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Implementation Success or Failure: The COP21 Agreement for the 21rest Century

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***Abstract*—Only a multidisciplinary approach to the COP21 framework will help understanding what is involved in carrying its policy vision into effect. i.e. implementing the global decision of halting temperature rise to + 2 degrees or less. The natural sciences tell us that global warming is proceeding at an ominous pace: the concentration of CO2 in the atmosphere keeps increasing: 399.6 (Jan 2015), 402.52 (Jan 2016) and 404.21 (March 2016). The COP21 idea is that this increase depends mainly upon the GHG emissions from energy production and consumption in a wide sense. Only the social sciences can analyse how the governments of the countries of the world may coordinate to decrease the CO2 emissions, before the methane emissions start augmenting. The standard energy projections for 21rst century speak of a Dena for immense increases, but energy consumption results in GHG emissions. This is the global contradiction between energy and emissions, stemming from the omnipresent demand for economic development or economic growth, The theory of policy implementation entails that implementation success is less likely than implementation failure, especially with a highly decentralised framework, like COP21. The consequences could be disastrous for the social systems of mankind and ecology systems everywhere. The UNFCCC Parties will have to struggle with a huge set of implementation issues over the next decades, but failure is in no way to be excluded. When COP21 is said to promise completely carbon neutral energy for the world, then the implementation perspective is long in time indeed, or the entire century.**

Keywords—Policy sciences, implementation, greenhouse gases (GHG), CO2 emissions, energy – emissions links, GDP - energy consumption links, decarbonisation, country energy pattern, Sachs, Wildavsky, UNFCCC, country predicaments.

INTRODUCTION

The global warming process is already going on and proceeds seemingly unstoppably, involving *inter alia* larger climate swings, deforestation, desertification, ocean acidification and rising sea levels. One does not really know whether it is an irreversible transformation of Planet Earth, or where it could be stopped: + 1, 5, +2, + 2, 7, +4, +6, or would end in a global catastrophe.

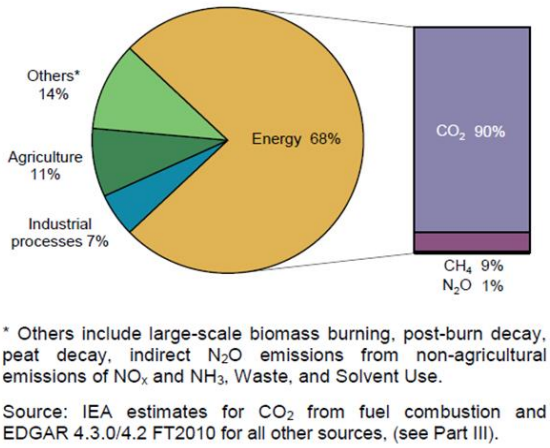
It is now argued that the global increase in GHG has stalled and that the dire link between GDP growth and CO2 emission increase has been undone. Yet, halting the growth of emissions will not be enough, as the level of yearly emissions stay at an enormous size. What is crucial is the undoing of the close link between energy consumption and GHG emissions. The emissions result *primarily* from energy use, especially the burning of fossil fuels or bio or waste materials, and only *secondarily* from economic activities or development. Economic growth that uses carbon neutral energy would reduce global warming. But this is a utopian goal for the entire global economy.,

The specific country strategies to enhance COP21 will depend upon their energy pattern in usage, Thus, the governments, the IGO:s and NGO:s and other experts on climate change must realize that halting or reducing the emission of GHG:s must involve costs. There are simply not enough alternative energy sources or innovations in renewables to draw upon, at the moment. Some countries will ask for special delays, others will call for economic assistance or compensation and some may even decide to promise but later renege. What is involved in this trade-off between reduction of greenhouse gases on the one hand and economic development or growth on the other hand? This article portrays this connection by means of figures on a few key countries. The closer the link between GDP and emissions is, the more painful or costly will the transition to a reduction of emissions be.

PRELIMINARIES

From Emissions to Energy

Greenhouse gases (GHG) contribute to the so-called greenhouse effect, which boils down to continuous overall warming of the Planet Earth. Atmospheric gases trap electromagnetic radiation from the sun that would otherwise have been reflected back out into space. These greenhouse gases include: methane, nitrous oxide, carbon dioxide, hydro fluorocarbons (HFCs), per fluorocarbons (PFCs), and sulphur hexafluoride (SF6). But these gases make up only a small fraction of the gases of the atmosphere. Here we focus upon the CO2:s (Figure 1).



* Others include large-scale biomass burning, post-burn decay, peat decay, indirect N_2O emissions from non-agricultural emissions of NO_x and NH_3, Waste, and Solvent Use.

Source: IEA estimates for CO_2 from fuel combustion and EDGAR 4.3.0/4.2 FT2010 for all other sources, (see Part III).

Figure 1. From Energy to GHC:s and CO2:s

In the first rounds of implementation of COP21, it is logical to focus on the CO2 emissions, but methane emissions may become a big headache later on.

From Energy to Coal, Oil and Gas

Globally speaking, more than 80 per cent of the energy consumed daily is derived from the burning of fossil fuels. How fast can this be changed and what could be the economic costs of decarbonisation? Countries can attempt to meet their obligations in the COP21 Agreement by decarbonisation, lower economic growth or more energy efficiency. New technology and innovations will be crucial, not only in small scale endeavours but used massively. We wish to find out below is how countries vary in terms of their energy consumption.

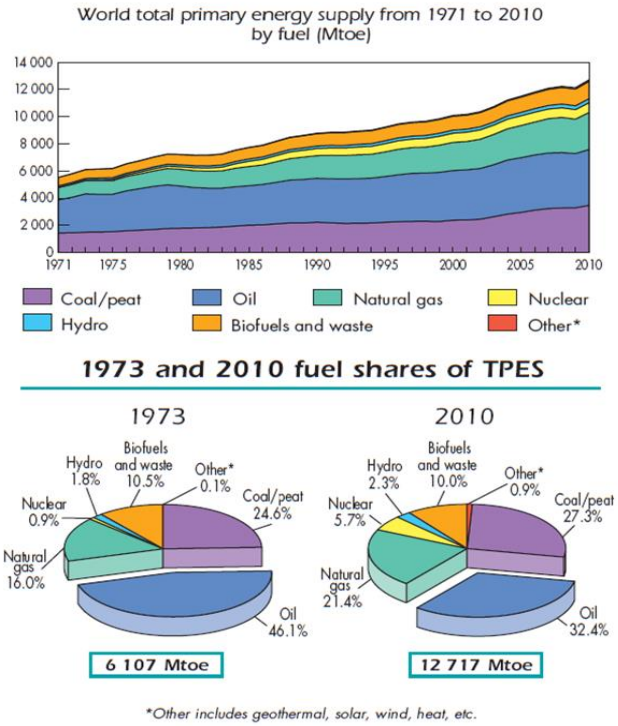


Figure 2. From energy to fossil fuels

Source: IEA: CO2 Emissions from Fuel Combustion, 2015.

Speaking with economist Sachs, one can only say that decarbonisation will be hard to come by, especially for countries with little hydro or nuclear power. When the requirements of sustainable development collide with conventional economic growth, something has to give. It is not likely that decarbonisation will trump economic development, at least not enough to avoid + 2,7, +4 or +6 scenarios. He states: “Economic development, social inclusion, and environmental sustainability are the three tenets underpinning the forthcoming post-2015 development agenda, a once in a generation opportunity to put mankind on the path to a sustainable growth model.” But consider standard energy projections, which defy Sachs' wishful thinking.

Fighting global warming involves reflecting upon several measures, as with the COP21 conference in Paris, including:

- Slowing population growth
- Changing agricultural production modes
- Water recycling and waste treatment
- Ocean protection
- Changes in energy consumption: “decarbonisation”
- Stopping deforestation and protecting rain forests.

Although energy is far from the only source of greenhouse gases, it is the single largest one. Energy use crops up in all forms of activities most often with an economic element: industry, transportation – land, sea, air, housing and commerce as well as food production and agriculture. The implementation of the COP Agreement can only succeed if coal is significantly reduced in electricity production and petroleum decreased in transportation. However, the stylised projections point to an altogether different world in 20-30 years (Figures 3).

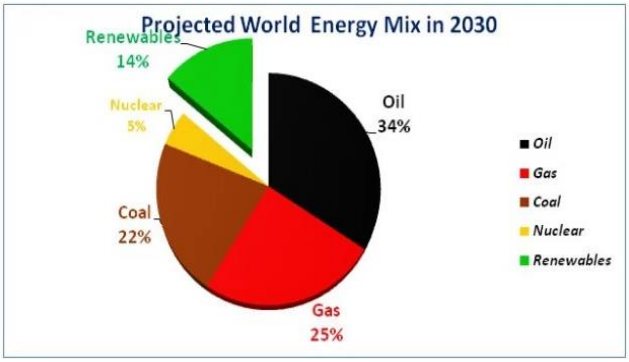


Figure 3. Energy projections about coal and petroleum

http://www.reportlinker.com/p02587099-summary/Annual-Renewable-Energy-Outlook.

The predictions found with all energy companies and agencies will when true undo the implementability of COP21. Consider the CO2 emission content of energy kinds in Figure 4.

Specific Energy, Energy Density & CO2

Fuel	Specific Energy kj/g	Density KWH/gal	Chemical Formula	lbs CO2/gal
Propane	50.4	26.8	C3H8	13
Ethanol	29.7	24.7	C2H5OH	13
Gasoline	46.5	36.6	C7H16	20
Diesel	45.8	40.6	C12H26	22
Biodiesel	39.6	35.0	C18H3202	19
Methane	55.8	27.0	CH4	3
Oil	47.9	40.5	C14H30	20
Wood	14.9	11.3	approx weight	9
Coal	30.2	22.9	approx weight	19
Hydrogen	141.9	10.1	H2	0

Source: DOE, Stanford University, College of the Desert, & Green Econometrics research

Figure 4. Energy Types and CO2:s

The main implications from Figure 4 are that the use of coal in electricity generation must be reduced and coal power stations be equipped with filters. Moreover, the employment of petroleum products must be decreased in transportations: land, sea and air.

From Energy to GDP

Sachs has launched a coherent call for the world to move towards *sustainable* development, based on decarbonisation of the energy systems of countries (http://jeffsachs.org/2015/08/sustainable-development-for-humanitys-future/). He has correctly emphasized the close link between economic development or growth and the massive use of fossil fuels as energy sources during the last 20 years, resulting in the enormous expansion of GHG emissions. The Figure 5 displays this link.

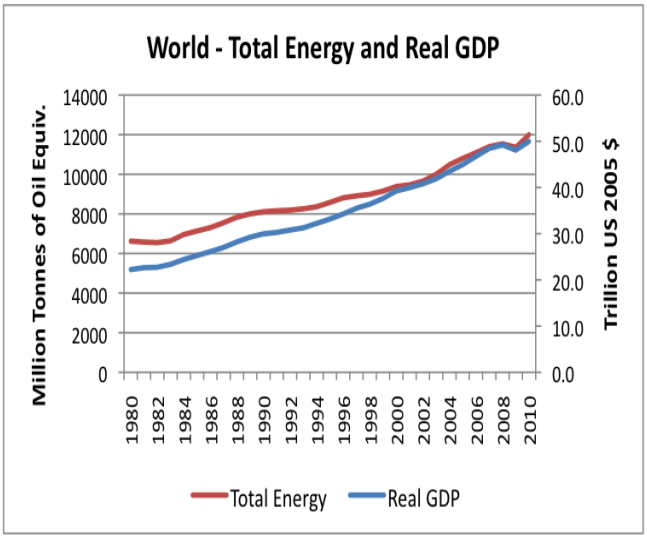


Figure 5. Growth in world energy consumption (based on BP data) and growth in world real GDP

Source: BP, Energy Outlook

However, given this close links between GDP, energy consumption and emissions, how can the countries of the world achieve decarbonisation without hampering economic development or growth? What is the country link between GDP and GHG emissions? It depends upon the nation in question!

COUNTRY PREDICAMENTS

It is up to each country to start implementing COP21. The more reliant upon coal for electricity and petroleum for transportation they are, the more difficult and costly will be the implementation process.

A FEW ASIAN NATIONS

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 emissions are the largest in the world, totally speaking (Figure 6).

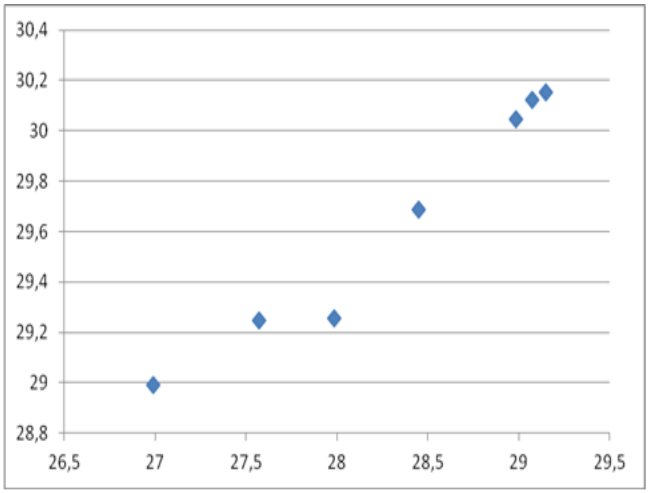
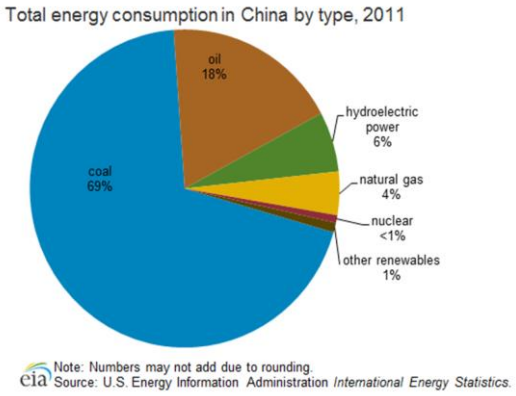


Figure 6. CHINA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

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 7).

Figure 7.



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 very small indeed. 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 COP21 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)

India will certainly appeal to the same problematic, namely per capita or aggregate emissions. The country is even more negative than China to cut GHG emissions, as it is in an earlier stage of industrialization and urbanization. Figure 8 shows the close connection between emissions and GDP for this giant nation.

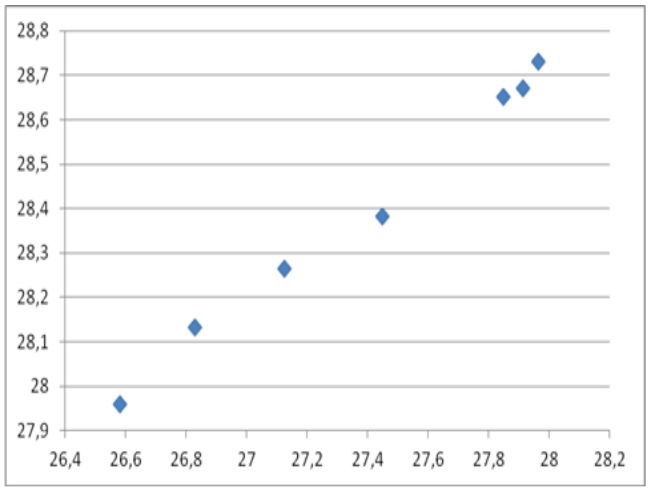
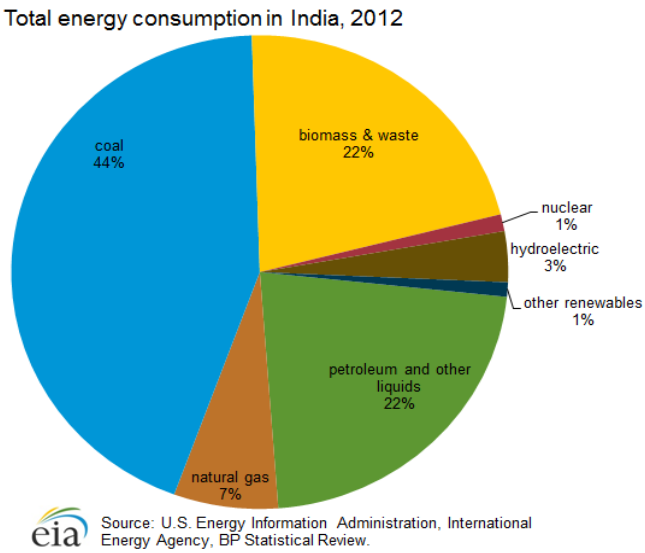


Figure 8. INDIA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

India needs cheap energy for its industries, transportation and heating (Figure 8) 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 smallest numbers for energy per capita, although it produces much energy totally. Figure 9 shows its energy mix where renewables play a bigger role than in China.

Figure 9.



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.

One may find a close link between GDP and emissions also in countries with an advanced economy. See Figure 10 for South Korea.

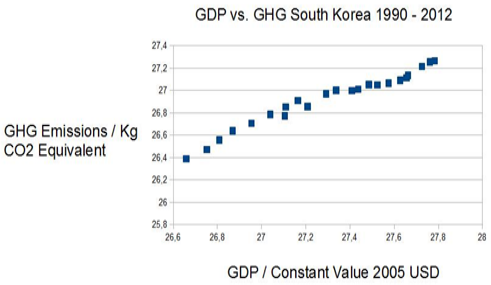
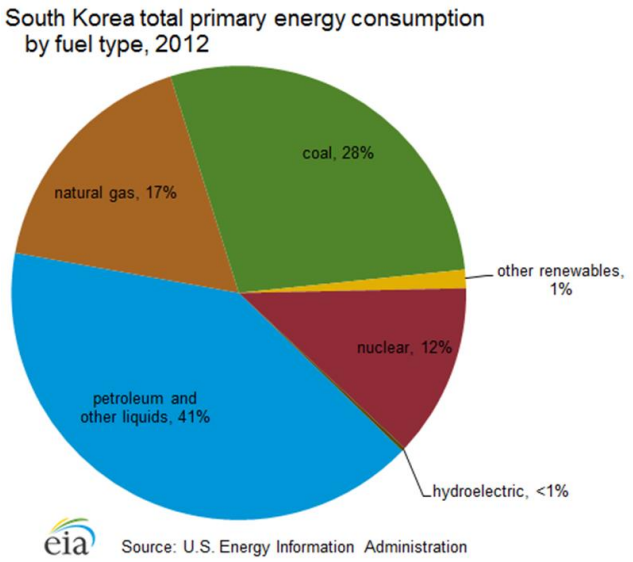


Figure 10. SOUTH KOREA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

Figure 11.



Lacking much hydro power, South Korea has turned to fossil fuels for energy purposes, almost up to 90 per cent (Figure 11). It differs from China only in the reliance upon nuclear power, where the country is a world leader in plant constructions. Reducing its hefty GHG emissions, South Korea will have to rely more upon renewable energy sources, as well as reducing coal and oil for imported gas or LNGs.

The above three countries are giant polluters in terms of GHGs. China and South Korea uses mainly fossil fuels for energy consumption, whereas India also employs renewables and hydro power, lacking in the other two.

SOME DEVELOPING COUNTRIES

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.

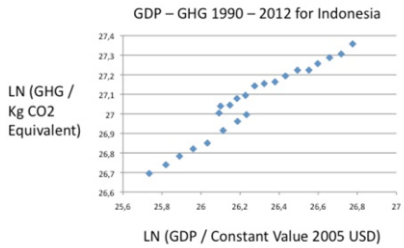


Figure 12. INDONESIA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

Indonesia is a coming giant, both economically and sadly in terms of pollution. Figure 27 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 28 presents the energy mix for this huge country in terms of population and territory.

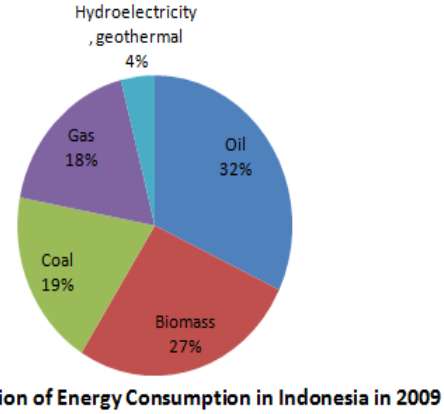


Figure 13. (http://missrifka.com/energy-issue/recent-energy-status-in-indonesia.html)

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.

The same upward trend holds for another major developing country with huge population, namely Pakistan (Figure 14).

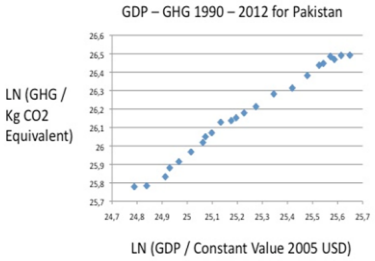


Figure 14. PAKISTAN: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

The amount of GHG emissions is high for Pakistan, viewed as aggregate. Pakistan is mainly reliant upon fossil fuels (Figure 15).

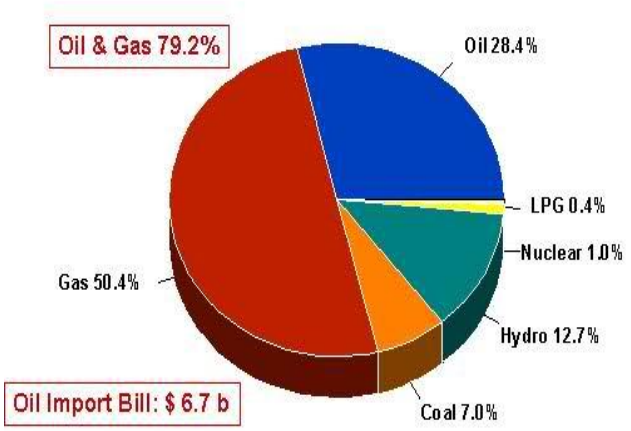


Figure 15. Pakistan Energy Consumption 2009 (by ShoXee)

But Pakistan employs a considerable portion of hydropower – 13 per cent – and a minor portion of nuclear power. Looking at South Africa in Figure 18, it is the same trend.

Emissions are high, because South Africa uses a lot of coal to generate electricity (Figure 19). Decarbonisation will be difficult and costly.

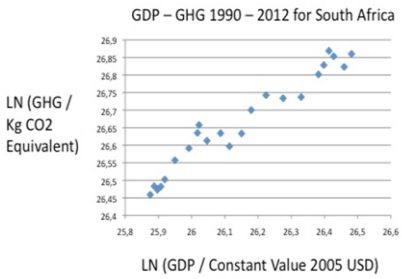
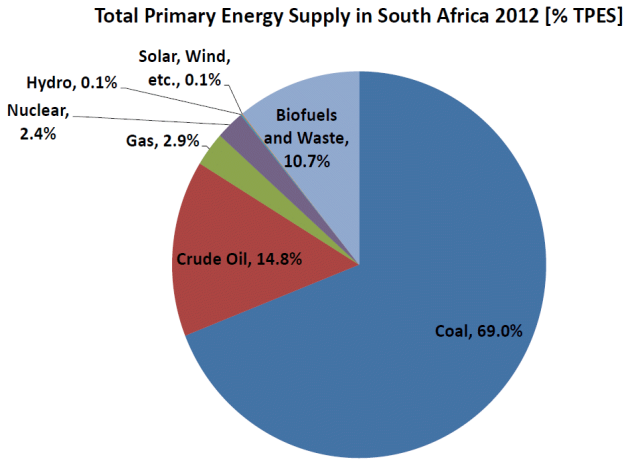


Figure 16. SOUTH AFRICA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

Figure 17. Energy consumption in RSA

The reliance upon coal in this largest economy in Africa is stunning.



NOT SO STRONG LINKS: GDP - Emissons

The picture of a very close link between GDP and emission of GHG:s that is to be found with the three giants in Asia does not necessarily hold for all countries. Let us look at a few countries where this link is weaker, starting with Canada that has halted the expansion of GHG:s (Figure 18).

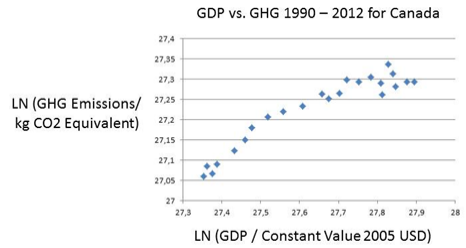
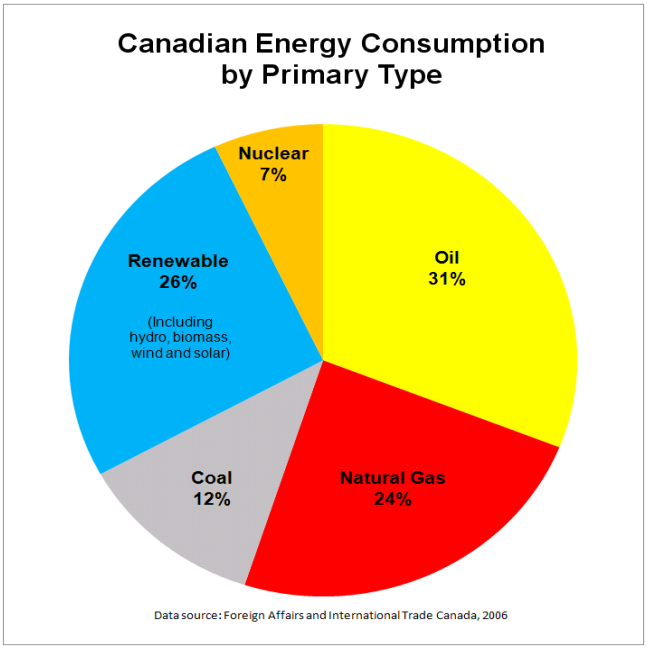


Figure 18. CANADA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

Although Canada is a major emitter of GHG:s as well as one of the world's largest fossil fuel producer – oil sands, it had managed to stem the increase in emissions for the most recent years, i.e. halting the augmentation. Figure 18 may be invoked to explain this, showing a very mixed energy consumption pattern.

Figure 19.



Canada has a strong advantage compared with for instance China and India in that it has access to lots of hydro power and natural gas. The burning of coal is as low as 12 per cent, but oil still makes up almost a third of energy consumption.

Let us look at the ethanol country *par preference*: Brazil. Figure 20 shows a considerable drop in total emissions, but it is followed by huge increases that tend to flatten out.

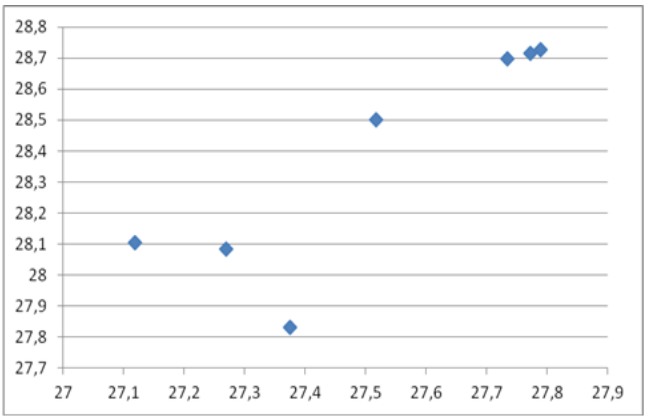
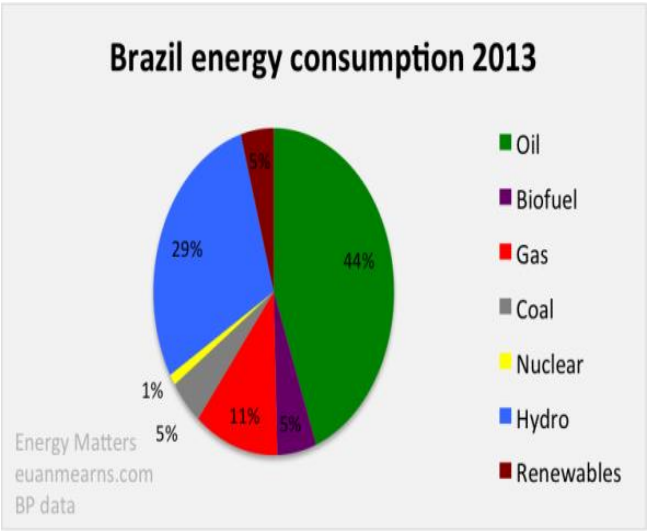


Figure 20. BRAZIL: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

Brazil employs the most biomass in the world, but the emissions stay at a high level, which is a reminder that renewables may also have GHG:s. One advantage for Brazil is the 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. Global warming reduces the potential of hydro power, and Brazil has very little nuclear power (Figure 21).

Figure 21.



For most countries hold that their emission of GHG:s increases, as well as augments with the GDP. However, there are a few notable exceptions of decreases that are worth mentioning. We start with the US (Figure 22).

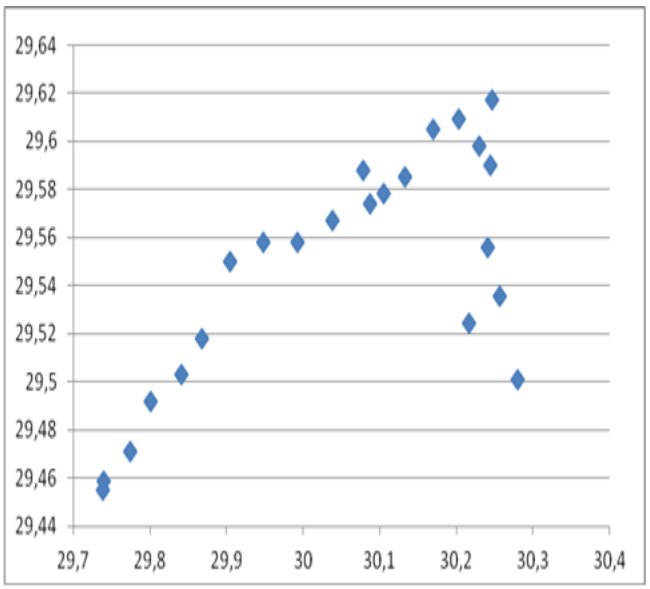
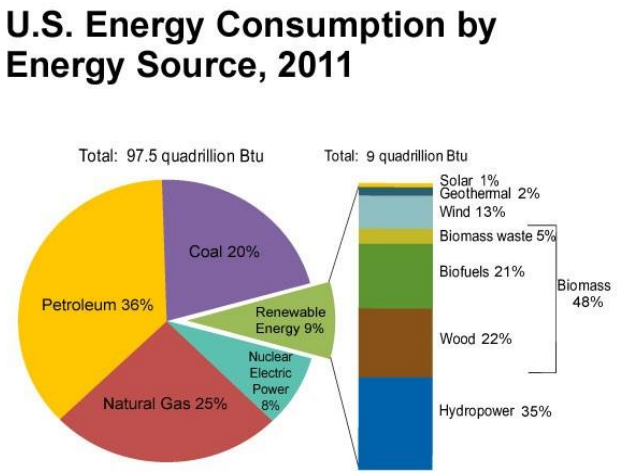


Figure 22. USA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

Recently, the level of GHG emission has been reduced significantly in the US. It reflects no doubt the economic crisis that began 2007, but the US remains the second largest polluter in the world, reflecting that it cannot draw upon a mixed bag of energies (Figure 23). Per capita GHG:s are of course extremely high for the USA. As the economy now starts to accelerate, emissions are bound to go up again.

Figure 23.



Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 10.1 (March 2012), preliminary 2011 data.

The US is heavily dependent upon fossil fuels, or some 89 per cent comes there from. What is changing is the more and more of energy is produced within the US and no longer imported from outside – the *shake oil and gas* revolution. Further reduction of GHG:s will meet with firm resistance from the Republican House of Congress, which may oppose the COP21 Agreement. 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.

Another interesting country is the largest EU economy, namely Germany. Figure 20 shows a marked decrease in GHG emissions.

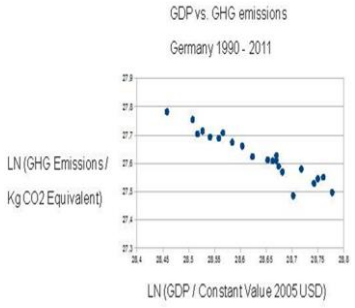
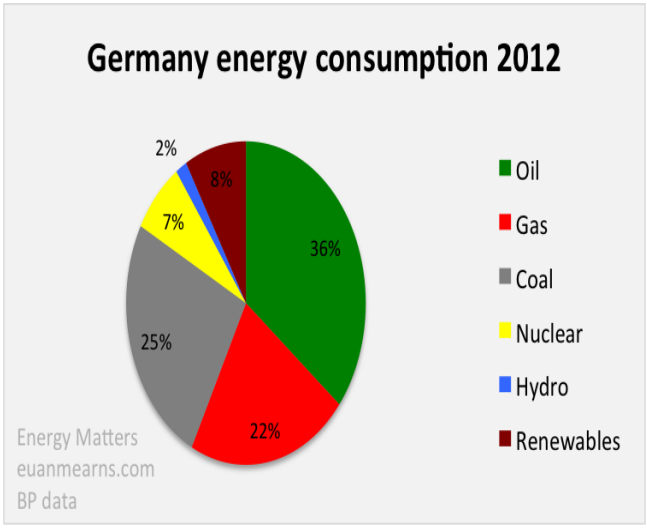


FIGURE 24. GERMANY: : LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

The German data shows a consistent decreasing trend, which is not to be found with many countries, if at all. How come this German exceptionable policy? Germany needs massive amounts of energy, but it decided to phase out nuclear power. Can really the domestic employment of renewables satisfy this gigantic demand (Figure 25)?

Figure 25.



It is true that nuclear power and renewables has made it possible for Germany to decrease its GHG:s, but the country is still dependent upon fossil fuels, especially coal and oil. What will happen with the nuclear power stations are phased out in 2022 is that most likely the GHG emissions will start going up again. To replace nuclear power with solar and wind power will be difficult to say the least. Already, Germany uses more coal from Columbia and gas from Russia.

Japan has a rather similar situation in that it will no longer rely much upon nuclear power. Its emissions have gone done recently, but seem to be on the rise again (Figure 26).

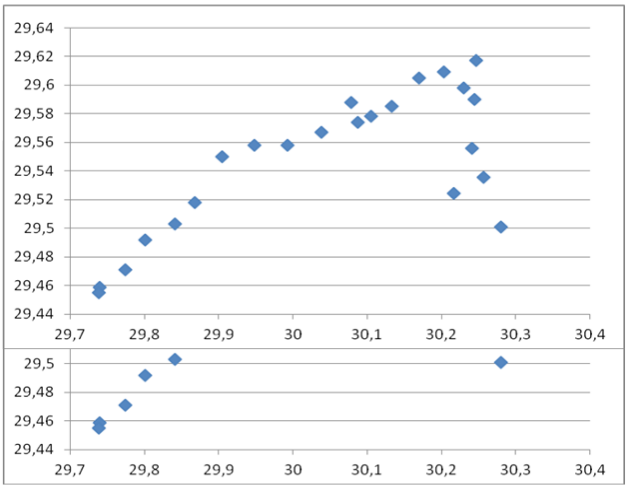
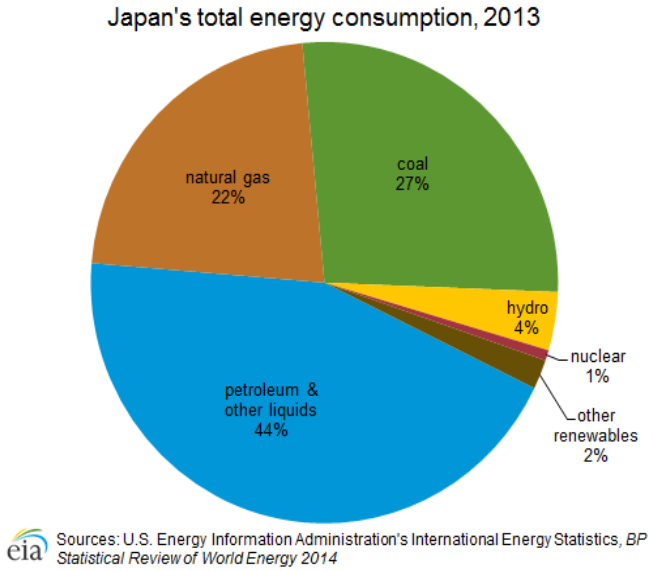


Figure 26. JAPAN: : LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

The decrease in emissions for Japan reflects the country's post-industrial developments. Production

sites have been moved out of Japan with heavy investments in other Asian countries as well as the EU and the US. Yet, Japan will still need massive amounts of energy (Figure 28). After the Fukushima disaster, it operates only 1 nuclear power station.

Figure 27.



As Figure 27 shows, Japan is very dependent upon fossil fuels for generating electricity and transportation, especially when nuclear power is no longer a major option with one nuclear power plant operating now in Japan.

THE "GREEN STATES": Strong links

Some countries applaud themselves for a positive energy policy, i.e. a policy that leads to decreases in emissions. But is it really true? Look first at Singapore in Figure 28.

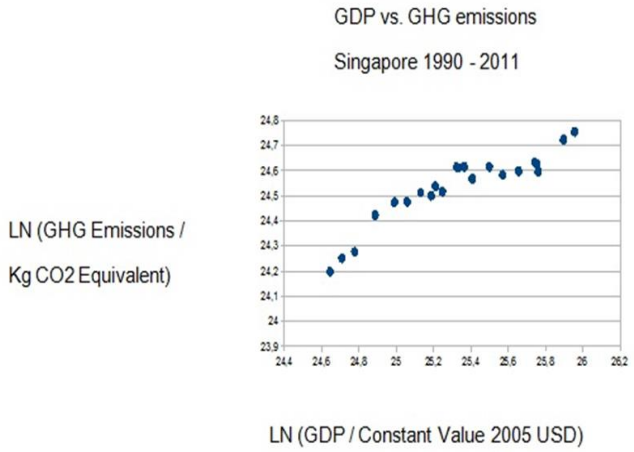
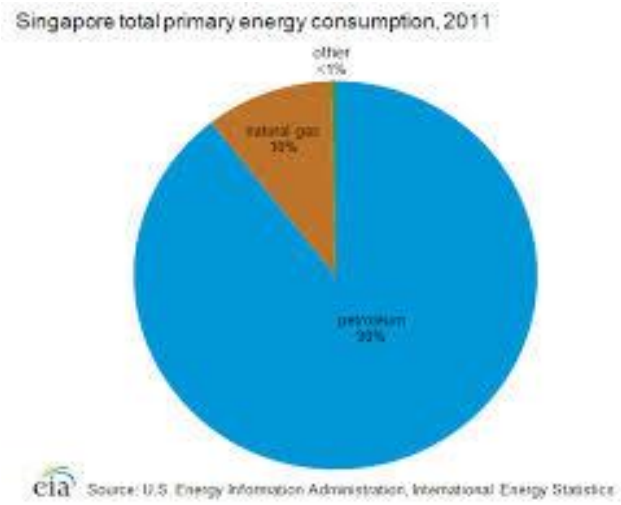


Figure 28. SINGAPORE: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

Despite its official statements about being a *GREEN* city, emissions have been going up steadily in Singapore. The GHG:s are very high if related to per capita. Its energy mix is only oil and gas, imported from abroad (Figure 29). Singapore needs lots of electricity to bolster its advanced life style (air conditioning, total waste water cleaning, etc).

Figure 29.



Why would this island state need too much energy, resulting in such an amount of emission of GHG:s? Reply: the need for fossil fuels to generate electricity and make transportation possible**.** Singapore has a hot climate and handles that with a complete use of air conditioners all over the place. It is also a huge hub for shipping and air travel. It is impossible to generate so much electricity without emissions when using fossils fuels. Singapore has a large oil refinery.

Consider now another "GREEN" state, the United Arab Emirates (Figure 30).

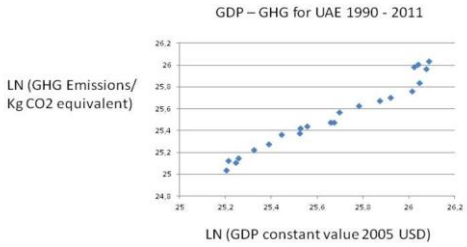
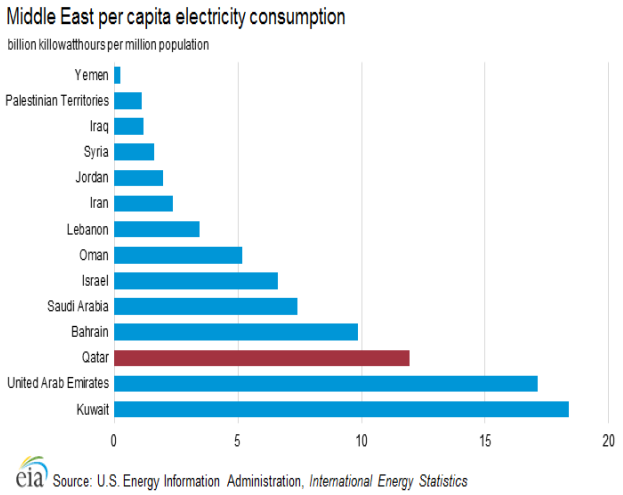


Figure 30. UNITES ARAB EMIRATES: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)

The UAE have increased their emission of GHG sharply in relation the positive economic development of these emirates. They rely upon the fossil fuels of Abu Dhabi with immense oil resources. Like other Gulf States, the UAE boosts with building entirely GREEN sites, with energy from solar power and almost no waste. But it is based upon their enormous consumption of electricity generated out of burning oil and gas (Figure 31). The Gulf countries use lots of petrol, gas and electricity to uphold a stunningly high standard of living, which also results in extremely high levels of emissions per capita.

Figure 31.



CONCLUSION

The overwhelming number of countries in the world hardly displays the downward trend for the emission of GHG:s. A few has managed to halt this progression, linked closely to economic development. But very few have embarked on a path of credible path of diminishing these emissions. The great developing countries are still heavily dependent upon fossil fuels. It is true that hydro power and nuclear power are employed in some countries, but a significant increase in these power sources cannot be expected. Wind and solar power are still in infancy. Biomass has been resorted to on a large scale in a few countries, but it is not carbon neutral.

Ideally, a country would wish to start reducing its emissions of GHG:s without any major impact upon the GDP. This would require a policy mix of promoting energy efficiency, moving towards the use of renewables massively and cutting back upon fossil fuels, especially coal. Why not start requiring filters upon coal fired power stations, perhaps financed with a Stern like fund?

When discussing the major objective of halting global warming at +2, in order to avoid +4 or catastrophically +6, a lot of measures are mentioned: carbon sequestration, carbon tax, support for new technologies and innovations, huge solar plants, massive wind power stations, wave energy, etc. But people forget that energy consumption is steadily going up, as global population increases and the quest for a high level life style is shared by more and more millions of people. What is gained on one side – decarbonisation, energy efficiency, small scale solar and wind power – may simply be cancelled out by what is lost on the other side: dismantling of nuclear power, expansion of car transportation, SUV:s, bigger cars and trucks, more buses, expansion of airports and airlines, more sea traffic, bigger ships, more containers, larger cement constructions, etc. Aaron Wildavsky, the most genial of American policy analysts, emphasized the dangerosities in policy implementation. He is right with regard to COP21 but he was wrong about climate change.

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