa	14

Sustainability

Cambridge Dictionary lists two meanings of "sustainable"; able to continue over the period of time firstly, and secondly causing no or little damage to the environment. Taking together these two concepts fit well into the environmental framework, but they do not apply to the demand and supply of energy. Here we need a second equation, namely: (II) CO_2 concentration in ppm=267.5 +10*Energy in Billion tonnes of oil equivalent; R squared equals 0.992. The regression tells us that one billion energy amounts to ten CO_2 ppm. Now, we can predict using these two equations (I) and (II) that temperature rise will be beyond the Paris Objectives. Look at figure 1 below

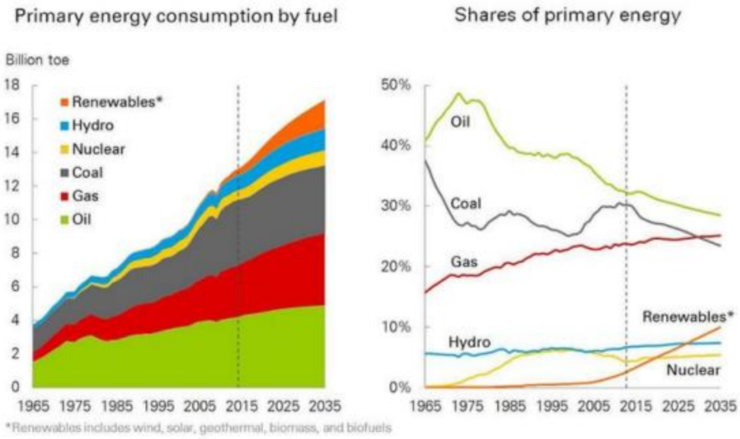

Figure 1. *Primary Energy projections (BP)*

Conclusion

Following the logic of the model on (I and II), one cannot but arrive at a sinister future for mankind. At levels of CO2 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 priority.

Any realist theory of greenhouse gas emissions must target Co2s. It predicts the following consequences of CO2 emissions:

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
28	450	1.3
20	470	1.5
22	490	1.7
24	510	2.0

In Table 2 the relationship between energy consumption and temperature rise is modelled. Energy consumption is near 16 billion with + 1 degree. Looking at stylised projections, we will move towards 24 billion with + 2 degrees. That would create lots of difficult problems for mankind.

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10 Global warming images

Introduction

The opinion on global warming is sharply divided. On the one hand, we have the climate change DENYERS with different arguments for their position. On the other hand, there are the climate change AFFIRMERS, also suggesting a variety of arguments to support their case. Both fact and value figure in the psychology of climate change.

The facts

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 CO_2 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 to be 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 theme to 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 CO_2 emissions yearly. Thus, we have:

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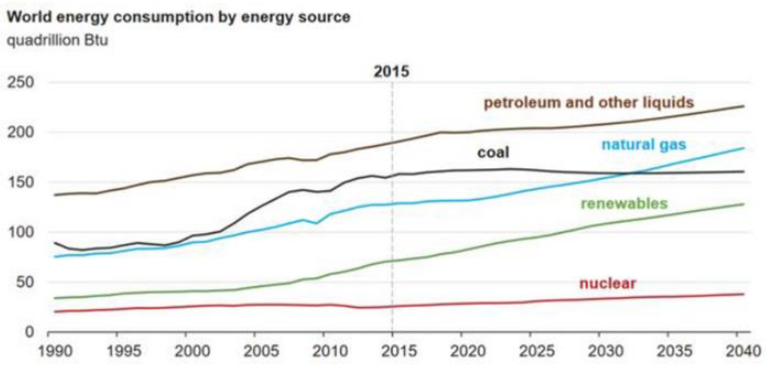

Figure 1. *Energy Projections according to IEA*

Conclusion

While the postmodern theory implies no action, the realist theory targets Co2s. It predicts the following consequences of CO_2 emissions:

Table 1. *Regression estimates for temperature rise based on energy consumption.*

Global Energy / btoe	CO_2 concentration / PPM	Temperature rise / degrees C
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ISBN: 978-625-8190-28-1 (e-Book)
KSP Books 2022

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