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The Global Demand for Energy Undoes Sustainable Economic Development: A Critique of Sachs

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ABSTRACT

There is cause for a kind of Malthusian pessimism about the future of our planet. The energy-emissions conundrum may make Mother Earth inhabitable during the 21rst century, as global warming is conducive to a reduction in work effort by mean and women, less food, deforestation, desertification and the acidification of oceans and lakes. Droughts come before water shortages. The UNCCC with its many meetings, now the COP22, is bound to fail to halt climate change, because several governments will renege, like the US, and CO2:s. international governance is weak, lacking adequate fund for its promised Super Fund, paying for a gigantic energy transformation in the Third World.

Keywords: GHG:s and CO2:s, the COP21 objectives: Goal I, Goal II, Goal III. Energy, energy link with GDP and GHG:s or CO2:s, Sachs, CO2

I. INTRODUCTION

Dismal Science

Perhaps it is time to re-read T. Mathus' An Essay on the Principle of Population from 1798, as population keeps growing to increase the standard of living for the human race. Malthusian pessimism is with us with a vengeance in the form of the energy-emissions conundrums. I will develop this position by means of some pertinent 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 go from realities to utopian vision.

Take the example of Jeffrey 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.

Source: 2210 www.thelancet.com Vol 379 June 9, 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 make 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

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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: 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 emissions up to 2020 (Goal I),
b) Reducing CO2:s up until 2030 with some 40 per cent (Goal II),
c) Achieve more or less total decarbonisation until 2075 (Goal III),

Will prove too demanding for most countries, I dare suggest. What are the hurdles for any decarbonisation project (whether the COP21 or another), if we stick to the ethos of the social sciences, viz. ethical neutrality being truthfully objective?

II. Energy Hurdle

Decarbonisation, resulting from the *anthropogenic* causes of CO2:s, can only be done when the fundamental pattern of energy consumption is transformed. At the present, energy comes from mainly fossil fuels and wood coal. Energy is the capacity to do work, which implies that energy consumption is a *sine qua non* for affluence, following A. Smith and J.B. Say among the classics. The utopians like Sachs promises that economic development will not be compromised, as SDG would include the Millennium Development Goals (*MDG*):

The SDGs should therefore pose goals and challenges for all countries—not what the rich should do for the poor, but what all countries together should do for the global well-being of this generation and those to come. Middle income emerging economies, such as Brazil, China, India, and others, will be crucial leaders of the SDGs, and will have their own internal challenges of balancing growth and environmental sustainability...

Source: p. 2208, www.thelancet.com Vol 379 June 9, 2012

Economic growth in advanced nations or economic development in the Third World has been based upon the burning of fossil fuels, besides the fact that extremely poor countries employ massive amounts of wood coal. And most countries, whether it be their governments or their private economies, plan for a sharp increase in energy consumption in the coming decades.
To understand the real role that energy plays for the economy and GHG:s, we turn to the Kaya model. The basic theoretical effort to model the greenhouse gases, especially CO2:s, in terms of a so-called identity is the deterministic Kaya equation (Kaya and *Yokoburi*, 1997). In theories of climate change, the focus is upon so-called anthropogenic causes of global warming through the release of greenhouse gases (GHG). To halt the growth of the GHG:s, of which CO2:s make up about 70 per cent, one must theorize the increase in CO2:s over time (longitudinally) and its variation among countries (cross-sectionally). As a matter of fact, CO2:s have very strong mundane conditions in human needs and social system prerequisites. Besides the breading of living species, like Homo sapiens for instance, energy consumption plays a major role. As energy is the capacity to do work, it is absolutely vital for the economy in a wide sense, covering both the official and the unofficial sides of the economic system of a country. The best model of carbon emissions to this day is the so-called Kaya model:

(E 1) Kaya’s identity projects future carbon emissions on changes in Population (in *billions*), economic activity as GDP per capita (in *thousands of $US(1990) / person year*), energy intensity in *Watt years / dollar*, and carbon intensity of energy as *Gton C as CO_2 per TeraWatt year*.” (http://climatemodels.uchicago.edu/kaya/kaya.doc.html)
Concerning the equation (E 1), it may seem premature to speak of a law or identity that explains carbon emissions completely, as if the Kaya identity were a deterministic natural law. It will not explain all the variation, as there is bound to be other factors that impact, at least to some extent. Thus, it is more proper to formulate it as a stochastic *law-like* proposition, where coefficients will be estimate using various data sets, without any assumption about stable universal parameters. Thus, we have this equation format for the Kaya probabilistic law-like proposition, as follows:

(E2) Multiple Regression: $Y = a + b_1X_1 {}^{+} b_2X_2 + b_3X_3 + ... + b_tX_t + u$

Note: Y = the variable that you are trying to predict (dependent variable); X = the variable that you are using to predict Y (independent variable); a = the intercept; b = the slope; u = the regression residual. Note: http://www.investopedia.com/terms/r/regression.asp#ixzz4Mg4Eyugw

Thus, using the Kaya model for empirical research on global warming, the following anthropogenic conditions would affect positively carbon emissions:

(E3) CO2:s = F(GDP/capita, Population, Energy intensity, Carbon intensity).

I make an empirical estimation of this probabilistic Kaya model with a *longitudinal* test for 1990-2014, i.e. World data 1990 - 2015:

(E4) Ln CO2 = 0,62*LN Population + 1,28*LN(GDP/Capita) + 0,96*LN(Energy/GDP); R2 = .90.

The close link in the Kaya model may be visualized in Figure 1.

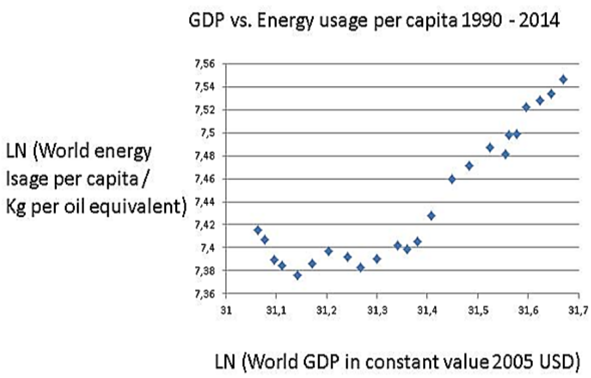

Figure 1. Global GDP-CO2 link: y = 0,80x + 5,96; R^2 = 0,97 (N = 59)

The findings show that total GHG:s or CO2:s go with larger total GDP, i.e. GDP per person * population. To make the dilemma of energy versus emissions even worse, we show in Figure 2 that GDP increase with the augmentation of energy per capita. This makes the turn to a sustainable economy (Sachs, 2015) unlikely, as nations plan for much more energy in the coming decades.

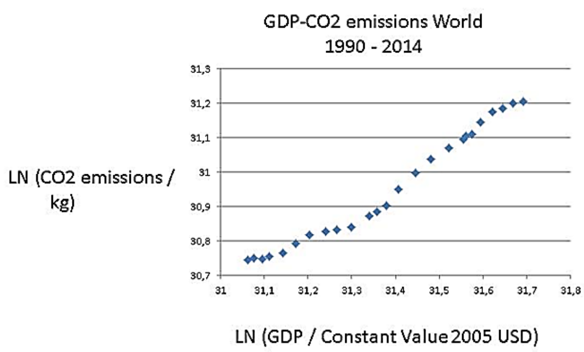

Figure 2. GDP and energy per person 1990-2014

Decarbonisation is the policy promise to undo these “dismal” links by making GDP and energy consumption rely upon carbon neutral energy resources, like modern renewables and atomic energy. Thus, the upward sloping curves must be reversed but still slope outward. Sachs says that decarbonisation can be achieved with a giant global recession, output falling some 20 per cent. But countries would rather renege upon decarbonisation goals. Putting Figures 1 and 2 together, we arrive at the characteristic energy-emissions conundrum. Besides the global conundrum – GDP requires energy, but energy leads to GHG:s – there is an energy-emission conundrum for each government that signed the COP21 Agreement, to be the object of a small inquiry below.
We need to model this energy-emission dilemma for the countries of the COP21 project, targeting the basic *hurdles*. To understand the predicament of Third World countries, we need to know whether GHC:s or CO2:s are still increasing (Goal I) and what the basic structure of the energy mix is (Goal II). Thus, I suggest:

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

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

To undo an energy-emission conundrum, the price of fossil fuels must increase sharply with a global carbon tax, used to finance the *Super Fund*. Third World countries need massive financial and technological assistance for *ENERGIWENDE*. The standard energy projections are completely out of tune with the COP21 project that can save mankind from a climate disaster of major proportions (Figure 3).

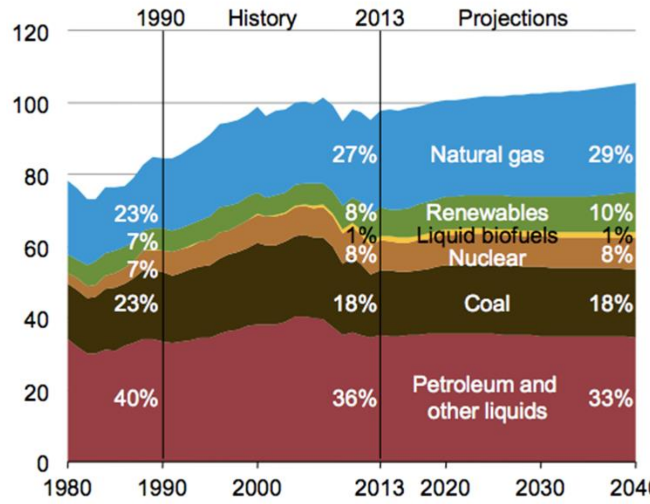

Figure 3. Standard Energy Projections

One encounters these energy scenarios with global oil producers, huge investment banks and the energy organisations: EID and IAG. They are completely at odds with the decarbonisation objectives, like the COP21 Goals, I, II and III. Something has to give, and I fear economic development trumps the environment and aggravates the energy-emissions conundrum.

THE “TAKE-OFF” HURDLE

Several very important Third World nations conduct an aggressive policy of reducing the gap to the First World. Some of them are now in the take-off stage, meaning that have embarked upon the process of industrialisation and urbanization that is irreversible. So far only China has succeeded, as it was Third World up until yesterday. They have no intention to halt their economic advances or slow down economic growth due to a lesser consumption of coal or fossil fuel energy. Let us look at for instance China, India and Indonesia that are responsible for much of the CO2:s.

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

China

China has recently made great strides towards halting its increasing CO2 emissions. Thus, solar, wind and atomic power plants have shot up the last years, but China has to do much more in the form of energy transformation. China was a developing country until yesterday. Now new and bigger cars and aircrafts are multiplying in new extravagant airports.

One finds almost always that the emissions of GHG:s or CO2:s follows economic development closely in Third World countries. The basic explanation is population growth and GDP growth – more people and higher life style demands. Take the case of China, whose emissions are the largest in the world, totally speaking (Figure 4).

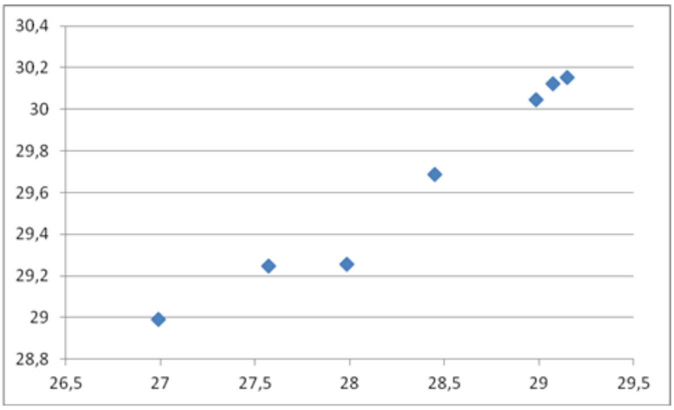

Figure 4. CHINA : LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

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

The sharp increase in GHG:s in China reflects not only the immensely rapid industrialization and urbanization of the last 30 years, but also its problematic energy mix (Figure 5).

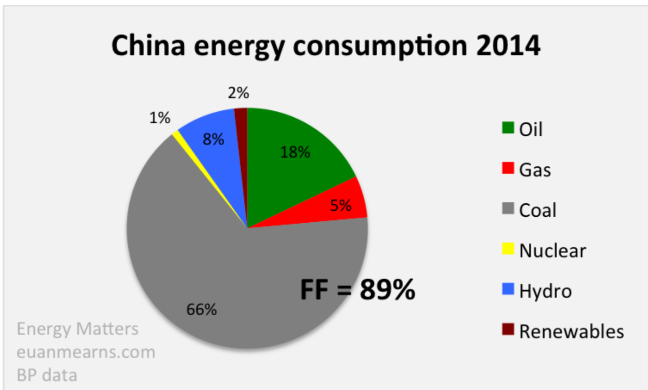

Figure 5

Almost 70 per cent of the energy consumption comes from the burning of coal with an additional 20 per cent from other fossil fuels. The role of nuclear, hydro and other renewable energy sources is small indeed, despite new investments. This makes China very vulnerable to demands for cutting GHG emissions: other energy sources or massive installation of highly improved filters? It should be pointed out that several small countries have much higher emissions per capita than China. This raises the enormously difficult problematic of fair cuts of emissions. Should the largest polluters per capita cut most or the biggest aggregate polluters? At the COP21 meeting, this issue was resolved by the creation of a Super Fund to assist energy transition and environment protection in developing counties, as proposed by economist Stern (2007). Will it really be set up with 100 billion dollars per year to spend n energy transformation? Or will some countries renege, like for instance Trump's USA?

India

India will appeal to the same fairness problematic as other Third World nations, namely low per capita emissions in the Third World against huge aggregate emissions. The country is even more negative than China to cut GHG or CO2 emissions, as it is in an earlier stage of industrialization and urbanization. India relies upon wood coal in a massive way, like central Africa. It has been claimed that wood coal is carbon neutral, but in reality it leads to deforestation and desertification on a huge scale.

Figure 6 shows the close connection between emissions and GDP for this giant nation.

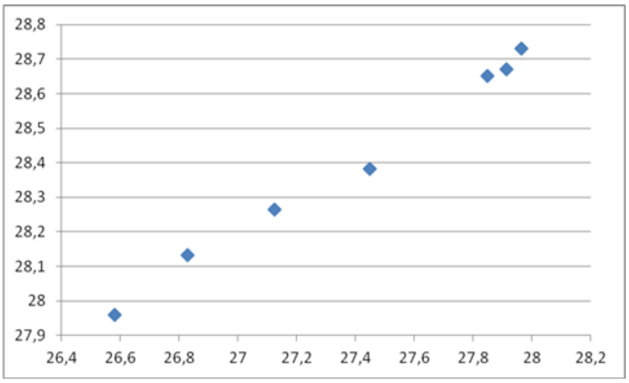

Figure 6. INDIA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

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

India needs cheap energy for its industries, transportation and heating as well as electrification. From where will it come? India has water power and nuclear energy, but relies most upon coal, oil and gas as power source. It has strong ambitions for the future expansion of energy, but how is it to be generated, the world asks. India actually has one of the smallest numbers for energy per capita, although it produces much energy totally. Public intellectual and former minister Ramesh (2015) admits openly that India cannot do without stone coal fired power stations for socio-economic development reasons. In addition, India relies massively upon wood coal.

Figure 7 shows its energy mix where renewables play a bigger role than in China.

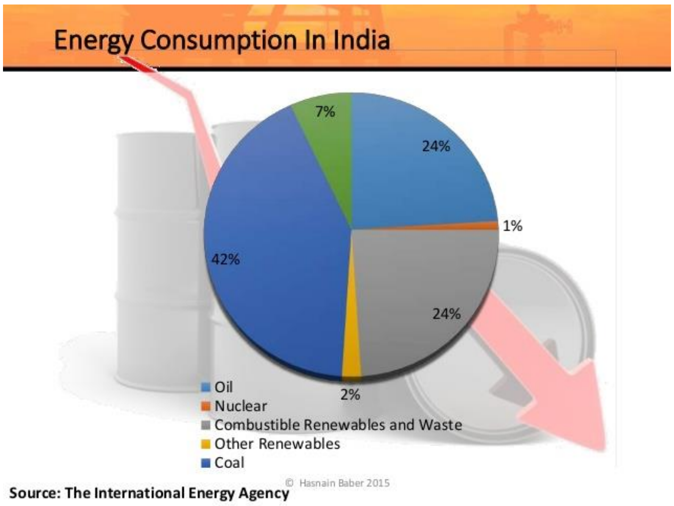

Figure 7

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

Indonesia

One may guess correctly that countries that try hard to "*catch-up*" will have increasing emissions. This was true of China and India. Let us look at three more examples, like e.g. giant Indonesia – now the fourth largest emitter of GHG:s in the world (Figure 8).

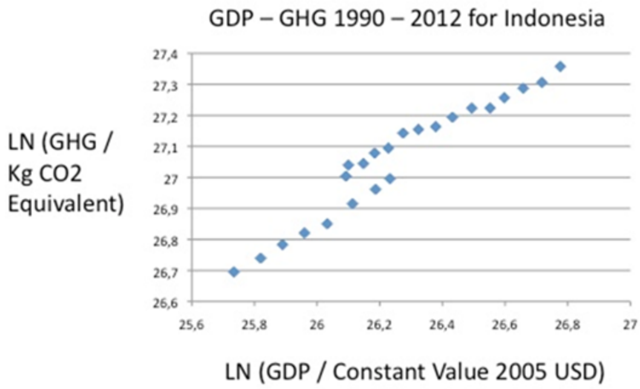

Figure 8. INDONESIA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

Indonesia is a coming giant, both economically and sadly in terms of pollution. Figure 6 reminds of the upward trend for China and India. However, matters are even worse for Indonesia, as the burning of the rain forest on Kalimantan augments the GHG emissions very much. Figure 9 presents the energy mix for this huge country in terms of population and territory.

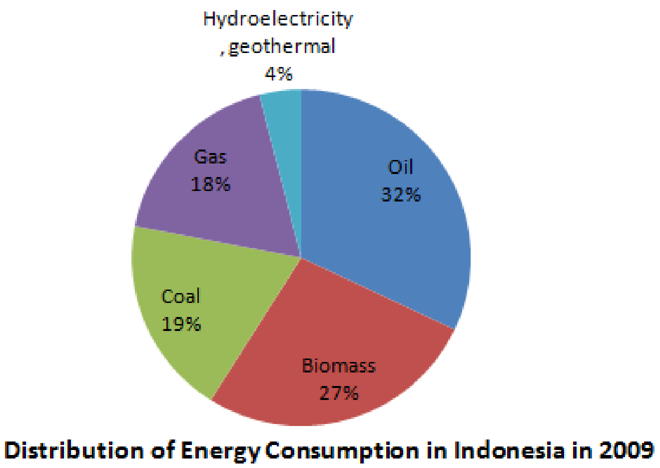

Figure 9. (http://missrifka.com/energy-issue/recent-energy-status-in-indonesia.html)

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

III. Incentive Hurdles

Several countries like for instance some of the Gulf States or emirates have massive CO2:s, because they drill and refine oil and natutal gas. Of couse, they burn in order to get electricity. Will they be motivated to reduce these fossil fuels and turn to solar or wind power? Well, it depends upon the economics or costs of energy trasfomation.

The Gulf

One may of course look at the leader of the OPEC, but the basic picture is trivial. Saudia Arabia burns oil and gas to maintain a very high standard of living, based upon abundant electricity. They have so much electricity that they can construct Green Oasis Towns.

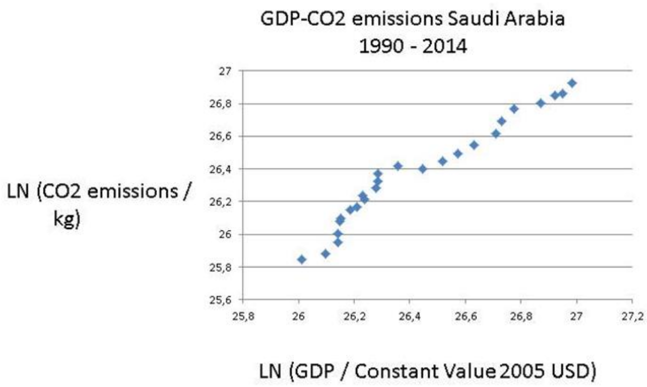

Figure 10. Link GDP-CO2:s for Saudi Arabia: y = 1,03x - 0,77; $R^2 = 0,95$

The recent economic downturn for this oil richest country in the world may spark a real turn to modern renewables. Yet, atomic power contructed by South Korea is an attractive option, onlyas long as the oil price stays moderately high. Solar power would of course be an option, but it is far less effective that burning oil and natural gas.

Turning to small Kuwait, we find the typical upward sloping curve for GDP and GHG:s (Figure 11).

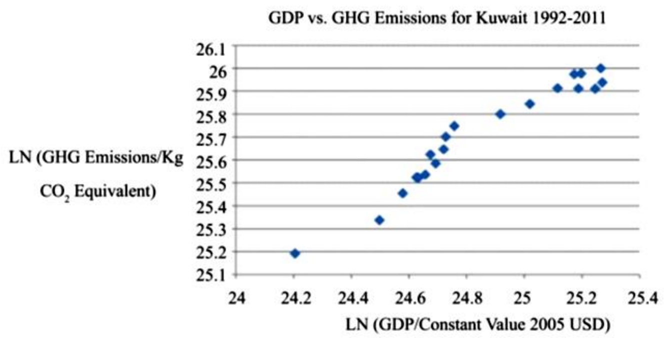

Figure 11. Kuweit's link GDP-GHG

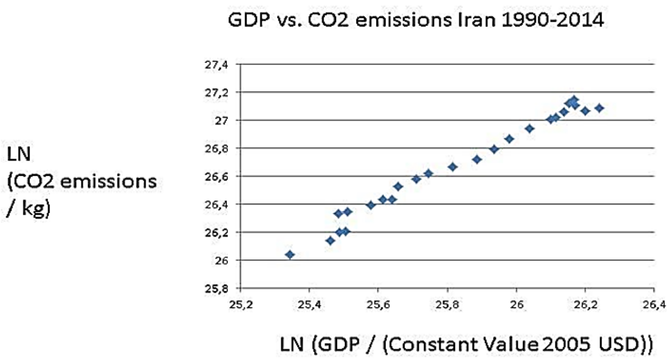

Figure 13. Iran: GDP-CO2 link ($y = 1{,}2229x - 4{,}91$; $R^2 = 0{,}98$)

These oil rich countries burn massive amounts to get electricity that is the basis for a very high standard of living. On a per capita basis, the emissions in these countries are far higher than in popolous the catch-up countries. Perhaps they should contribute more to the Super Fund?

The same question of fairness is apparent in the UAE data, where CO2 emissions are the highest in the world except for Qatar, Figure 12 has the charactiristically upward slopig trend,

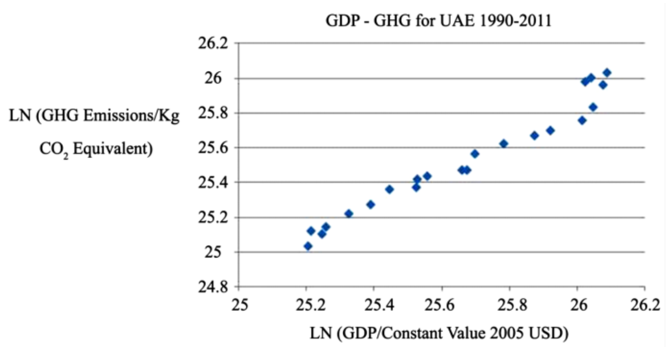

Figure 12. The United Arab Emirates: Equa.: $y = 0.9824x$; $R2 = 0.9646$.

Iran

If Iran can continue to enter the global enery market, it is large enough both as a producer and a consumer to impact climate change. To shift to modern renewables ot atomic power, it needs a decent price for its fossil fuels. Figure 13 shows the standrad upward trend for the oil countries.

Iran is together with Russia and Qatar the largest owner of natural gas deposits. But despite using coal in very small amounts, its CO2 emissions are high. Natural gas pollute less than oil and coal, but if released unburned it is very dangerous as a greenhouse gas. Iran relies upon its enormous resources of gas and oil (Figure 14).

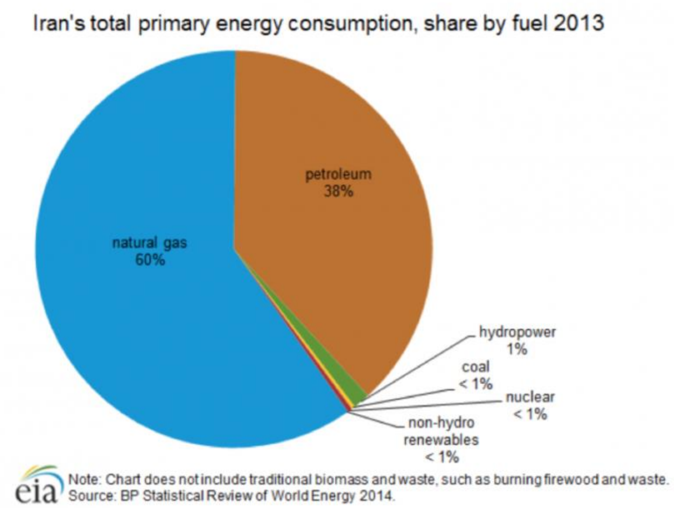

Figure 14. Iran: Energy Mix

Iran needs foreign exchange to pay for all its imports of goods and services. Using nuclear power at home and exporting more oil and gas would no doubt be profitable for the country. And it would also help Iran with the COP21 goals achievement.

Mexico

For Mexico having a fast growing population with many in poverty and an expanding industry sucking electricity, holds the following situation (Figure 15). Can economic growth and decarbonisation go together here?

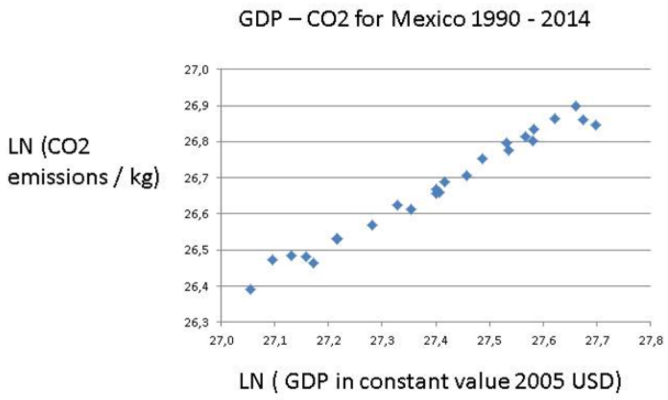

Figure 15. GDP-CO2 in Mexico: y = 0,77x; R^2 = 0,98

The close link between economic development and CO2 is discernable in the data, but the emissions growth seems to stagnate in the last years. This is of course a promising sign, whether it is the start of a COP21 inspired 40% reduction in CO2:s remains to be seen. I doubt so, but let us enquire into the energy mix of this huge country that is of enormous economic importance to both North and South America.

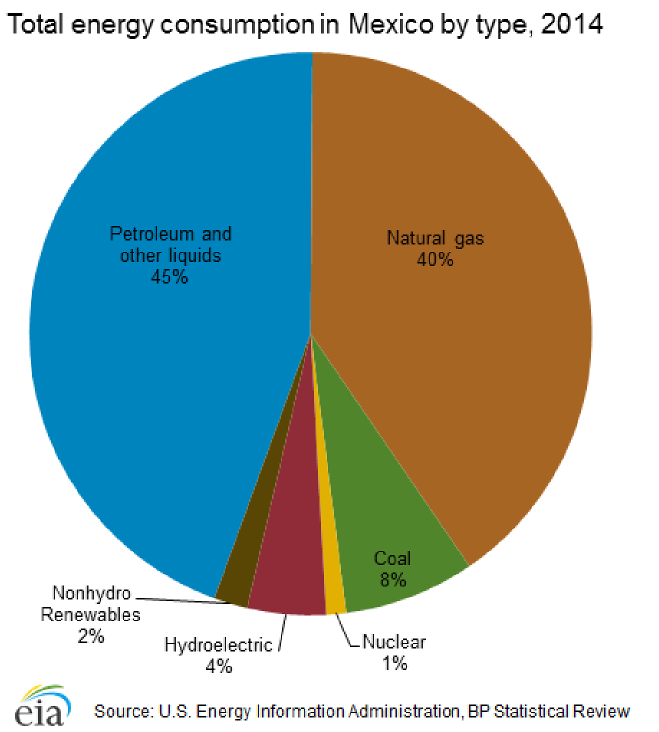

Figure 16. Energy mix for Mexico

Few countries are so deependent upon fossil fuels as Mexico. One find the same patter with the Gulf States. The Mexican government must start now to reduce this dependency, by for instance eliminating coal and bringing down petreoleum, instead betting upon solar, wind and nuclear power. Mexico will face severe difficulties with the 40% reduction target in COP21.

Algeria

Algeria ia a major exporter of natural gas and oil, Thus, we expect that it relies mainly on fossil fuels, like Mexico and the Gulf States. Figure 17 verifies this expectation.

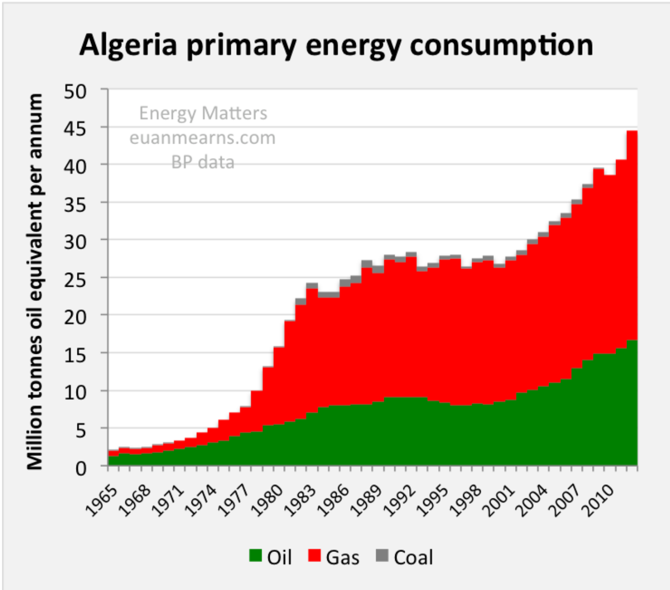

Figure 17. Algeria's GDP-CO2 link

Source: http://euanmearns.com/post-peak-algeria/

Although Algeria may trust in the availability of future fossil fuels resources, it still faces the demand for a 40% reduction of its CO2 emissions. They have thus farfollowed the economic progress – see Figure 18.

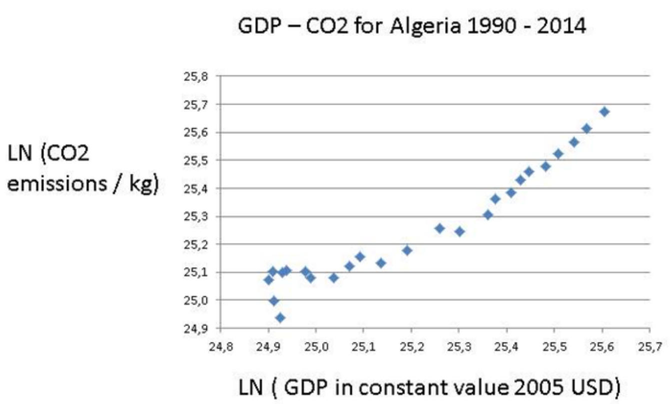

Figure 18. GDP-CO2 in Algeria: y = 0,81x; R^2 = 0,93

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, also Algeria has been plagued by the attacks of terrorists or looters.

IV. No Resources Hurdle

Decarbonisation requires massive new investments. Many countries are in such economic troubles that they just cannot make them. Either they have to renege or they must be assisted by some kind of Super Fund. One example that comes to mind is the unfortunate country in Latin America that faces profound political instability.

Venezuela

We first examine the energy mix of Venezuela that includes a healthy hydro power part. As a matter of fact, countries like Egypt, Nigeria and Argentina would envy the energy mix of this socialist country (Figure 19).

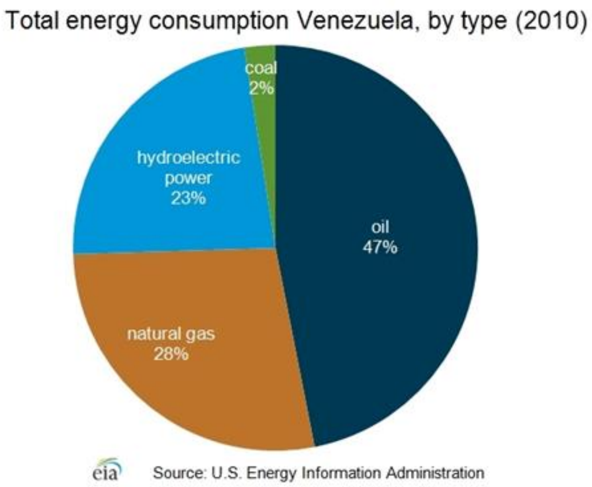

Figure 19. Energy consumption in Venezuela

However, the country still relies upon fossil fuels up to almost 80 per cent, which are their own for sure. It comes as no surprise that the trend is upward in Figure 20.

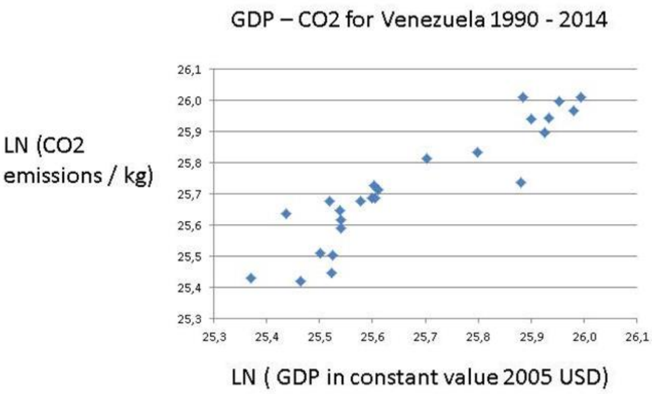

Figure 20. Link GDP-CO@:s

The present severe difficulties of Venezuela with massive power shortages hindering the economy depend upon water shortages as well as the low oil price, both aggravated by mismanagement. How could Venezuela afford to decarbonise in the 21rst century?

Argentina

Although this country has had a volatile road economically, it keeps expansing its CO2 emissions as a function of GDP. Figure 21 shows a smoth linear growth trend between GDP and CO2:s for the last 24 years, exceptfor the years of the economic collapse.

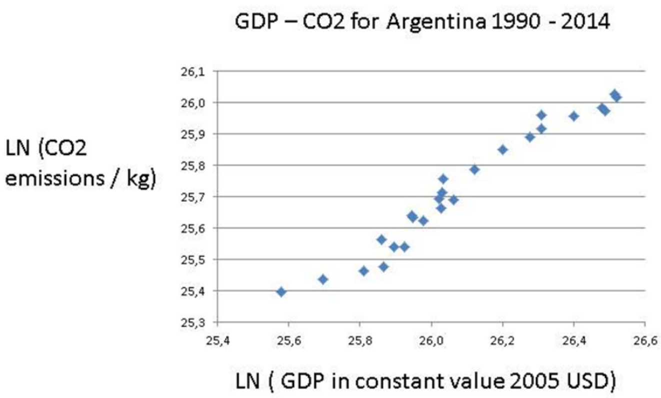

Figure 21. GDP-CO2: $y = 0{,}7409x$ $R^2 = 0{,}96$.

Now, what is the energy mix behind this increase in CO2:s that is quite substantial? Figure 22 has the answer.

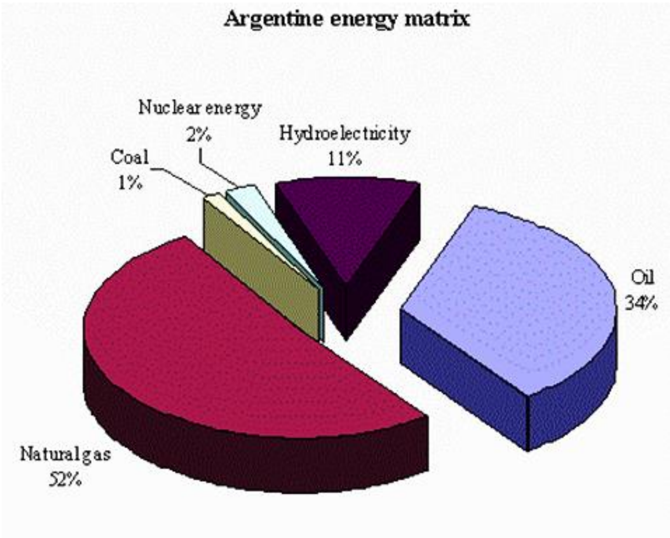

Figure 22. Energy consumption in Argentina

Source: BP Statistical Review of World Press (information corresponding to 2011)

Argentina depends to more than 85% on fossil fuels, but it is not coal that figures prominently in this energy mix but natural gas. This reminds of Qatar and Iran. Natural gas is better for halting global warming than coal, on the condition that it does not leak out before burning. But there is bound to occur leakages resulting in the very harmful methane emissions.

Argentina disposes of hydro power, but the snow over the Andes is diminishing just as the glaciers are melting fast. The country needs to turn to solar power or nuclear power in order to accomplish the promised 40% reduction with COP21. It imports fossil fuels that Venezuela does not.

The RSA has a modern economy running on mainly coal (Figure 23). 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?

South Africa

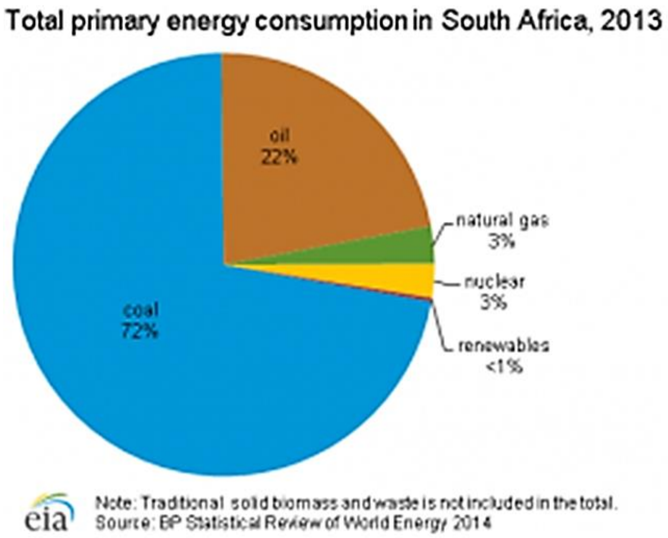

Figure 23. Energy consumption in RSA

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

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 – see Figure 24.

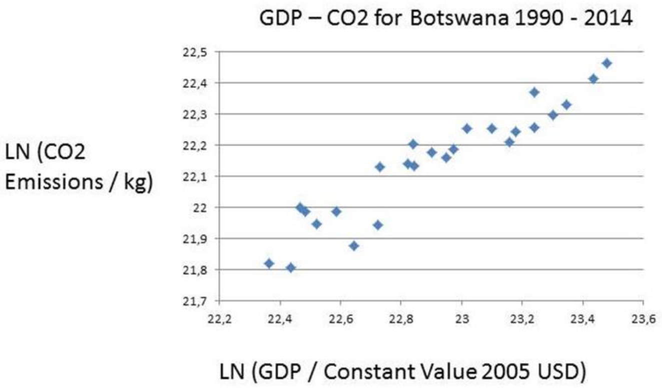

Figure 24. Botswana: GDP-CO2: $y = 0{,}51x$, $R^2 = 0{,}89$

Yet, Botswana relies mainly upon fossil fuels, oil and coal, to deliver its economic output from mining and minerals (Figure 25).

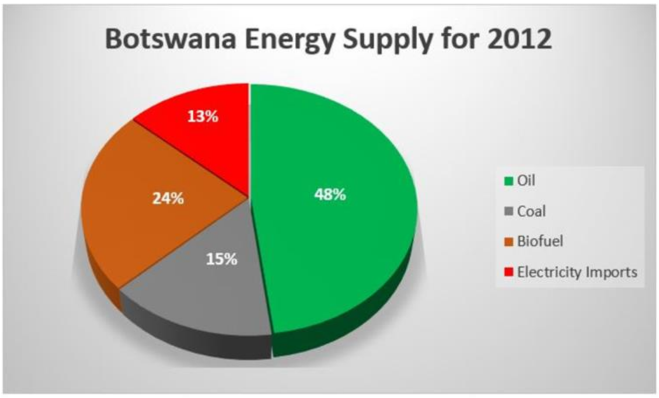

Figure 25. Energy consumption in Botswana

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.

Egypt

Dismally poor Egypt that has neither much hydro power or oil and gas assets, but the emission trend is clear. It has a huge population with high unemployment and mass poverty besides a certain level of political instability, resulting from religious conflicts. But surely it has electricity from inta giant Assuam dam and the Nile? No, it does not count for very much, where most people live in the Nile delta (Figure 26).

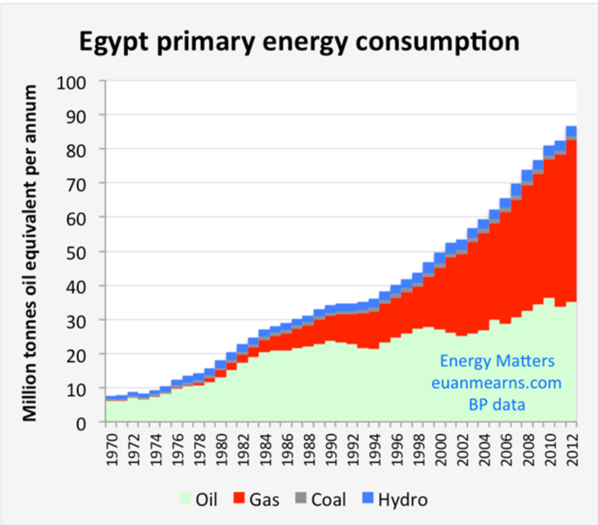

Figure 26. Egypt's eergy mix

The share of hydro power is stunning low for a country with one of largets rivers in the world. Actuallu, the water of the Nile is the source of interstate confrontation between Egypt, Sudan and Ethiopia.

As Egypt relies upon fossil fuels, it has massive CO2 emissions, the trend of which follows its GDP (Figure 27).

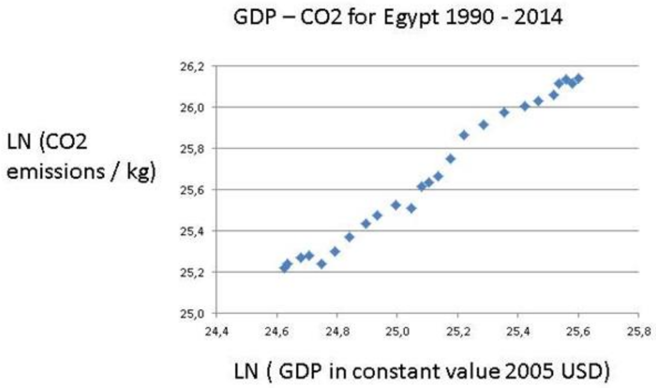

Figure 27. GDP-CO2 for Egypt: y = 1,02x; R^2 = 0,99

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?

V. The Wood Coal Hurdle

A general claim in the climate change debate is 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 a household;
- New renewables: solar, wind, geo-thermal and wave energy that are indeed carbon neutral, at least at the stage of functioning.

Congo, Nigeria and Ethiopia

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

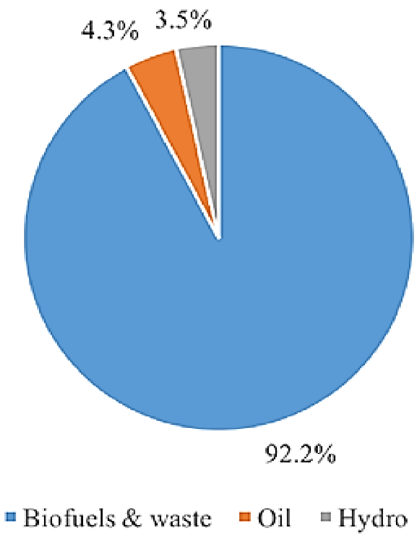

Figure 28. DR CONGO

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

One notes how little of hydro power has been turned into electricity in Congo, 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. Congo can now move directly to modern renewables like solar power, but it has no money at all.

Angola

An enormous reliance upon traditional renewables is to be found also in Angola and Nigeria, although both have access to massive fossil fuels: oil and gas. Figure 29 describes the energy mix for Angola.

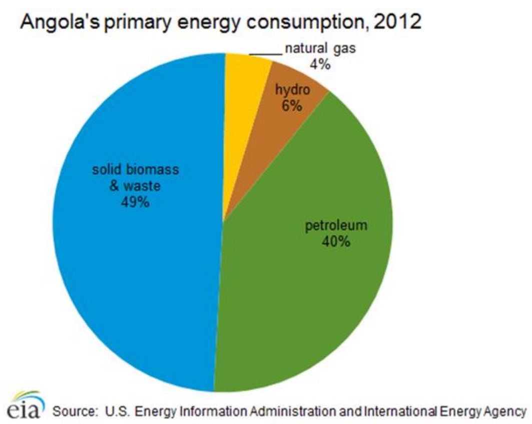

Figure 29

Angola has suffered from long and terrible civil war. In the mass of 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.

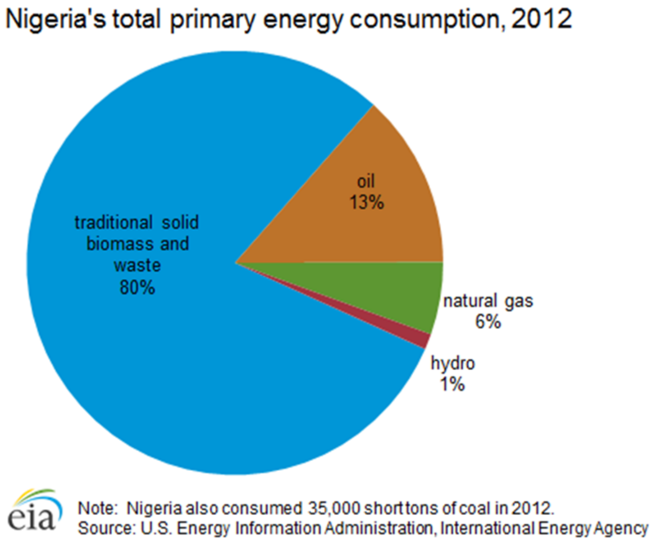

Figure 30. Nigeria's energy mix

Nigeria would have to diminish the use of traditional renewables in order to meet the COP21 goals. The very same policy recommendation applies to two countries in the Nile valley, namely Sudan and Ethiopia – extremely poor countries relying mainly upon traditional renewables.

Surely, both Ethiopia and Sudan would want to utilise the great Nile River for their electricity consumption. However, Egypt wants to have a SAY over the energy planning of these two countries up the river. Thus, far many rounds of negotiations have resulted in the construction of only a few power plants, a few in Sudan (Merowe Dam, etc.) and one another huge in Ethiopia – Grand Ethiopian Renaissance Dam. The problem is the common pool of the Nile, where one country, Egypt, may find that the water level has shrunk too much for its own needs, electricity or irrigation. Actually, the risk of draughts is a real one for all countries trying to exploit the Nile. 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? 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 31 displays a unique predicament.

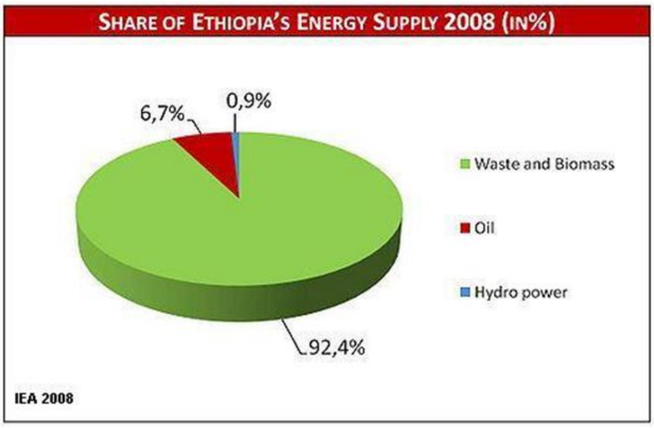

Figure 31. ETHIOPIA: Energy mix

Are there any advantages with such a skewed energy mix? No, because even mainly rural Ethiopia works with lots of CO2: - see Figure 32.

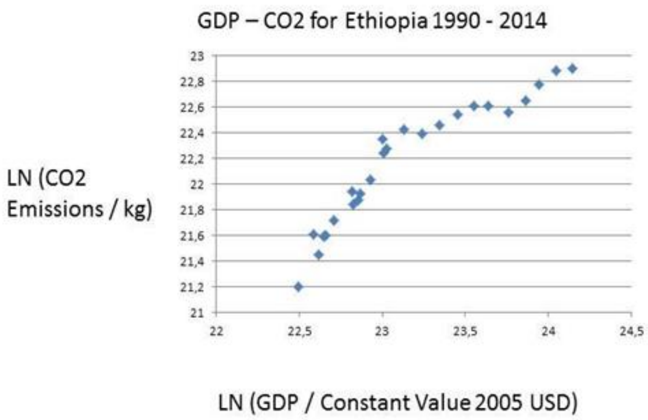

Figure 32. Ethiopia: GDP and CO2: y = 0,90x, R^2 = 0, 88

The zest with which Ethiopia is pursuing its control over water resources becomes fully understandable, when Figure 27 is consulted. What we observe is the same smooth linear function plotting CO2:s upon GDP, as is obvious in countries based upon fossil fuels – see below. For Ethiopia, to comply with decarbonisation 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

VI. RENEGING HURDLE

At the end of the day, some countries may simply renege upon the COP21 or decarbonisation. They may find it unwarranted from a scientific point of view (Trump's USA) or they feel they cannot afford an immense energy transformation.

USA

The US is a major carbon polluter, both in aggregation and per person. Figure 33 shows its dependence upon fossil fuels.

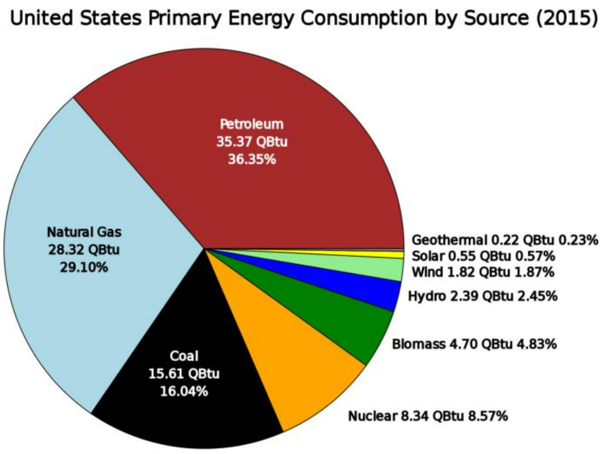

Figure 33. Energy mix for the US

Yet, the positive signs for the US include a downward sloping curve in Figure 34. But as solar power and wind power expands, so atomic power is reduced and shale oil and gas augmented. Politics will be decisive here, as the US may renege upon the COP21 decarbonisation goals.

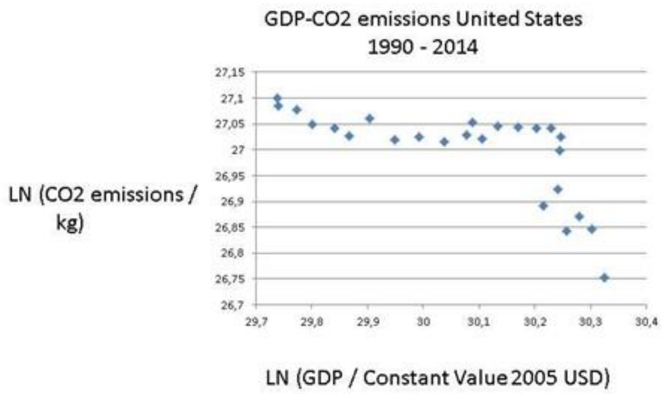

Figure 34. USA: Link GDP-CO2

Developments in the US are promising, as most countries display upward sloping GD-GHC (CO2) links. But to comply with the draconic COP21 goals, the US needs to do much more. Will it, or will the Trump administration renege? There is no clear and consistent energy policy in the US.

Japan

Japan started the Asian growth miracle, although without internal energy resources. As the economy of Japan stagnated in the 1990s and the country began using nuclear power massively, Japan managed a dramatic reduction in the emission of greenhouse gases in the first decade of the new century.

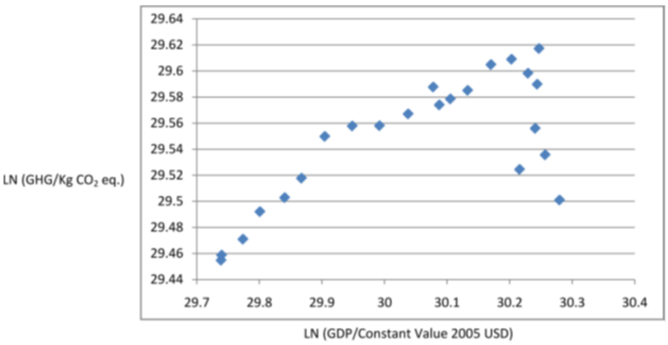

Figure 35. Japan's GDP-CO2 link: $y = 0.2648x$; $R^2 = 0.194$.

However, the numbers will go up again to high levels of emissions. Governments make plans, but they may not hold for unforeseen developments. Take the case of Japan (Figure 36).

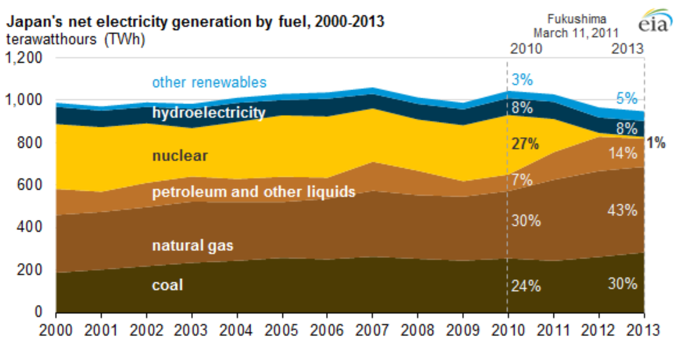

Figure 36. Energy for electricity in Japan

Japan is today more dependent upon fossil fuels than earlier due to the debacle with its nuclear energy program. When forced, governments renege, i.e. they will turn back to the fossil fuels, as for them economic growth trumps the environment. After all, nations are brutally egoistic, at least according to standard teachings in international relations. Can Japan meet its enormous energy demand by solar or wind power plants? Only to some extent, one would be inclined to say, given the climate of the country. Will Japan go back to atomic power massively? Probably not. What then: reneging!

Russia

We find a sharp reduction in CO2:s for Russia, which is a major polluter. It reflects the de-industrialisation of the Soviet Union. No countries treated their environments as badly as the Communist regimes. But Figure 32 also shows that emissions are no longer falling.

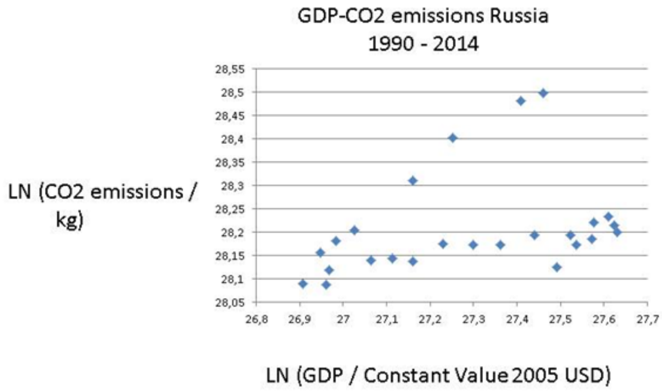

Figure 37. Russia: GD-CO2 link

The statistics for Russia is erratic, but recently the trend is up. The country could never fulfill the three decarbonisation goals above. It runs on fossil fuels to 90 per cent (Figure 38).

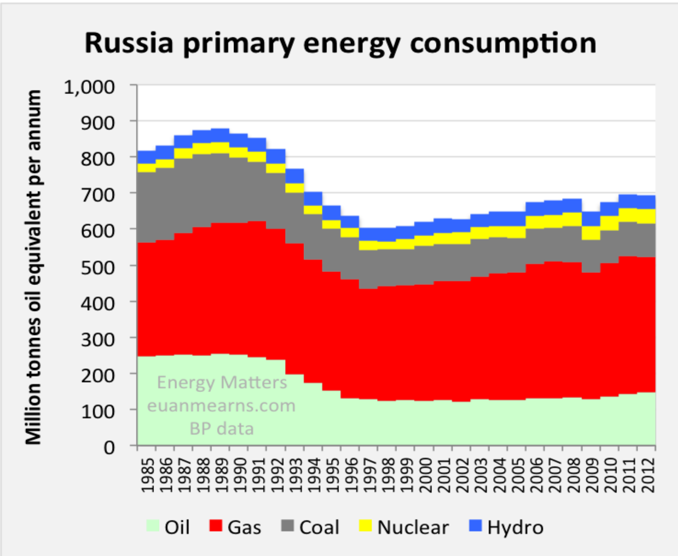

Figure 38. Russia: energy consumption pattern

Russia has accepted that its hope for a major industrialization failed, concentrating its ambitions on the hope of being a global resources based economy. Energy wise, Russia is a fossil fuel country that when faced with the implications of decarbonisation a la CO21 will renege. Its global power ambitions can only be promoted by the employment of its fossil fuels. When challenged in the future, it falls back on its energy rich economy.

Why the erratic curve for the link GDP-CO2:s above? Perhaps a problem with correct statistics, but it also reflects the demise of the Soviet Union, like the number for Kazakhstan in Figure 39 below.

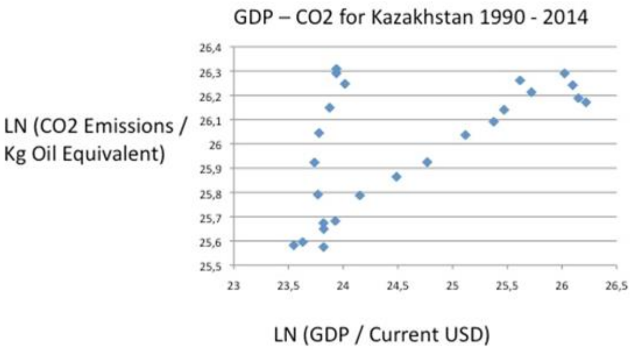

Figure 39. Kazakhstan: link GDP-CO2

Kazakhstan burns fossil fuels for its energy needs, even more than Russia. The trend has been upwards since overcoming the demise of Soviet Union. To pay for a dramatic energy transformation, Kazakhstan would need a high price for its oil and natural gas exports. This is not likely, given the enormous resources of shale rock, also in the former Soviet Union.

VII. CONCLUSION

By mixing decarbonisation with the economics of environmental sustainability as well as the struggle against poverty, Sachs bets much too much upon politics, policy-making, state intervention and international governance. If decarbonisation could be promoted as a spontaneous order, it could be feasible. Planned decarbonisation is not incentive compatible for reasons spelled out above, but spontaneous decarbonisation must be based upon the economics of external effects, involving charges for real costs and subsidies for true beneficial outcomes.

Yet, even the adherents of a spontaneous order like the market economy did not anticipate or recognize that it may fail (Barry, 1982). Hayek (1991) saw only the impossibility of planning and large scale policy-making, but failed entirely to foresee that too much of externalities would bring the market economy. If the globe overheats, then market economics cannot operate. If or when temperature rise goes to plus 4, then men and women can only function normally in air-conditioned settings, but it would further fuel climate change and hurt the environment – the perfect *circulus vitiosus*.

The energy implications for the SDG:s have to be spelt out. The large attention paid to energy recently has had reasons, namely: Fear of a global *Hubbert peak* for the consumption of fossil fuels, especially oil; The negative effects of rising energy consumption upon the environment, especially climate change: global warming > 2 degrees.

Whereas the first concern has eased considerably, the second one just keeps going up in political relevance, comprising a lot of difficult and complicated policy issues. The immense augmentation of energy consumption during the latest decades when several of the emerging economies managed to catch-up with the advanced capitalist economies has resulted in more and more of conspicuous consumption that is incredibly energy consuming. The environmental worries about the sharp rise in energy production and consumption pointed at several ecological menaces, but the centre of interest has become the emissions of greenhouse gases stemming from *anthropogenic* sources in the economy, especially the burning of fossil fuels, forests and cement constructions. Thus, energy is now the main topic in the globalisation process; How to decarbonise the world economy without losing economic momentum?

The concept of energy is complex, identifying several forms of energy. In general, energy is the capacity to do work. Thus, it is a central element of all social systems, from advanced economies to simple households. It is of course vital in politics and warfare. In the natural sciences, Einstein made energy the core of the Universe with his famous formula, equating mass with energy.

For the social sciences and economics, the importance of access to energy sources has increased with industrialisation, urbanisation and the port-industrial society. The process of globalisation has further underlined the centrality of energy sources and energy consumption for economic well-being and public policy. With more and more humans coming on the stage and people seeking higher standards of living, the demand for energy has exploded the recent decades. And stylised projections for the coming decades talk about another doubling of demand. Now, following the basic laws of physics, energy is indestructible. This entails that all now existing energy came forth on the BIG BANG. However, energy can change form. Energy can become inactive in a state of *entropy*, which could be the final end predicament of the Universe (cooling hypothesis).

The basic forms of energy for the globalisation period and its societies, rich or poor, comprise;

- fossil fuels: coal, oil, natural gas
- shale oil and gas: shale rock energy
- traditional renewables: wood, charcoal, peat, waste
- modern renewables: solar, wind, geo-thermal
- nuclear power. Fission or maybe someday fusion.

The ongoing shale rock revolution eliminated all Hubbert peaks, also for the US. With huge deposits around the globe of shale rock, fossil fuel prices will stay low for a long time, which puts pressure upon the large scale development of modern renewables. Yet, the easing of energy prices due to falling oil prices just makes the other problematic more urgent, i.e. greenhouse gases and global warming.

The governments of the world have finally come around to accept that climate change is not a positive for mankind and Planet Earth. No one knows with certainty how dangerous global warming may be or what are all the driving mechanisms behind it, as well as the possibilities or probabilities of positive and negative feedback lopes emerging. Despite that climate change involves the well-known uncertainties and risks of economist F. Knight, 193 states have been committed to the objective of a major decarbonisation process, which if implemented would completely alter the present patterns of energy production and consumption.

Not only may all forms of energy be measured, but all 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 huge numbers involved – see Table 1.

Table 1. Energy consumption 2015 (Million Tonnes 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)

Examining Table 1, one understands the size of the task of decarbonisation. Complete decarbonisation would mean the elimination of the energy consumption of fossil fuels and traditional renewables. This is a herculean task, impossible simply. But the mix of energy usage will change during this century towards more of carbon neutral energy sources.

The hidden intervening variable in climate change is of course energy, or the needs for electricity all over in society and a variety of transportation needs. Mother Earth cannot provide American living standards to a seven billion plus population. Mathus is back with his dismal science, writing his message in red. He emphasized food resources, somewhat wrongly it has been pointed out many times. It is the energy-emissions conundrum that threatens mankind, both globally and in most countries.

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