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ECONOMICS OF GLOBAL WARMING: "CATCH-UP" AGAINST "MATURE" ECONOMIES

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ABSTRACT

The UNFCCC meetings bring together two sets of countries with entirely different economic goals. The first set of late industrializes in the Third World aim at "catch-up", as they have recently "taken-off". In an effort to close the affluence gap to the First World. The other set of early industrializes remain content with slow economic growth, protecting life-style and environment values. The COP21 goal of decarburization in the 21rst century is accepted by the first set, only if it does not reduce their catch-up capacity, whereas the send set is generally favorable to move to renewable energy. Thus, the demand for compensation arises. Since global warming was started by the early industrialisers, they should assist the late industrializes technologically and financially with decarburization so that socio-economic development is not hurt. This is the rationale of the Super Fund, promised but not set up yet. This paper analyses the necessity of the huge Super Fund, but also warns about the temptation of some mature economies to renege, i.e. chose defection on their promises to the Third World.

INTRODUCTION

The logic of globalization is the links between GDP – energy consumption – greenhouse gases. The last decades have witnessed an enormous increase in energy consumption, mainly fossil fuels, that have been accompanying the expansion of global GDP and the "catch-up" processes in emerging market economies. The outcome has been the rise of the level of CO2:s in the atmosphere to record levels with attending temperature rise, among other things like droughts, ocean heating and acidification, water shortages, etc. We now stand at about 405 ppm, according to daily measurements (Earth Co2). This paper examines the expansion in energy consumption among the big CHG or CO2 polluters in order to contrast the late industrialisers with the early industrialisers. A few central countries have been selected in both sets, the cutch-up and the mature economies. More of people mean more anthropogenic emissions every day. They breathe carbon dioxide, which necessarily entails that huge countries pollute more than small ones, speaking to total CO2:s. But the additional causes for GHG:s include economically relevant factors, especially energy consumption. To understand the debates within the UNCCC conferences and the call for a Super Fund, one must separate between catch-up countries on the one hand and mature economies on the other hand.

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They face entirely different conditions for implementing the COP21 goals:

Halting CO2:s by 2020
Reducing CO2:s by 40 per cent
Complete decarbonisation by 2075.

How radical these goals are appears from Table 1:

Table1. 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
	13147,3	100,0

Source: BP Statistical Review of World Energy 2016.

The consequences of implementing the COP21 objectives are very different for the two sets of countries studies here, if indeed decarbonasation is at all implementable.

THEORY: Population, energy sources and emissions

The best model of carbon emissions to this day is the so-called Kaya model. It reads as follows in its standard equation version – *Kaya's identity*:

(E1) Kaya's identity projects future carbon emissions on changes in Population (in *billions*), economic activity as GDP per capita (in *thousands of $US(1990) /* person year), energy intensity in Watt years / dollar, and carbon intensity of energy as Gton C as CO_2 per TeraWatt year." (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 is 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), in a stochastic form with a residual variance, all to be estimated on most recently available data from some 59 countries.

Empirical findings

I make two empirical estimations of this probabilistic Kaya model, one longitudinal for 1990-2014 as well as one cross-sectional for 2014.

Ongitudinal analysis

I make an empirical estimation of this probabilistic Kaya model - the longitudinal test for 1990-2014, World data 1990 - 2015:

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

Cross-sectional analysis

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:

(E5) k1= 0,68, k2=0,85, k3=0,95, k4=0,25; R2 = .80.

Note: LN CO2 = k1*LN (GDP/Capita) +k2*(dummy for Energy Intensity) + k3*(LNPopulation) + 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).

These two tests of the Kaya model shows that the key factors in anthropogenic climate change are the size of the economy, energy consumption and the carbon content of energy. The more a country has passed its "take-off" stage, hunting the "catch-up" option of strategy, the larger the energy-emissions effects. Similarly, the more the country in its "catch-up" strategy relies upon fossil fuels, especially coal, the larger the impact upon CO2:s.

Kaya's model explains total CO2:s by means of the huge country factors, such as GDP and population as well as energy mix. This is all about total emissions, which makes a set of 10-15 countries mainly responsible for the energy-emission conundrum, with some 70 per cent of CO2:s. If one adds global transportation on sea and in air, one arrives at almost 80 per cent of aggregate emissions. Of course, these are the countries whose governments should conduct anti global warming policies, not an unwiedly set of 200 countries, running up transaction costs. However, taking emissions per capita into account and speaking of fair contributions to halt climate change alters the debate fundamentally. The high per capita emissions are to be foumd with the rich countries, i.e. the mature economies and the Gulf States as well as the newly rich Asian Tigers. They should take their fair share of the burden, even if huge poor nations pollute more. In principle, there are two ways for rich countries to do more than poor countries within the COP21 project of decarbonisation:

- Cut GHG:s or CO2:s proportionally more than COP21 Goals;
- Pay much more to the Super Fund.

Let us examine a few countries from the point of view of energy and emissions. These countries play a major role in the global warming debate, as the huge populous countries – the G20 – are responsible for almost 80 per cent of emissions. If they could coordinate an adequate response, one would not need the cumbersome UNCCC and its transaction costs heavy conferences. Yet, besides aggregate emissions we have emissions per person. The Thirld world will always remind the first world that emissions per capita tends to be higher in rich countries than in poor countries. What are the implications for the goals of global decarbonisation? If indeed energy is the missing link between GDP and emissions, then we expect to find increasing emissions in rapidly expansing economies, driven by the consumption of more and more energy resources. Similarly, one would expect decreasing emissions in countries where energy consumption has stalled. The type of energy used must also be taken into account, as nations with considerable renewable energy sources or atomic power would have less emissions. After the Second Wolrd War, the global economy was divided into three world, of which the Second world now has disappeared with the exception of North Korea. Thus, we:

Set I: Rich countries, mature economies;
Set II: Poor countries, emerging economies.

THE general trend is for countries in set II to ”catch-up” with set I, closing the gap in GDP. Not all countries in set II succeed in doing so, as several Third World countries fall even more behind. But enough countries in set II has managed to stage a ”take off” point from which they catch up with the First World. First East Asia did so, then South East Asia and finally South Asia. Catch=up strategies are to be found also in the Arab World – Gulf States – and Iran besides Latin America – Brazil, Chile and Mexico for instance. The emerging economies bet upon one factor to succeed in closing the gap, namely access to massive amounts of energy.

Countries with strictly increasing curve

I will examine the development of totalenergy in a few countries during the recent decades to get a grip upon this driving factor in the global warming process, speaking of anthropogenic causes of climate change. These countries constitute the heavy polluters, whem it comes to aggregates. We start with Number 1: China.

CHINA

In a uniquely rapid economic development over a few decades, China has moved from the Third World to the First World with stunningly new giant cities cropping up and modern infrastructure being introduced to its old cities. With economic growth rates hovering around 10 per cent, China is no longer a poor nation. The trick has been to employ market incentives, resorting to a massive mobilisation of energy, partly imported from Australia among others. Figure 1 has the colossal step forward towards a mature economy.

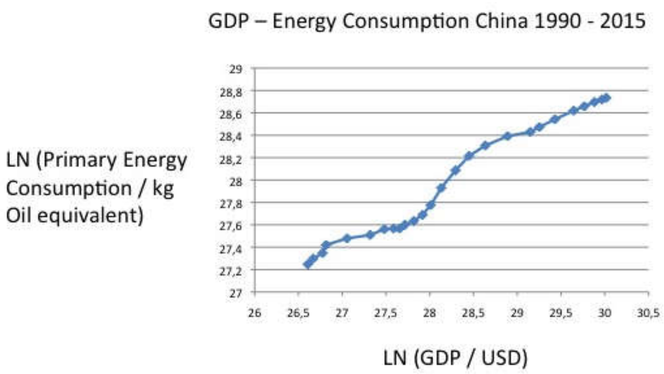


Figure 1. Energy and GDP: y = 0,46x ; R² = 0,97

China has multiplied its energy usage several times over, drawing upon internal and external resources, mainly fossil fuels. It used to rely upon internal oil and natural gas, but now it is a major global importer. Its exports are gigantic to the US and the EU, and it is tying other Third World countries into patterns of cooperation, or some would say dominance economically, like African nations and Pakistan. However, the price is not only overall environmental deterioration but also the world’s largest CO2 emissions (Figure 2). A few nations do not depend upon any foreign assistance, because they are highly developed technologically and can draw upon own substantial financial resources. One may find that the emissions of GHG:s follows economic development closely in many countries. The basic explanation is population growth and GDP growth – more people and higher life style demands. Take the case of China, whose CO2 emissions are the largest in the world, totally speaking. China was a Third World country up until yesterday.

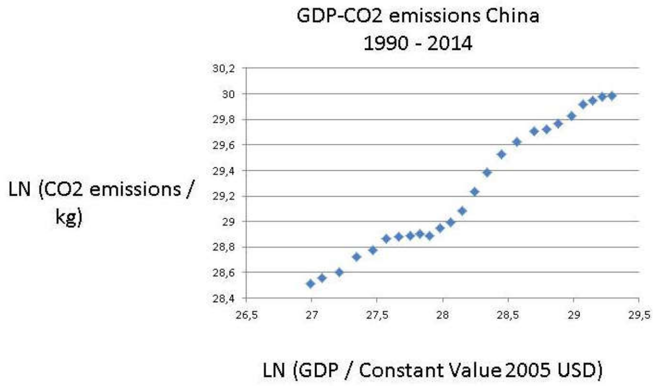


Figure 2. CHINA: GDP-CO2 link: y = 0,70x; R² = 0,97

The sharp increase in CO2:s in China reflects not only the immensely rapid industrialization and urbanization of the last 30 years, but also its problematic energy mix with around 90 per cent of energy consumption coming from fossil fuels.

INDIA

Energy consumption in India is planned to augment over the coming decade, as the ambition is to provide electricity to the whole population. Some 300 million people are today without electric power, and the population of India is growing fast. Mass povertyis the only outcome of this imbalance between total energy and total population, where India is heading for becoming the largest country in the world soon population wise. Public intellectual and former minister Ramesh (2015) states that India has no alternative but to build more coal firef energy plants. Thus, we may expect that Figure 3 will show more of an upward trend in the decade to come.

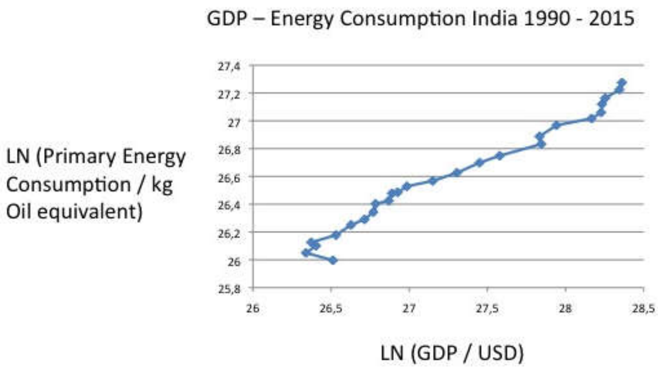


Figure 3. India: y = 0,55x ;R² = 0,98

Besides burning lots of fossil fuels, Indian housholds rely much upon wood coal in its various forms, uch as charcoal, peat and dung. Wood coal is detrimental to people and the environment. As wood coal releases CO2:s, the use of biomass is typically defended by the argument that it also stores CO2, meaning that biomass would be basically carbon neutral. However, this argument completely bypasses that wood coal in poor nations is conducive to deforestation and desertification, which is what happens on a large scale in India. Figure 6 shows the constant increase in emissions. India will certainly appeal to the same problematic, namely per capita or aggregate emissions. The country is more negative than China to cut GHG emissions, as it is in an earlier stage of industrialization and urbanization. Figure 4 shows the close connection between carbon emissions and GDP for this giant nation.

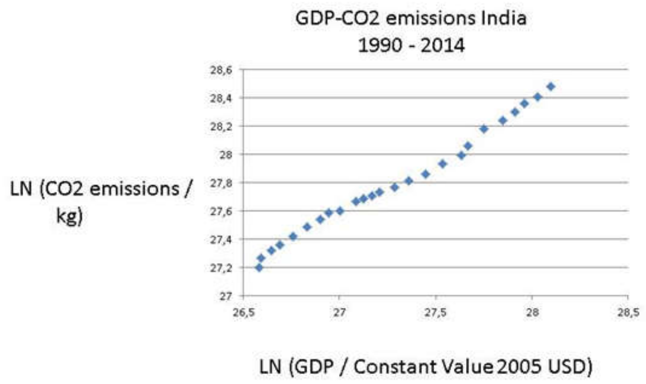


Figure 4. India: Link between GDP and CO2: y = 0,77x + 6, 79; R² = 0,99

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. In its energy mix traditional renewables – wood, charcoal and dung - play a bigger role than in for instance China.

INDONESIA

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

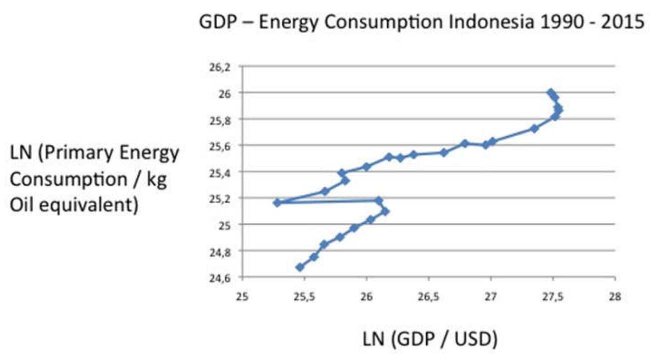


Figure 5. Indonesia: y = 0,46x ;R² = 0,79

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

The bad CO2 emissions stem partly from the burning of rain forests and adjacent land on Kalimantan and Sumatra, which the government is to weak to control. The illegal fires affect other neighbouring countries but little is done to stop them. The search for more land for agriculture, especially soya planations, drives the externality. Emissions even outpace energy consumption.

One may guess correctly that countries that try hard to "*catch-up*" will have increasing emissions. This was true of 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 6).

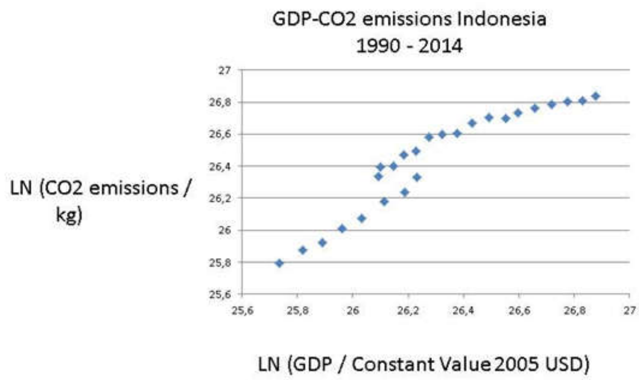


Figure 6. Indonesia: GDP-CO2 link: y = 0,95x + 1,58; R² = 0,89

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 and Sumatra augments the GHG emissions very much.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.

SOUTH KOREA

A major industrial country in East Asia is South Korea with an advanced economy and large population. It deviates from the pattern of mature economies to display a slowing down in the CO2:s.

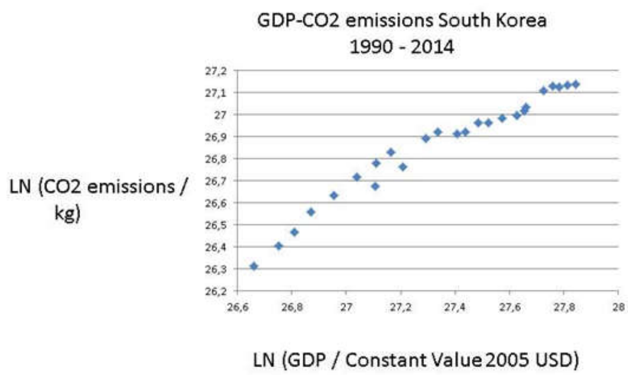


Figure 7. South Korea: GDP=CO2 link: y = 0,65x + 9,19; R² = 0,96

Lacking much hydro power, South Korea has turned to fossil fuels for energy purposes, almost up to 90 per cent. Now, it builds nuclear plants, but South Korea needs to move aggressively into solar power to reverse trends.It differs from China only in the reliance upon nuclear power, where the country is a world leader in plant constructions. Reducing its GHG emissions, South Korea will have to rely much more upon modern renewable energy sources, as well as reducing coal and oil for imported gas or LNGs. Its appetite for energy is not slowing down (Figure 8)

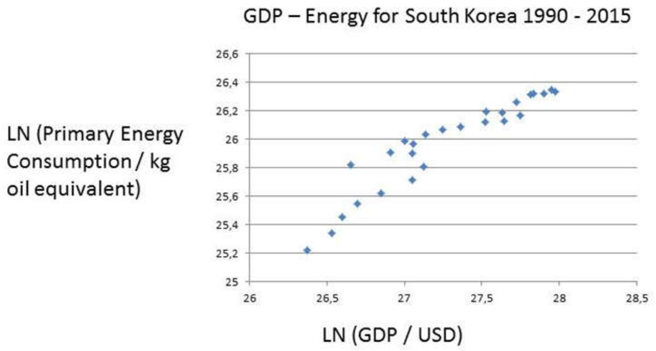


Figure 8. GDP-energy for South Korea: y = 0,622x; R² = 0,88

South Korea is of course a mature economy, but it still pursues an aggressive catch-up strategy with strong claims in electronics and nuclear power technology besides shipping and car industry.

SAUDI ARABIA

The upward sloping curve for GDP and CO2:s is characteristic for the oil and natural gas producing countries. Some of them have already caught up, but remains committed to keep expanding their wealth, like giant Saudi Arabia (Figure 9).

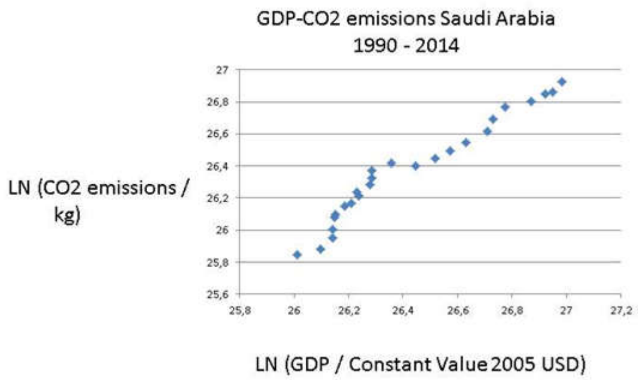


Figure 9. Saudia Arabia's GDP-emissions: y = 1,03x - 0,77; R² = 0,95

Saudi Arabia consumes much energy to maintain its flamboyant life-style (Figure 10). It remain to be seen if the present economic difficulties of the country results in more of energy efficiency or a turn to renewables.

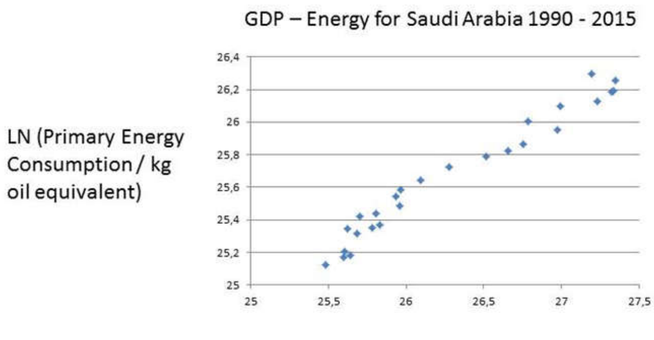


Figure 10. Energy-GDP in Saudi Arabia: y = 0,56x ; R² = 0,96

The drop in the oil price during 2016 has hurt Saudi Arabia badly, as it is now considering a new economic policy to maintain its affluence. Does it have enough resources for decarbonisation according to the COP21 scheme? As long as the oil price stays low, the incentives for decarbonisation must be weak.

Egypt

If India will become the largest CO2 polluter in need of outside help, then Egypt is in the same predicament, as it is basically bankrupt. Having a quickly growing population concentrated to the Nile delta, the country faces great environmental challenges. The regime is hardly stable politically, and it receives American economic support. If India will become the largest CO2 polluter in need of outside help, then Egypt is in the same predicament, as it is basically bankrupt. Having a quickly growing population concentrated to the Nile delta, the country faces great environmental challenges. The regime is hardly stable politically, and it receives American economic support. As Egypt relies upon fossil fuels, it has massive CO2 emissions, the trend of which follows its GDP (Figure 11).

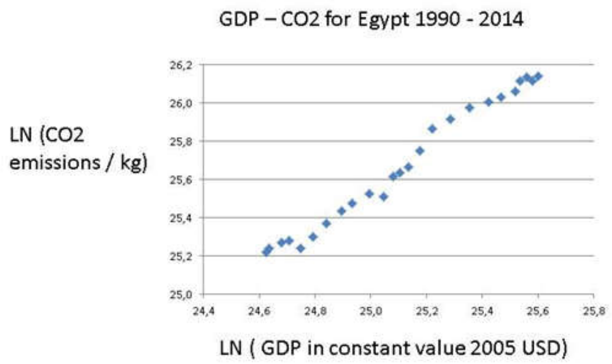


Figure 11. GDP-CO2 for Egypt: y = 1,02x; R² = 0,99

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?

Egypt has been lucky recently, finding huge gas deposits. They are enough for strong exports. Egypt also has oil, but not enough to cover domestic consumption. Egypt is a fossil fule dependent country – more than 90 per cent., as hydro power is not as available as one may have thought. Given the population explosion in the Nile delta, energy consumption is of course up (Figure 12).

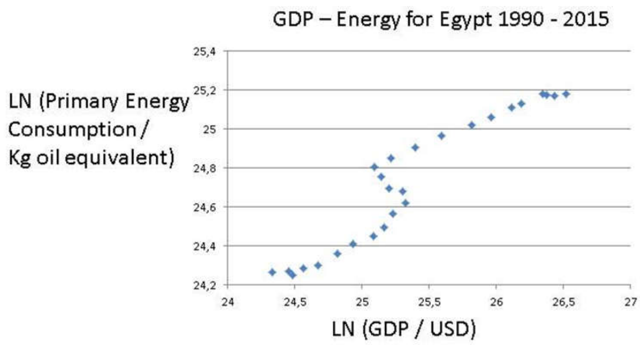


Figure 12. GDP-energy in Egypt: y = 0,49x; R² = 0,91

TURKEY

Turkey has become a heavy-weight in the Asia Minor thanks to a rapid economic development of the country with huge population. Figure 13 supports this picture of Turkey as no longer a poor developing country. Comparing the picture for Turkey with that of "catch-up" nations, one may state that Turkey has the typical GDP-GHG link, despite lots of hydro power. Strong economic development is combined with heavy emissions increase. Since the world organisations – the UN, WB and IMF – opt for more of economic growth, one must ask whether emissions growth really can be halted.

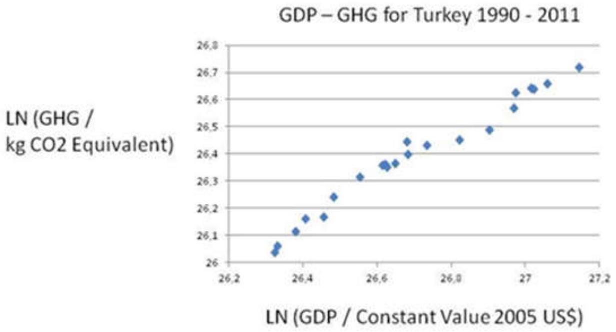


Figure 13. Turkey (Equation: Y = 0,7837x; R^2 = 0,972)

Thus, Turkey has become a heavy-weight in the Asia Minor thanks to a rapid economic development of the country with huge population. Figure 14supports this picture of Turkey as no longer a developing country.

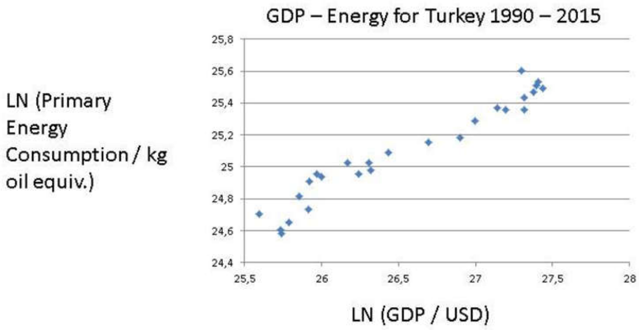


Figure 14. Turkey: energy-GDP link

Comparing the picture for Turkey with that of France and Germany, one may state that Turkey has the most typical curves. Strong economic development is combined with heavy emissions increase. Since the world organisations – the UN, WB and IMF – opt for more of economic growth, one must ask whether emissions growth really can be halted. The above countries are responsible for a huge part of the CO2 emissions. As they pursue the "catch-up" strategy in relation to the advanced capitalist countries, they are not very eagre to take on the burden for global decarbonisation, especially if it hurts economic development. They would demand compensation from the promised Super Fund.

Countries Withvolatile but Upward Curve

Besides the above countries, one must mention Russia and Brazil with heavy emissions and an ambition not to lag behind. Yet, their energy consumption curves are somewhat erratic, reflecting the lack of both economic and political stability in these two nations.

RUSSIA

Concerning emissions, Russia comes very high, reflecting noy only its past but also its economy geared towards natural resources. In terms of energy, Russia is on an upwards trend, although it use more in the 1990s before the "dirty" industries were dismantlled. Figure 15 has the erratic GDP-energy link for this country.

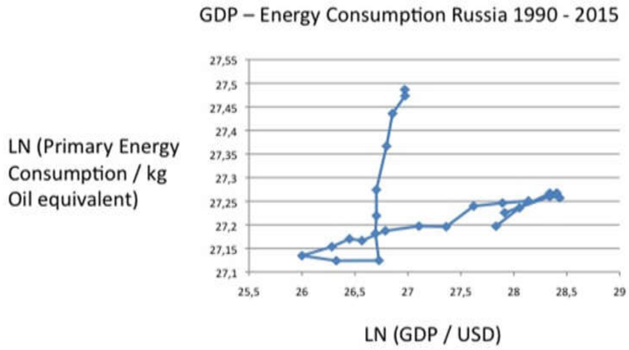


Figure 15. Russia:y = 0,024x; R^2 = 0,036

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. 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.The emissions curve shows the changes in energy consumption (Figure 16).

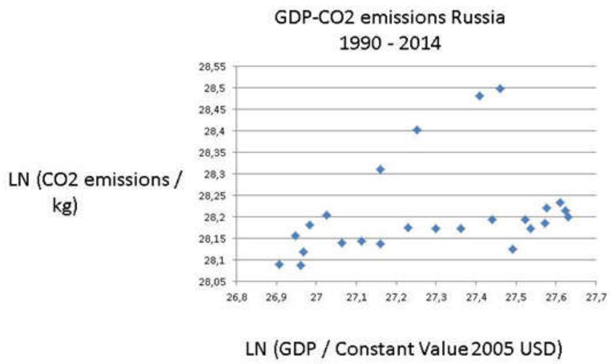


Figure 16. Russia: y = 0,14x + 24,3; R^2 = 0,11

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 16 also shows that emissions are no longer falling.

BRAZIL

As the largest economy in South America with a swelling population, Brazil is in need of energy resources. Itmay tap several domestic sources like oil and gas, ethanol and hydro power. The energy needs increase rapidly when there is positive economic growt (Figure 17). Brazil employs the most biomass in the world - ethanol, but the emissions stay at a very high level, which is a reminder that even modern renewables may lead to CO2:s. One advantage for Brazil is its large component of hydro power, but the overall picture for the largest Latin American country is not wholly promising, when it comes to reduction of emissions. Will it accomplish GOAL I – maybe! But hardly GOAL II. Two caveats:

Global warming reduces the potential for hydro power – water scarcity, and Brazil has very little nuclear power. There are plans for mega hydro projects in the Amazon basin, but Brazil has first and foremost to come to terms with the extensive deforestation of this huge rain forest, contributing a lot to global warming. And other nations are involved here.

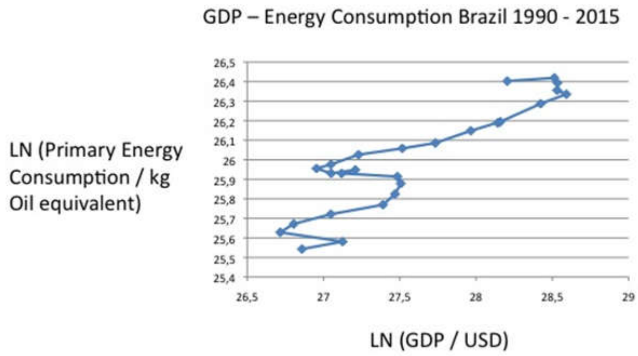


Figure 17. Brazil GDP-energy: y = 0,37x ; R² = 0,81

Biomass and waste only contribute to decarbonisation when there is a sequence of harvesting and build-up of new carbon consuming entities. When the rain forest is cut down once and for all, or poisonous waste burnt, then there is carbonization. Brazil pollutes a lot (Figure 18).

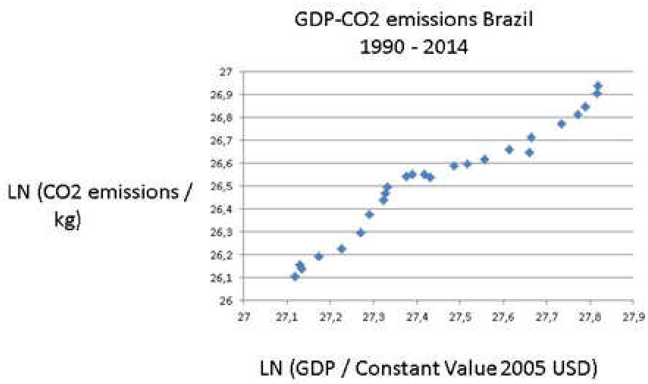


Figure 18. Brazil GDP-CO2: y = 1,03x - 1,7; R² = 0,95

I believe most "*emerging economies*" will rely much upon fossil fuels, like the examples above. One finds no example of declining GDG-CO2 (GHG) links in Latin American nations, nor in Africa or Asia, meaning that COP21 management will struggle to get GOAL I implemented**.**Again the Super Fund may be invoked.

Countries with Decreasing curves

Only mature economies have the opposite curve for GDP and energy or emissions. This is due to two different factors. On the one hand, several of these countries have recently experienced close to zero economic growth, or at least meagre growth rates. On the other hand, some of them have been anxious to move away from the dirtiest energy source, i..e. coal. However, reductions in this of natios do not cancel out increases in the first set above. Let us look at a few mature economies that deliver much emissions.

USA

Energy consumption is almost as high in the US as in China, despite a much smaller population, meaning that per capita energy consumption is the highest in the world, outside of the Gulf States where Qatar is on top. Energy and affluence is basically the same, viz capacity to do work. Figure 19 indicates that the upwards trend has recent stalled. This may be due to the financial recession starting in 2007-2008, but it may also be related to the ongoing energy transformation in the US, away from fossil fuels that deliver some 85 per cent of US energy consumption.

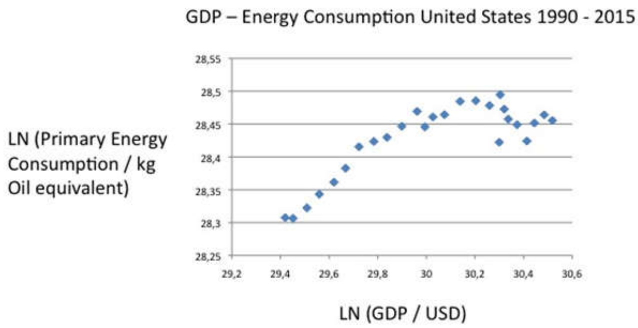


Figure 19. US: Energy and GDP: y = 0,46x; R² = 0,97

The plans of the EIA for future energy needs in the US include a heavy augmentation, but one cannot tell whether it will come about from renewables or fossil fuels like fracking. The market for energy is somewhat bewildering in the country with the start of oil and natural gas exports again as well as the shut down of a few atomic power plants. Yet, fracking is not environmental friendly. Lots of solar plants are coming up, but their efficiency is low compared with nuclear plants. Figure 20 shows that carbon emissions have peaked for the US.

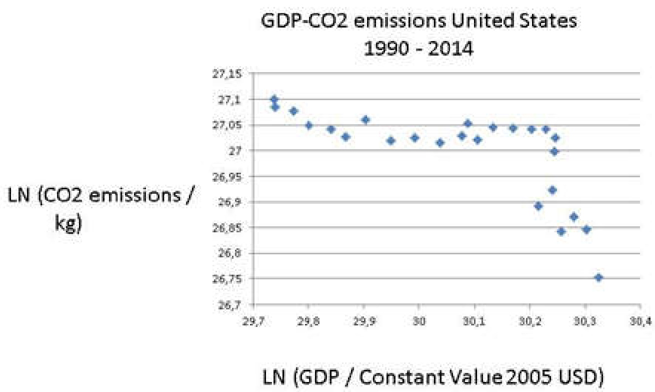


Figure 20. The US: y = -0,32x + 36,7; R² = 0,49

Recently, the level of CO2 emission has been reduced significantly in the US. It reflects partly the economic crisis that began 2007, but the entire energy pattern is undergoing change, from coal towards modern renewable. Yet, the US remains the second largest polluter in the world. This CO2 reduction reflects that the US can draw upon a mixed bag of energies. including nuclear and hydro power, with solar power expanding rapidly (Figure 16). The US is still heavily dependent upon fossil fuels, as some 85per cent comes there from, the US facing a challenge of reaching GOAL II. What is changing is the shale rock innovation, as more and more of energy is produced within the US, allowing even for considerable export of petroleum. The *shake oil and gas* revolution may though not promote decarbonisation. Further reduction of CO2:s may meet with firm resistance from the Republican House of Congress, which may oppose the COP21 Agreement, like president elect Trump. However, solar power should be attractive in many US states, both in micro use in households and large plant use. Not only coal consumption is being decreased but also atomic power is cut back, as it cannot compete with energy from shale rock. Yet, when solar and wind power falters, natural gas enters the picture. Solar plants take enormous amounts of space. Energy policy-making is most active in Washington, involving a complex system of tax deductions and returns. The advent of shale oil and gas has changed the entire energy markets, lowering the price of oil most substantially. This implies not only that there will be no Hubbert peak oil for the world, but also that switching to renewable energy source will be extremely expensive, relatively speaking compared with shale oil and gas. When petroleum is abundant, then investments in carbon neutral power sources may be non-lucrative and require massive state subsidies. Energy is extremely vital to the entire US society, including for its superpower position. When further reductions in CO2:s threaten vital national interests, the US like other nations will no doubt employ fossil fuel. This is what the new President-elect and his administration plan at least.

JAPAN

Japan has a huge energy consumption, but it hovers from year to year, reflecting not only the stagnation of the economy but also the occurrence of natural disasters. Japan has been forced to increase fossil fuel imports to compensate for the close down of several nuclear plants (Figure 21).

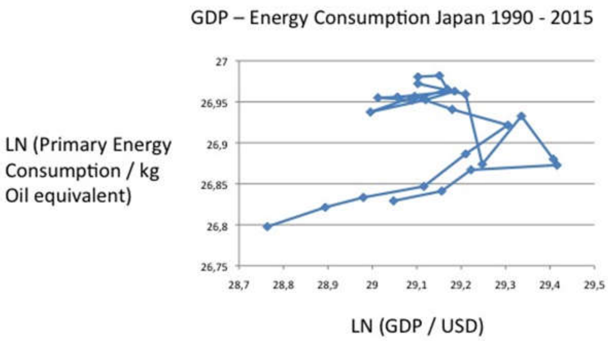


Figure 21. Japan energy and GDP: y = 0,092x ; R² = 0,056

It is hardly a daring guess that the nuclear plant disaster in Japan together with the decision to close most such power plants has further increased emissions, as the country now relies upon fossil fuels much more. Governments make plans, but they may not hold for unforeseen developments. Japan is today more dependent upon fossil fuels than earlier due to the debacle with its nuclear energy program. Is really solar, wind or atomic power realistic in Japan on the scale needed for massive decarbonisation? 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.

GERMANY

For the EU as a whole, one would certainly expect that emissions are down, given the eonomicdecline of the EU, and especially the EURO-zone.

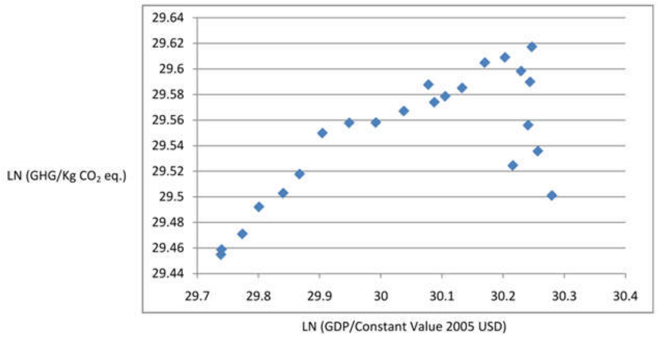


Figure 22. Japan's GDP-CO2 link: y = 0.2648x; R² = 0.194.

However, there is also another factor to be taken into account, namley energy policy. Take the case of Germany, which has not experienced economic decline but still shows a downward sloping curve for emissions (Figure 23).

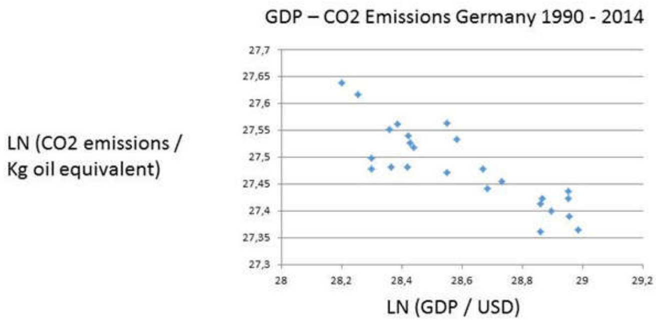


Figure 23. FRG GDP- CO2:s: y = -0,24x; R² = 0,73

What is interesting with regard to Germany is that it has managed to do well economically with reasonable growth rates, despite consuming less ebergy (Figure 24). Not only is Germany engaged in *ENERGIWENDE*, in volving a move towards modern renewables away from fossil fuels, but the country is also on the way to closing down its nuclear power plants. This may be a negative for decarbonisation hopes.

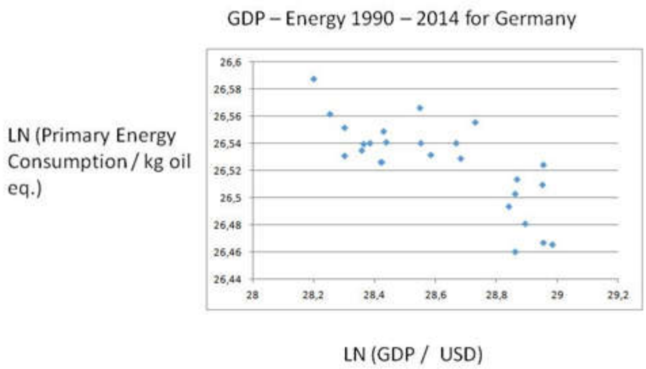


Figure 24. FRG energy and GDP: y = -0,095x; R² = 0,59

THE UK

The economic stagnation of the UK can be seen in its emissions curve, which is slightly downward slopping (Figure 25). The BREXIT will probably strengthen this trend. At the same time, the UK is pursuing its own policy of decarbonisation. The outcome of decarbonisation policy and economic slowdown is a downward sloping energy curve. This is most promising, but the UK must do more in relation to the COP21 goals. Massive wind power installations and new giant nuclear plant will promote the capacity to live up the COP21 expectations. Figure 26 shows that energy consumption is down.

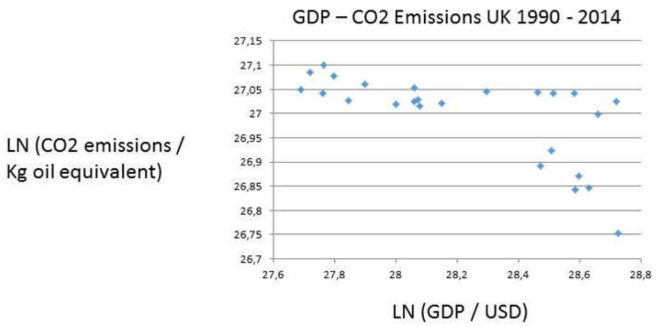


Figure 25. The UK: y = -0,17x; R^2 = 0,45

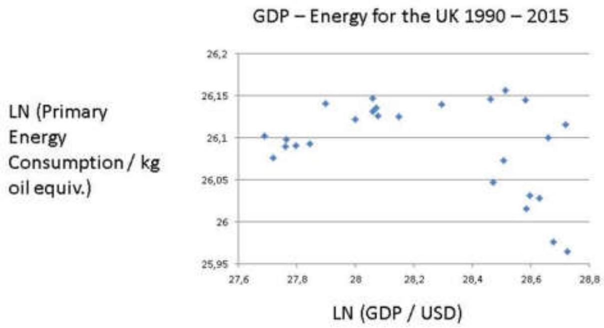


Figure 26. The UK energy and GDP: y = -0,06x; R^2 = 0,16

CANADA

One should not take for granted that mature economies reduce their carbon imprint. It is true CO2:s are falling some of the First World countries due to energy efficiency reforms, the shift away from coal and improved petrol efficiency with cars. Yet, also these economies need more energy all the time – see for instance South Korea above. Now, we look at energy giant Canada. Its policies on oil and oil sands as well as natural gas will affect the whole COP21 project. Figure 27 shows that emissions are NOT going down as in other mature economies.

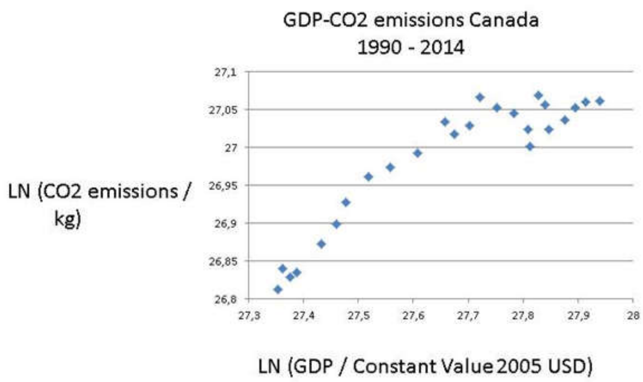


Figure 27. GDP-emission in Canada: y = 0,41x + 15,7; R^2 = 0,85

Although Canada has a mixed energy consumption pattern with considerable hydro power, it still relies much upon fossil fuels, up to 65 per cent. And its energy needs follow its economic growth curve (Figure 28). It cannot be excluded that the energy needs of advanced economies become so essential that they renege upon the COP21 objectives.

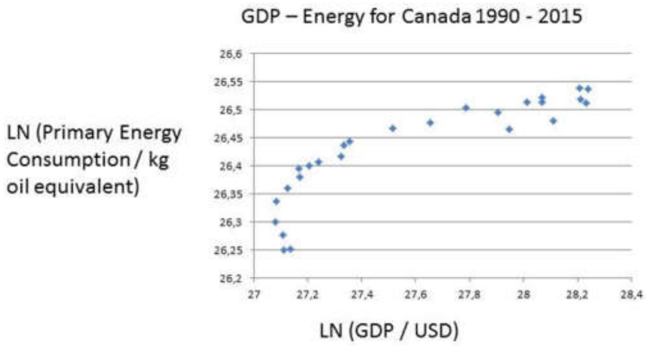


Figure 28. Canada's GDP-energy link: y = 0,18x; R^2 = 0,77

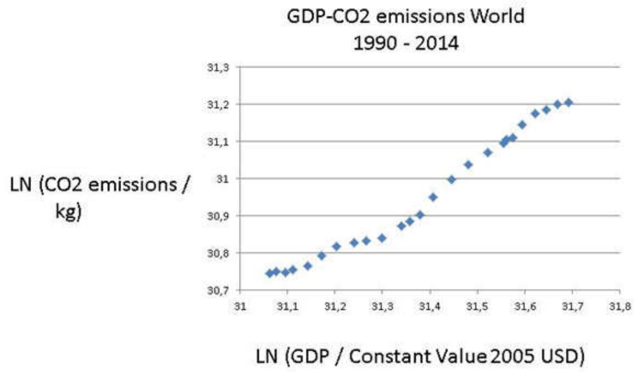
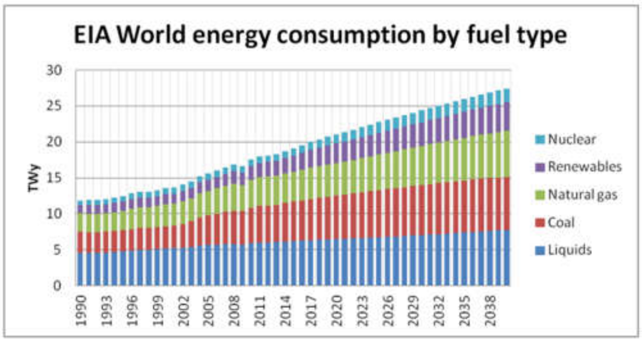


Figure 29. Global GDP and emissions: y = 0,80x + 5,96; R^2 = 0,97



Source:http://euanmearns.com/emissions-reductions-and-world-energy-demand-growth/

Figure 30. Energy projections

Conclusion

As the UNFCCC continues its work towards global coordination on a policy to halt climate change, it will have to confront the energy-emissions conundrum with its explosive tension between the Third and the First Worlds. Mankind is confronted by the overall predicament, depicted in Figure 29. As people or households strive every day to improve their lot in broad economic terms, they make use of various kinds of energy. The requirement of decarbonisation is that energy transformation is a necessity to save Planet Earth from overheating and all its dismal consequences. This entails the reduction of the use of fossil fuels and wood coal, to be replaced by renewable energy sources or atomic power. But at the same time as governments agree on the decarbonisation goals, they have no plans how to fund the changes. Instead, the plan is for much more of energy (Figure 30). If these projections come true, then decarbonisation according to the COP21 Treaty will be impossible to achieve.

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