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Time is Running Out for Halting Abrupt Climate Change

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This paper should be cited as follows:

Lane, J-E, (2018). **"Time is Running Out for Halting Abrupt Climate Change",** Athens: ATINER'S Conference Paper Series, No: **ECO2018-2479.**

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URL Conference Papers Series: www.atiner.gr/papers.htm

ISSN: 2241-2891
02/08/2018

Time is Running Out for Halting Abrupt Climate Change

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Abstract

The new theme of abrupt climate change ("Hawking tipping point") must be taken up by global coordination through various international organizations, such as the United Nations Framework Convention on Climate Change (UNFCCC), Intergovernmental Panel on Climate Change (IPCC and the Group of Twenty (G20). The only viable policy response is to reinforce the COP21 project, and start managing the quick implementation of decarbonisation. More decisive climate change policies i.e., eliminating coal and charcoal, using solar power parks, and possibly implementing carbon capture may not guarantee the goal of +2 degrees Celsius, but they may help avoid climate chaos. Only global coordination can break through the resistance of markets in rich countries and governments in the Third World together with vibrant civil society. The large COP21 Secretariat must become a management agency for rapid decarbonisation with support from other global bodies (WB, IMF) and the G20.

Keywords: abrupt climate change, Arctic ice meltdown, Hawking tipping point, methane emissions from permafrost, positive feedback lopes

Introduction

Climate and earth scientists have convinced a large majority of people that climate change occurs today. The new theory of abrupt climate change indicates that huge feedback loops will change the Earth quickly within the next one or two decades. This is a matter of Arctic ice melting and methane emissions from the permafrost that may bring temperatures much higher than the COP21 Treaty predicted. This would bring uncertain, but disastrous, consequences for both Mother Earth and mankind. Natural science research still remains to be done in order to reduce the large uncertainties about temperature rise and its consequences for a number of vital outcomes of humanity.

Yet, this information is only half the story, as the pragmatic side is also part of discussions on climate change. Namely, will the COP21 promise of global decarbonisation be fulfilled? This would require global coordination by states and governments, which is very hard to achieve, an obstacle that the COP process of the UNFCCC and the IPCC never speaks about. The aim of this paper is thus to emphasize that global decarbonisation can only be accomplished by global state coordination, which reduces the probability of COP21 success considerably.

Political Economy of Energy

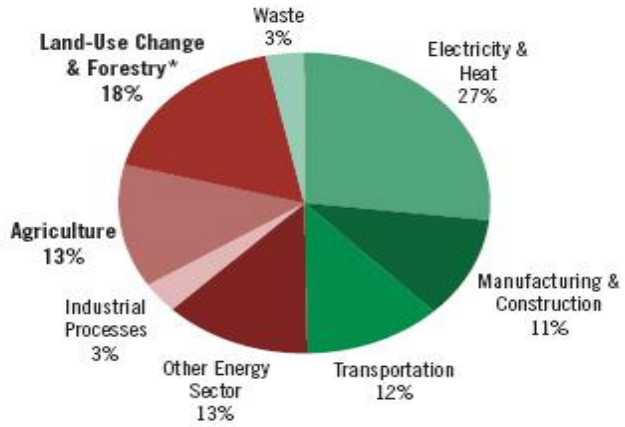
Political economy references the interdisciplinary study of the interaction between markets and governments in determining poverty or affluence, democracy or dictatorship, and war or peace. As such, political economy affects the sources of global warming, as driven by the energy consumption of fossil fuels, and specifically involves:

1. Market searches for affluence and the subsequent bypassing of climate change;
2. Government struggles against poverty and fears of social upheaval.

Markets: Affluence, Economic Growth and Enormous Energy Need

The market economy operates according to the logic of J.B. Say. Supply determines demand. Thus, the firm aims to produce as much as possible at the lowest cost, making the enterprise profitable for its three interests – owners, managers and workers. Ideally, it is on a sustainable growth path over time, but this requires access to energy. Energy needs show up in every sector of the economy in a broad sense, from transportation, industry, households and agriculture, as well as electricity. Figure 1 attests to this by showing the GHG emissions of various sectors.

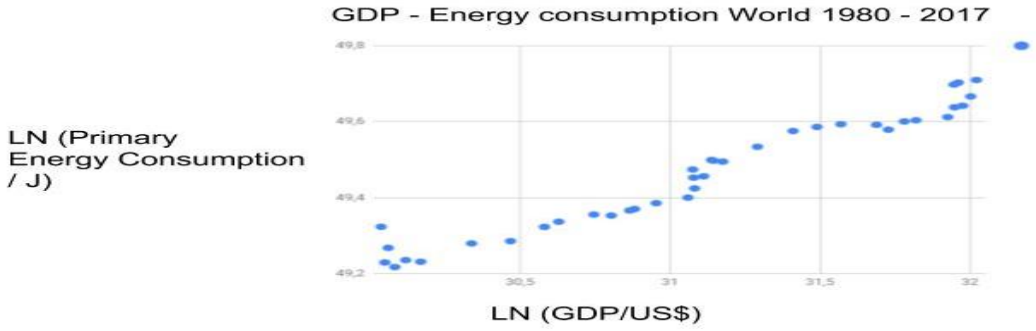
Figure 1. *Energy, Sectors and Ghgs Globally*



Source: https://www.eeducation.psu.edu/geog438w/node/375.

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

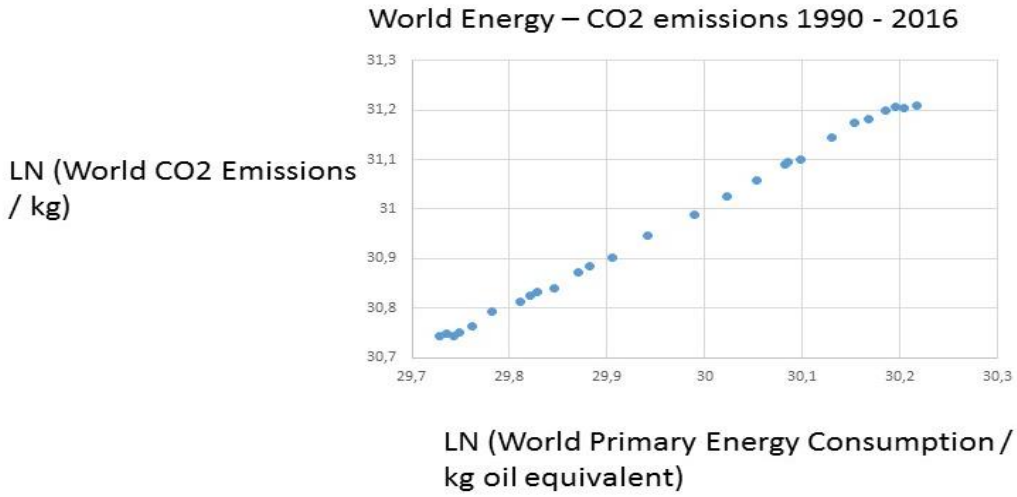
Figure 2. *Affluence and Energy, 1990-2016*



Note: R2 = 0.95
Sources: BP Statistical Review of World Energy World Bank Data Indicators.

The market players would of course want this trend to go on, but the resulting CO2s call for a major change as shown in Figure 3 through the global connection between energy consumption and CO2 emissions. Markets may resist, underestimate, or simply try to postpone these necessary changes.

Figure 3. *Energy and CO2: s: y = 1.01x; R² = 0.99*



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

Markets have not yet fully anticipated the enormous costs of abrupt climate change. Production must be forthcoming that uses less energy in total, but more from other renewable sources. Businesses are making innovations like electrical cars, solar and wind energy and improved atomic power, but the size of fossil fuel energy still remains much too large. Hating uncertainty, markets are in general favourable to the established energy plans.

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

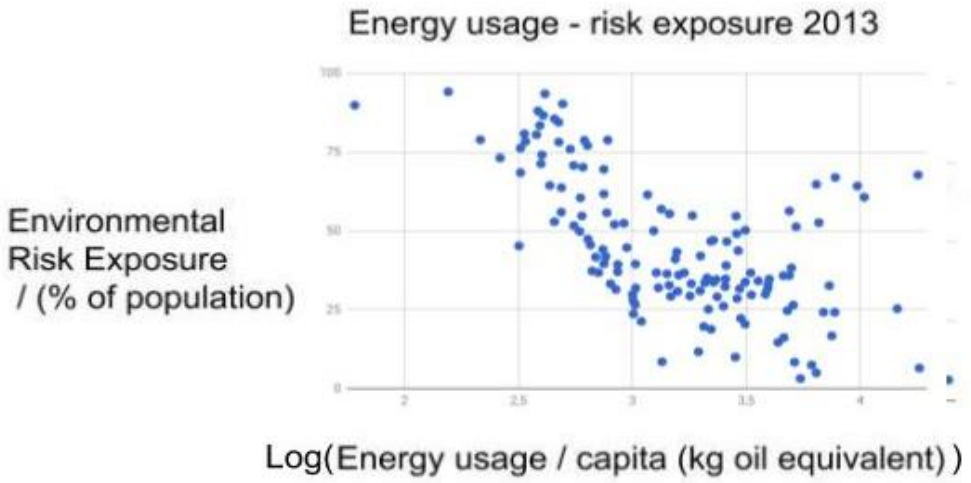
Governmental Fears of Massive Instability, Poverty and Energy Shortage

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

The living conditions in the poor countries in Latin America, Africa and Asia, as well as the Pacific, reflect the low level of energy employed. This basic fact determines life opportunities in a most dramatic fashion. The low access to energy has consequences for the environment and the living situation of people, including their health, schooling, work, food and potable water. African countries are poor

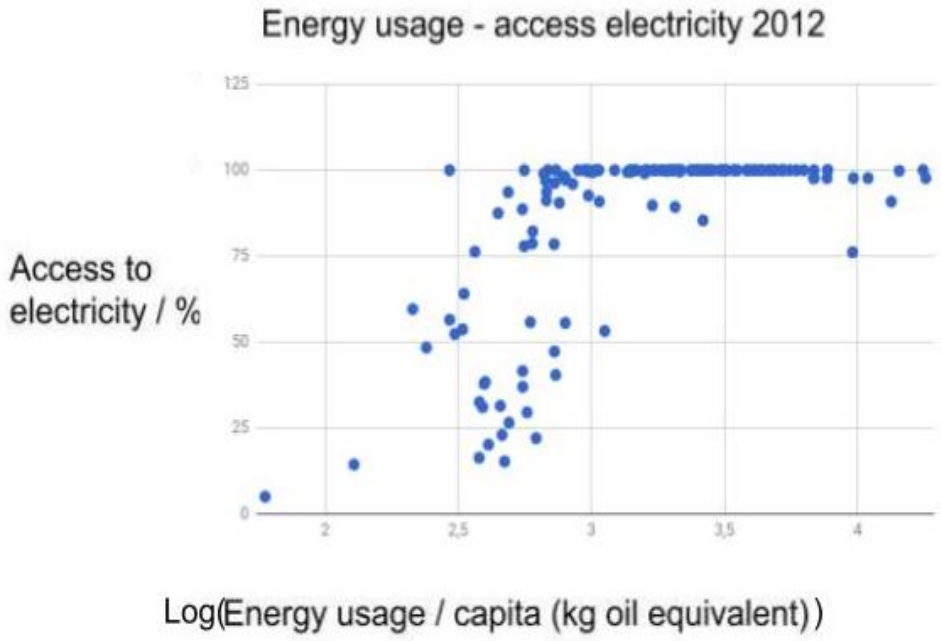
because they have too little energy. Thus, they have much lower GHGs than Asia. Yet, they need the COP project of the UNFCCC to renew their energy sources and move from fossil fuels and traditional renewables to solar power. Hydropower depends upon water availability, which shrinks with global warming.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

Figure 4. *Energy and Environmental Risk Exposure*



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

Figure 5. *Energy and Electricity Access*

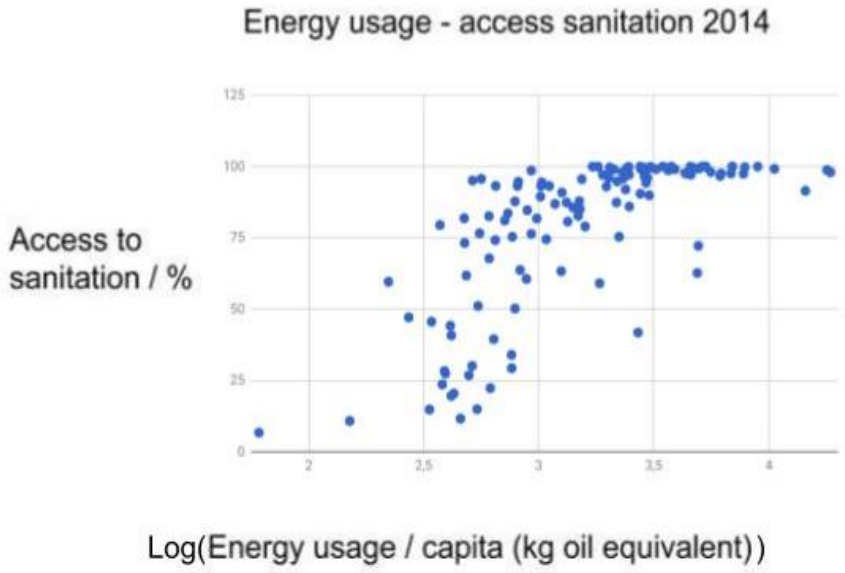


Source: Environmental Performance Index, Yale University, https://epi.envirocenter.yale.IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/index).

Low energy use leads to poverty, malnutrition, lack of potable water, insufficient sanitation, and even death. Typical of many Latin American, African and Asian nations is the lack of stable electricity sources, which hampers everything and reduces environmental viability. Figure 5 shows the global picture of the relationship between accessibility and usage.

Access to safe and stable electricity is crucial for health, schools, food, and water. Without this access to energy, access to other related necessities of this kind is impaired. Figure 6 shows such links between energy and proper sanitation.

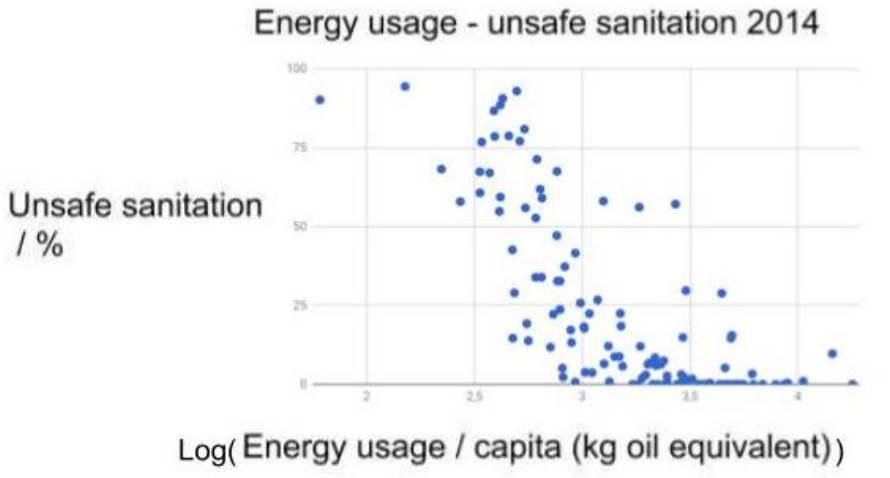
Figure 6. *Sanitation and Energy*



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

The rapidly growing African and Asian mega-cities especially lack in this case. In some instances, they are entirely missing sewage plants, which is unsustainable in a metropolis. Thus, dirty water is put into the big rivers on which other cities downstream rely for their potable water. As such even some places with access to resources are pulling unsafe resources. If some of the sources of this problem were resolved, however, safety and accessibility may improve. Figure 7 thus underscores the necessity for more energy in poor coutries.

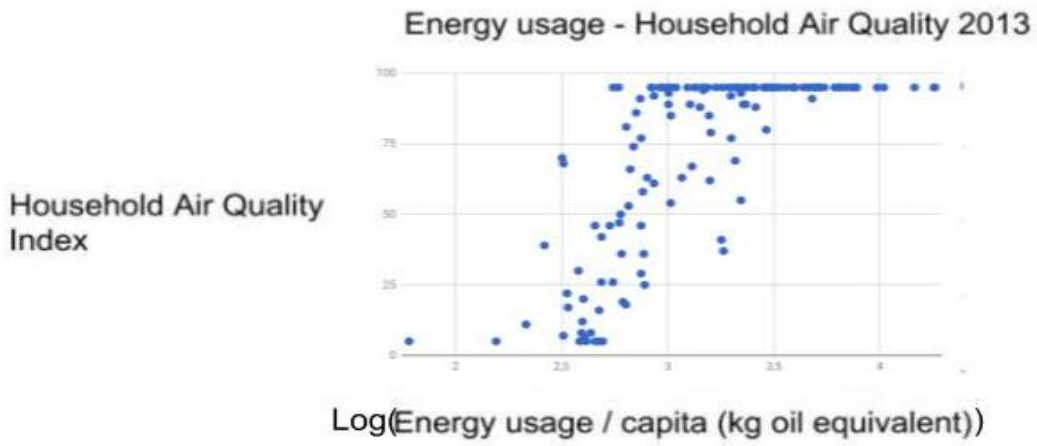
Figure 7. *Energy and Unsafe Sanitation*



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

Air quality similarly depends upon energy access as shown in Figure 8.

Figure 8. *Energy and Air Quality*



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

The data shown in the preceding figures is typical of many poor nations – in Latin America, Africa, and Asia – where the lack of stable electricity hampers work and reduces environmental viability. The access to safe electricity is crucial for health, schools, food, and water. This lack of enough energy in poor countries is conducive to the above bad living conditions; and as such, one understands the hopes of the poor countries for assistance with energy transformation. Governments in the third world would like to have an assurance that the global COP21 project of decarbonisation will not lead to less energy or more expensive energy for them. Otherwise, governments may face social upheaval.

Abrupt Climate Change: Upgrade Cop21

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

a. stop the increase in CO2s by 2020;
b. reduce CO2s by 30% by 2030;
c. full decarbonisation by 2075.

Abrupt climate change alters the Keeling curve by projecting quicker temperature increases due to two dismal feedback loops. First, we have the Arctic melting that is causing a jump in temperature. Second, there is the melting permafrost and the resulting release of methane, which is conducive to climate chaos. No one knows really how the objective limit of +2 degrees Celsius was decided upon in COP21, but with this abrupt climate change, temperatures will likely go past this limit in 10-20 years.

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

a. Close down all coal everywhere and charcoal in poor countries (deforestation);
b. Start building giant solar power parks everywhere;
c. Find out if geo-engineering, such as carbon capture, works on a large scale.

These measures will not aggravate the situation, but can only help, at least to some extent. Why then is global coordination so slow? The solar power revolution allows a massive reduction in fossil fuels. Let us see in Table 1 what it entails in terms of management tasks for global coordination, assisted by the COP21 Secretariat and the IPCC. Table 1 is based upon the following sources: Paris 2015: Tracking country climate pledges. Carbon Brief[1], EDGAR v 4.3.2, European Commission, Joint Research Centre (JRC)/PBL Netherlands Environmental Assessment Agency. Emission Database for Global Atmospheric Research (EDGAR)[2], CO2 Emission Reduction With Solar[3]

[1]https://www.carbonbrief.org/paris-2015-tracking-country-climate-pledges
[2]Release version 4.3.2. http://edgar.jrc.ec.europe.eu
[3]http://www.solarmango.com/in/tools/solar-carbon-emission-reduction

Table 1. *Number of Ouarzazate Plants for 40% Reduction of CO2 in Some Giant Countries (Note: Average of 250 - 300 Days of Sunshine Used for All Entries Except Australia, Indonesia, and Mexico, Where 300 - 350 Was Used).*

Nation	**Co2 reduction pledge / % of 2005 emissions**	**Number of gigantic solar plants needed (Ouarzazate)**	**Gigantic plan needed for 40 % reduction**
United States	26 – 28	2100	3200
China	None	0	3300
EU28	41 – 42	2300	2300
India	none[ii]	0	600
Japan	26	460	700
Brazil	43	180	170
Indonesia	29	120	170
Australia	26 – 28	130	190
Russia	none	0	940
World	N/A	N/A	16000

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

Of course, many large economies argue against such a speedy 40% reduction in CO2s, claiming that it leads to economic recession. Even if this is the case, it would nevertheless reduce future higher costs. After all, economies adapt and will recover due to all the new investments needed in a decarbonized world. Ramesh (2015) emphasizes that India needs much economic assistance for decarbonisation – a giant task for global coordination to assist poor nations! Let us look at the American situation in Table 2.

Table 2. *Number of Ouarzazate Plants Necessary for 40 Per Cent Reduction in CO2 (Note: Average of 250 - 300 Days of Sunshine per Year was used for Canada, 300 – 350 for the Others)*

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

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

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

Table 3. *Number of Ouarzazate Plants Necessary in 2030 For 40 Per Cent Reduction in CO2 (Note: Average of 300 - 350 Days of Sunshine per Year Was Used)*

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Algeria	7 - 22	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
Kenya	30[iv]	3	4
Botswana	17[iv]	1	2
Zambia	25 – 47[iv]	0,7	1
South Africa	none[ii]	0	190

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

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

Table 4. *Number of Ouarzazate Plants Necessary for 40 Per Cent Reduction in CO2s. (Note: Average Of 250 - 300 Days of Sunshine was used for Kazakhstan, 300 - 350 Days of Sunshine Per Year for the Others).*

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Saudi Arabia	none[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

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

Given the recent economic advances in Asia, most countries now need a large number of solar power parks in order to reach the goals of decarbonisation. The COP21 management would be able to help.

Finally, we come to the European situation. Numbers on various countries are shown in Table 5.

Table 5. *Number of Ouarzazate Plants Necessary for 40 Per Cent Reduction in CO2s (Note: Average Of 250 - 300 Days of Sunshine Per Year was Used)*

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

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

Carbon Capture and Geo-Engineering

Many scientists put their hopes in carbon capture or carbon sequestration. There are various methods to achieve this, but they all aim at eliminating CO2s by hiding them under ground, either ex ante production or ex post production. Experiments on a small scale indicate that it can be done, but the costs are high.

Whether it can be done on a massive scale is uncertain. The basic problem is to make sure CO2 stays put in the Earth's crust. If it is released again into the atmosphere, all is in vain.

Several proposals of geo-engineering have been launched in order to cool the Earth somehow, for example using aerosols. However, the side effects of geo-engineering techniques are not fully known, which poses tremendous risks for mankind. More research on geo-engineering is vital and urgent before undertaking such an endeavor. Were it to be possible though, could the COP21 secretariat and IPCC coordinate and assist various efforts at national geo-engineering?

Reducing CO2s forever by using solar power parks appears to be easier than carbon capture or geo-engineering, but both types of policies can be helpful together.

Country Planning: Elimination of Coal and Charcoal?

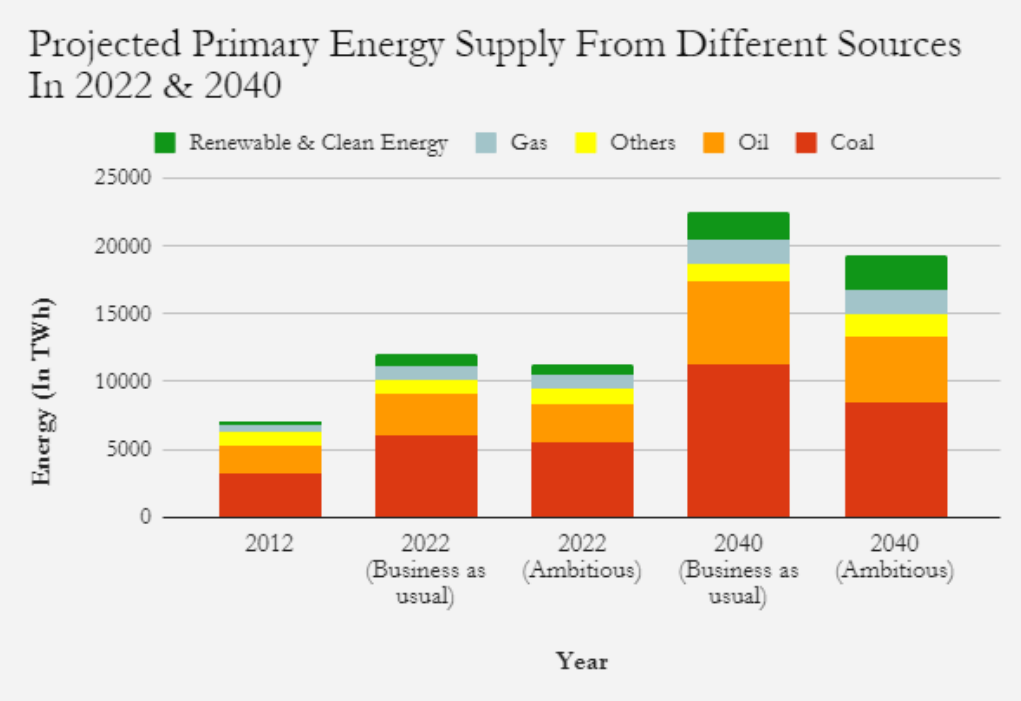
The quickest and most effective way to jump start global decarbonisation would be to simply shut down all of our coal power stations and eliminate all charcoal use. This policy would send the most powerful signal that the decarbonistion era has begun. Countries would need to find alternative energy resources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

But what would a total coal ban mean for the largest polluters of CO2? Can they handle this shift in a time of abrupt climate change? There is no "WE" in climate policy-making, because all policies must be decided by the governments of the states, using unanimity only in global coordination boards like the UNFCCC or G20. Even in these groups, there is always an exit option. Each government's decision must be made on the basis of its own energy situation, which varies much from country to country. Understanding global warming, one must therefore look at the energy predicament of each nation.

India

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

Figure 10. *India`s Energy Future*



Source: https://scroll.in/article/843981/indias-new-energy-policy-draft-projects-coal-fired-capacity-will-double-by-2040-is-that-feasible.

India has rapidly become a major CO2 emitter due to its high growth rates since 1990. It uses lots of coal, stone and wood. Charcoal is bad for households and results in forest destruction. India is trying to broaden its energy supply from modern renewables, like solar, wind and hydro power. Yet, it will likely remain stuck with fossil fuels for decades. It nthus eeds assistance from the COP21 project, especially for solar power parks. Figure 10 indicates that India cannot meet its COP21 promises, as Ramesh (2015) has underlined.

Brazil

Brazil is a "catch-up" economy with its "take-off" point occurring in the 20th century. Compared with India, it never really succeeded in closing the width to North America, tumbling now and then into dictatorship or recession. Figure 11 shows its energy plans and questions whether they arein agreement with COP21 hopes of decarbonisaton.

Figure 11. *Energy Plans in Brazil*

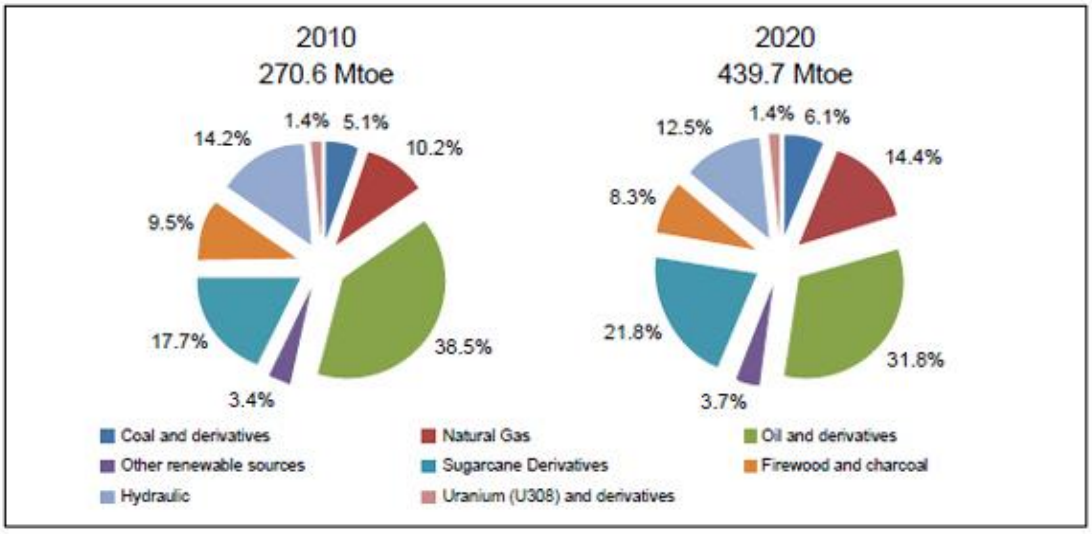


Figure1–Evolution of the total primary energy supply

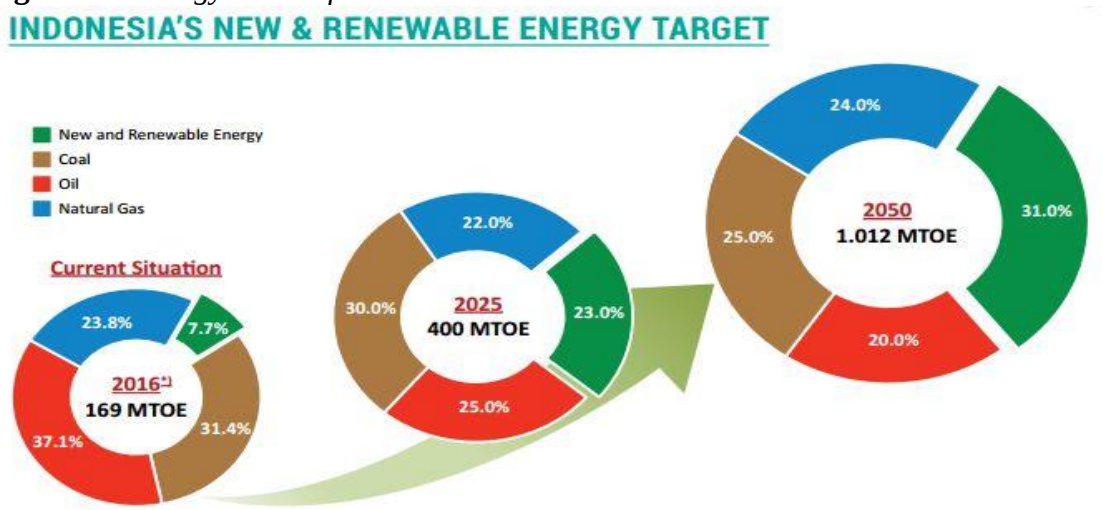
Source: http://www.scielo.br/scielo.php?pid=S0103-40142012000100017&script=sci_arttext&tlng=en.

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

Indonesia

Indonesia is like India in that it is a "take-off" country, enjoying rapid economic growth with attending augmentation in energy consumption. The outcome is that this giant nation has quickly become a major GHG emitter. What makes the situation worse is the burning down of the rainforest in parts of Indonesia. As shown in Figure 12 below, energy supply hopes in Indonesia are completely unrealistic. Unfortunately, there is no real decarbonisation in sight.

Figure 12. *Energy Future for Indonesia*

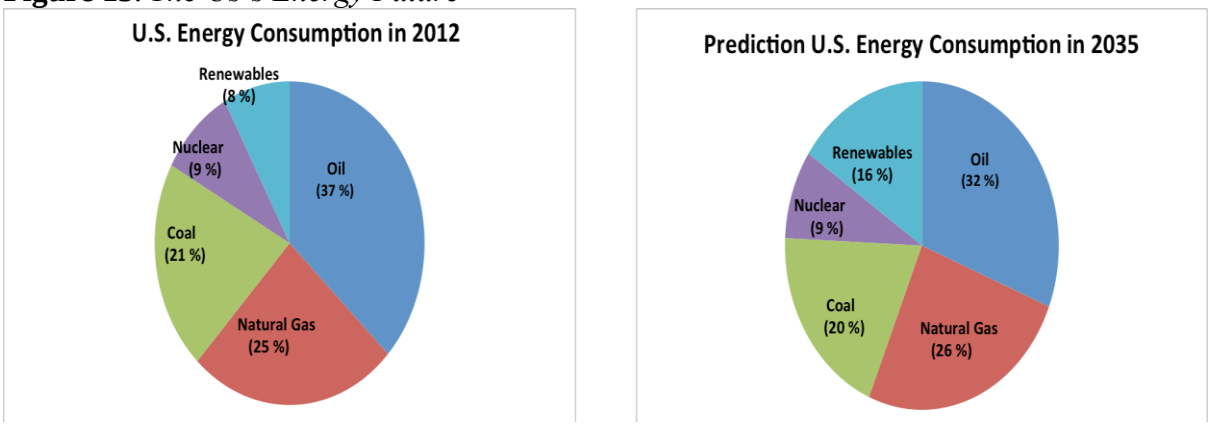


	2016	2025	2050
NRE Mix	7.7 %	23%	31%
Energy Supply	169 MTOE	400 MTOE	1.012 MTOE
Generation Capacity	59 GW (NRE 8 GW)	136 GW (NRE > 45 GW)	443 GW (NRE > 167 GW)
Electricity/Capita	956 kWh	2.500 kWh	7.000 kWh
Electrification Rate	91%	~100%	~100%

USA

The US has reduced its CO2 emissions during the last few years, mainly through a shift to natural gas. Actually, several mature economies have been able to halt the rise of CO2 emissions in this way, either by increasing energy efficiency or shifting to natural gas and other renewables. Figure 13 captures this aspect and some other features of US energy plans.

Figure 13. *The Us's Energy Future*



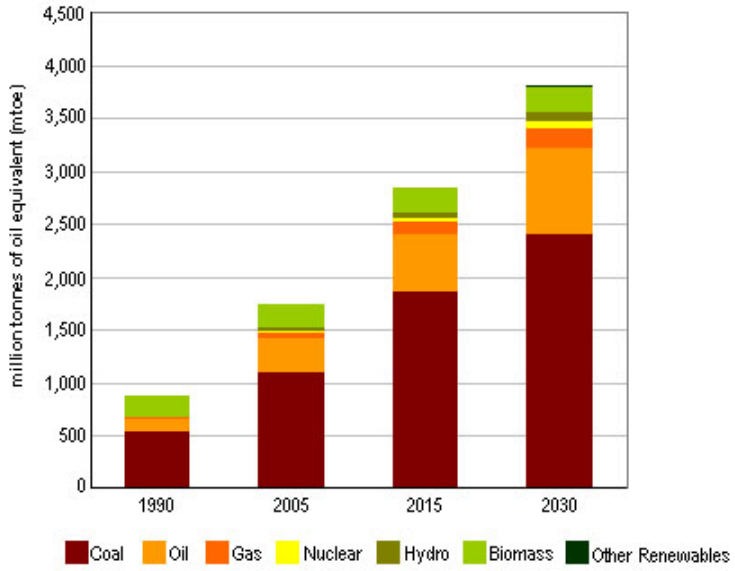
Source: https://www.e-education.psu.edu/egee102/node/1930.

Although Figure 13 predicts a doubling of renewable energy, US dependency on fossil fuels, including coal energy, will not be reduced significantly. We are talking here about relative numbers, but if the US increases its total amount of energy supply, then there may even be more fossil fuels used. This is especially true given the growing *fracking* business. The reduction in CO2s during recent years seems to be coming now at a reduced rate. The hope is for economic growth without energy increases, but we are not there yet. Most countries demand more energy for the future.

China

China is now entering the First World, as it has long since passed its "take-off" point around 1980 and has pursued a successful "catch-up" policy for a few decades. Its energy consumption, especially fossil fuels, has skyrocketed with GDP, resulting in the largest CO2 emissions globally. Figure 14 shows a projection for China.

Figure 14. *Energy Projection for China*



Source: http://www.wrsc.org/attach_image/chinas-projected-energy-growth-fuel.

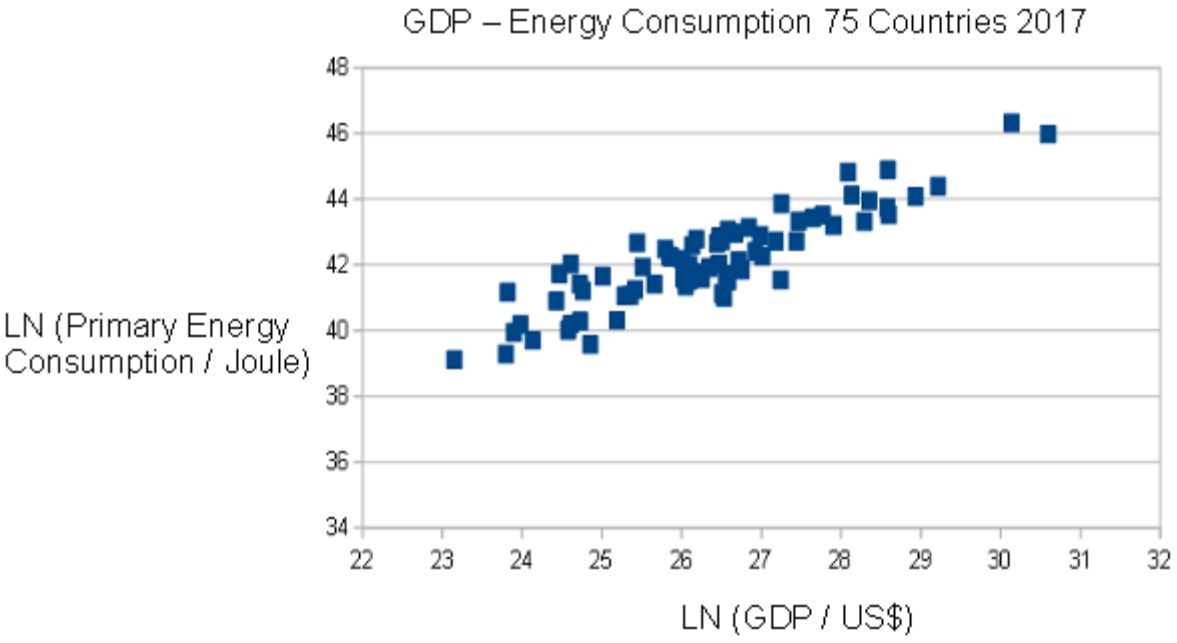
Decarbonisation does not seem highly probable. Much hope was placed in a recent reduction in CO2s, but water shortages forced China to revert to coal in 2017, resulting in the augmentation of CO2 emissions. China is investing in both renewables and atomic power, but it also plans for large energy increases in the coming decades with lots of energy consuming new projects.

Conclusion

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

A study on charcoal and deforestation in Africa showed that 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 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. The same findings apply to Kenya, Sudan and Ethiopia, and also to South Asia. As such, the time for major energy transformation is now. To save humanity from Hawking irreversibility, the window of opportunity is much smaller than earlier believed (Stern, 2007, 2015).

Figure 14. *Global Energy Consumption 2017*

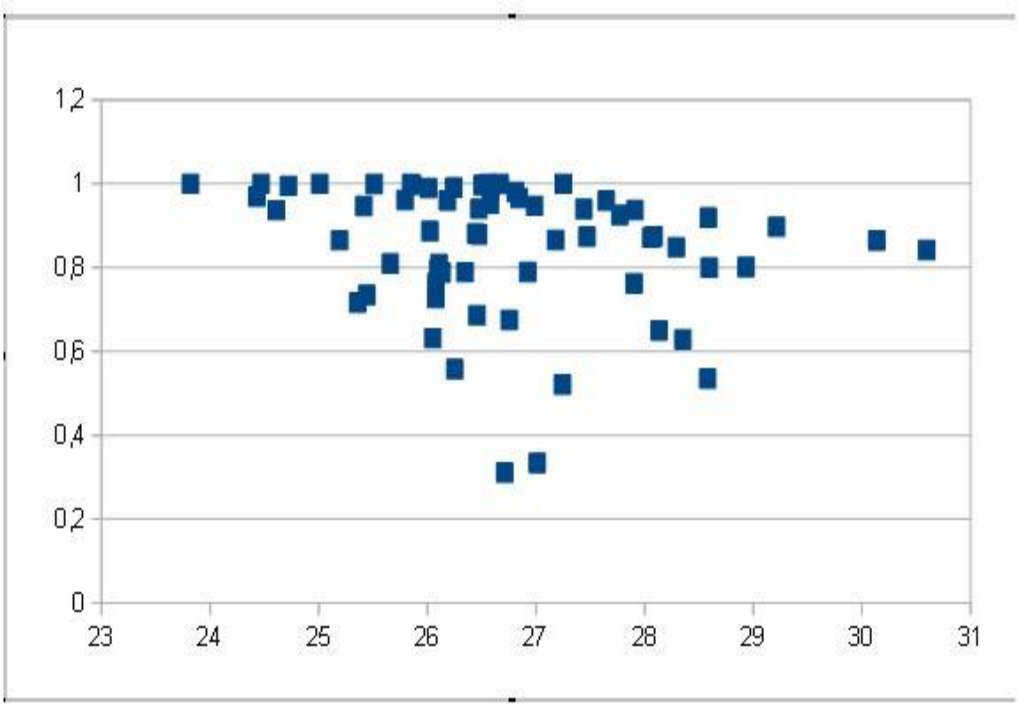


Source: Author.

Energy consumption is closely related to country affluence. The poor countries can only improve living condition by increase energy supply. Their energy demand can only go up, because energy supply is highly skewed to the advantage of the rich countries – see Figure 14.

Poor countries need much more energy, but of a new kind. They need assistance to move to modern renewables, as they will give up fossil fuel only if there is compensation by other new energy sources. The enormous demand for more and more of energy comes with a major drawback, namely the GHG emissions. Figure 15 has the picture for the carbon intensity of energy, resulting in CO2s.

Figure 15. *Energy and Carbon Intensity*



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

It must be underlined that GHG emissions like CO2s are a function of GDP and population. Only very big poor countries have huge GHG emissions, like India, Brazil and Indonesia. Small poor nations have little GHGs, as they lack energy in great quantity. Yet, poor countries wish to participate in saving the planet from the dangers of climate change on the condition of financial assistance from the COP project and it's Super Fund.

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