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# COP21 and The Decarbonisation of Societies: Can it be Pulled Off in this Century?

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**Abstract:** Ecology versus economic growth? There is not general solution to this dilemma or trade-off (de Bruyn, 2012; Eriksson, 2013; Managi, 2015). Following the COP21 Agreement objectives and their decentralised implementation over this century, the countries of the world, guided by international governance, must learn how to invest in projects that both foster growth and innovation as well as environmental sustainability and decarbonisation. It will be far more difficult, not to say much uncertain, whether the COP21 approach can work.

**Keywords:** Decarbonisation; Greenhouse gases (GHG); GDP-CO2 links; Sustainable development (Sachs); Implementation (Wildavsky); Energy mixes superfund (Stern).

## 1. Introduction

The 21rst century will focus much upon ecology. On the one hand, there is the trend towards general environmental degradation. On the other hand, there are the greenhouse gases that cause global warming. Together, these two trends are extremely dangerous for mankind in general and poor countries in particular.

Here, we deal with the greenhouse problematic, and enquire into the CO2:s in relation to the COP21 Agreement. This major international governance instrument promises the decarbonisation of the country economies during this century, meaning a massive reduction of fossil fuels and their carbon dioxide emissions. Can it be pulled off by decentralised policy-making and implementation?

First, we deal with the GHG:s. Second, we examine the concept of policy implementation. And third, we look at some countries in order to find out the implementability of the COP21 promises.

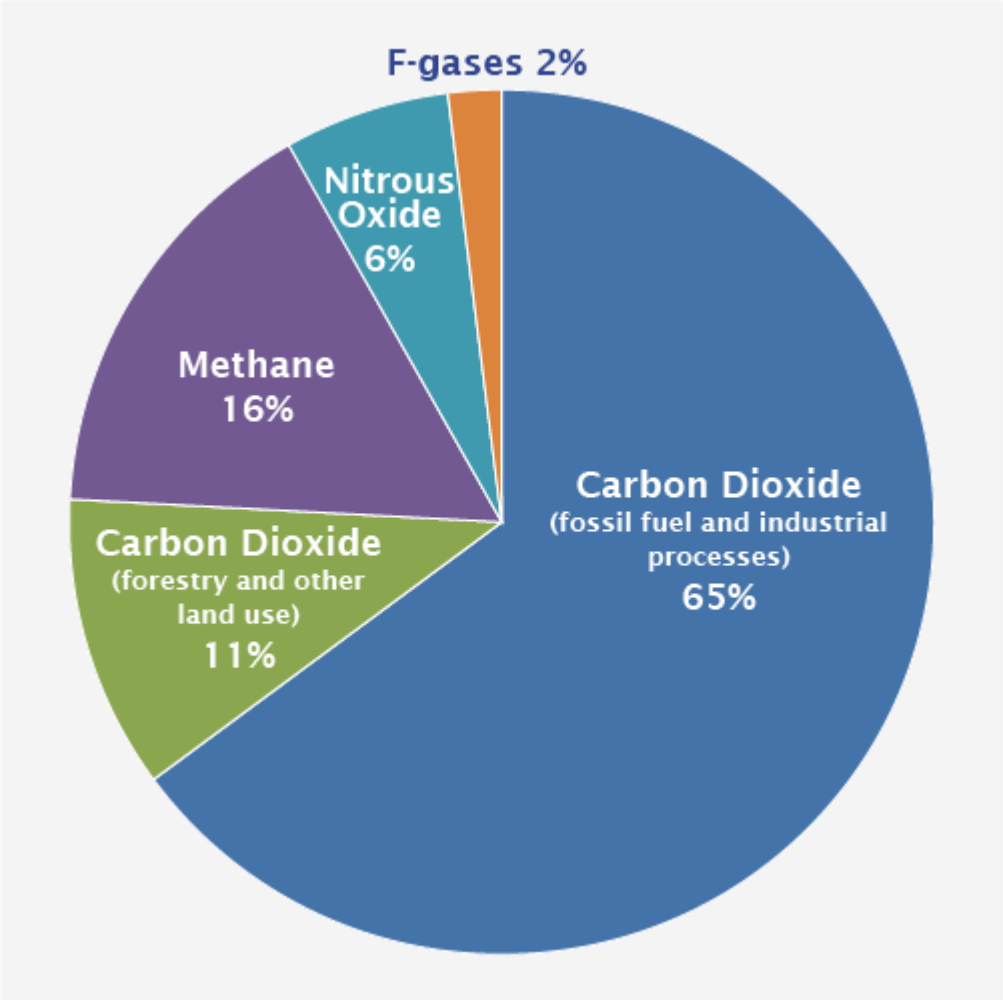
### 1.1. GHG:s And CO2:s

The anthropogenic greenhouse emissions form a very small part of the global cycles that govern the biology and chemistry of Planet Earth. However, these emissions have increased in such a manner since 1750 that they now play a major role for climate change. The greenhouse effect was analysed already more than 100 years ago by chemist Arrhenius and others, but its negative effect upon the social and ecological systems of the globe became an issue in the 1980s. The argument of the cornucopians was launched, declaring that climate change was a figment of the imagination with hard core environmentalists, aiming at a social criticism of the existing economic system and its viciousness. Economist Simon (2003) and political scientist Wildavsky (1979, 1987) stated that Mother Earth could handle this increase in GHG:s and CO2:s through natural absorption. And Lomborg (2007) made cornucopianism a global issue, rejecting the relevance of global warming policy-making.

The response from biologists and chemists to cornucopians (*horn of plenty*) was extremely harsh. Enormous amounts of empirical evidence were marshalled in support of a most fundamental change in the history of the Earth, namely the starting of a global warming process that appeared to accelerate. Moreover, theoretical support for the global warming theory was searched for the basic laws of heat and energy, i.e. thermodynamics and its idea of increasing disorder or entropy.

As things now stand, global warming theory is sufficiently corroborated in order to take it seriously politically, because the threat to the future of mankind, intelligence and civilisation is truly frightening. Figure 1 shows how the sources of GHG:s is modelled, as the models are the same in the standard texts.

**Figure-1**.




**Source:** IPCC (2014); based on global emissions from 2010.

These greenhouse gases in Figure 1, especially the CO2:s, have increased spectacularly during the last two decades. The COP21 Agreement wants not only to halt this increase but also diminish it radically during the 21rst century. According to the COP21, decarbonisation of the countries of the world will proceed in three steps:

- Halting emissions growth
- 40% reduction of CO2:s up until 2030
- Complete decrease of CO2:s until second half of 21rst century.

Is this realistic? What would be the means to these goals? First a few reservations will be done.

## a) Methane

Now, it may be pointed out that the exclusive concentration upon CO2 and neglect of for instance methane is unfortunate and hardly warranted. The emissions of methane increases too yearly and they are much more detrimental. One factor here is the number of cows, and it is expected to increase much. Meat production comes with methane, although experiments are under way to reduce them. The methane problematic could worse than the CO2 problematic, if the permafrost melts and gives away an awful lot of methane.

## b) No Hubbert peak

It was hoped that the reduction of CO2:s would be done automatically by market forces. With an oil price near 150$/barrel, modern renewables would be both competitive and attractive. However, there is no Hubbert peak for the production of oil and gas in sight, after the shale oil revolution in the last years. How can consumers be brought to buy energy from modern renewables? Or who will invest in these new energy technologies? Reply: state subsidies!

## c) "Sustainable Economy"

The same question about means can be raised in relation the hope of a decisive step towards "sustainable development". Economist Sachs looks upon the COP21 as a major step towards his model, but why would consumers and producers accept it? Without government intervention and planning, the concept of a "sustainable economy" as a viable alternative to the market economy is rather empty.

## 2. Concept of Implementation: A Short Theoretical Note

As the most gifted American political scientist of the 20th century emphasized in his manifold writings, Wildavsky (1979, 1987), policy implementation involves much more than ordinary public administration or governance. The central distinction is that between output, i.e. decisions, legislation and budgeting, on the one hand and outcome, i.e. the real results occurring in the social systems at some point in time (Pressman and Wildavsky, 1973, 1984). Redirecting political science and public administration towards policy analysis of outcomes, he was joined by scholars from other disciplines in new centres to study the *actual effects* of government decisions and actions, and not only its *intensions* or promises.

The empirical enquiries into a number of implementation processes with the national or local governments in a country revealed the occurrence of a number of surprising features, such as:

**i)** An often sharp distinction between intended and unintended outcomes;
**ii)** Unintended outcomes were often more dys-functional than eu-functional;
**iii)** Often important unrecognized outcomes were identified;
**iv)** In an implementation process, the means and the goals could be confused – goal displacement;
**v)** Over time, implementation proved often to be dynamic, meaning that both means and goals were reinterpreted and replaced;
**vi)** The concept of rational policy-making as complete and efficient achievement of stated objectives had to be questioned and the inherent difficulties in policy implementation be recognized.

Wildavsky drew the sound conclusion that policy analysts face the task of informing government, bureaucracies and civil society as well as markets about the *TRUTH* concerning the probability of accomplishing objectives by clearly stated means (Wildavsky, 1979, 1987). He did not, it should be pointed out, exaggerate the implementation problems into a theory of irrational behaviour – the so-called *carbage can* model (March and Olsen, 1976). But one must be aware of the problematic motivation with several players in an implementation process, which economist Williamson (1973) called "opportunistic behaviour with guile".

It is always underlined in teachings about international politics and public international law that enforcement is the weak link in the entire system of regulations by international organisations and treaty laws. Implementation of intra state agreements can often not be enforced, which opens up for many kinds of opportunistic behaviour: *promise against compliance*.

When we look at the different positions of a few states with regard to the implementation of COP21, we have to take into account both their emissions profile and the possibility of *reneging*. If, and I emphasize IF, a government is forced to choose between CO2:s reduction and economic development, it may be very tempted by reneging in some form or another. Anthropogenic emissions originate often with energy consumption, which is basic to the economy in a wide sense – industry, transportation, housing, construction, agriculture, etc.

## 3. The Framework of Analysis of Country Strategies

To understand the logic climate change policy-making in a country, one needs to know two essential things:

(2) <GDP-COP (GHG) link, Energy mix>

Where the first tells you how dependent the country economy is right now of emissions, and the second element informs you about the energy alternatives that are feasible for this country.

Generally speaking, one may wish to argue that:

The closer the link between GDP and CO2 is positively, the more costly it will be to halt and reduce the rise in emissions;

**1.** If this link is linear, then reductions in CO2:s may come at the cost of recession or economic decline;
**2.** The fewer the alternative energy sources are, the most costly will be the implementation of an energy policy resting upon renewables;
**3.** Countries that are poor tend to rely heavily upon some of the fossil fuels and will require massive help from the superfund in the COP21;
**4.** There is a blatant risk of reneging on the part of several countries, meaning the occurrence of implementation failure.
**5.** Implementation being the process of carrying a policy into effect may fail, as the objectives stated do not surface in social life. Instead, polices may lead to irrelevant or even opposite outcome, when judges by the goals.

Successful implementation can only occur when a government has:

**1.** Clear objectives
**2.** Knowledge of the means
**3.** Support from bureaucracy and society – "advocacy coalitions" with Mazmanian and Sabatier (1989).

I would like to state that decarbonisation policy-making does not fulfil these three essential and necessary requirements. Let me mention a few country examples where decarbonisation will prove difficult.

The COP21 framework focuses upon CO2:s among the GHG:s, although methane may become very dangerous. In addition, the COP21 targets only certain sources of CO2:s, namely anthropogenic ones stemming from energy consumption in a wide sense. Energy is indispensable not only in the Cosmos of stars and planets, but also for all kinds of social systems of men and women. When analysing the greenhouse gases (GHG), one focuses upon the following energy sources and their emission impacts:

1. Fossil fuels – strong CO2 impact
2. Traditional renewables – strong CO2 impact
3. Modern biofuels – CO2 impact
4. Nuclear power – no CO2 impact
5. Hydro power – no CO2 impact
6. Wind power – no CO2 impact
7. Thermal power – no CO2 impact.

The construction of power stations has in general a CO2 impact, when lots of cement is employed. However, these are the options that countries may pursue, depending upon their environment and capacity to import and export energy.

The emission consequences of these energy sources may be identified in a few global Figures, clarifying the actual global predicament concerning the real sources of CO2. What we want to know is how energy consumption results in emissions *outcomes*. Moreover, what would a 40% reduction of CO2:s mean for a country, when one examines its unique energy mix?

## 4. Findings: Various Country Scenarios

It seems reasonable to argue that the required 40% reduction of CO2 emissions from their 1990 base will prove extremely difficult to implement for most countries in the world, at least if it is to be done without cuts in economic output. Moreover, it also appears adequate to claim that countries that are heavily reliant upon fossil fuels today will face most difficulties. Thus, they may have incentive to renege one way or the other.

On the other hand, one would like to say that countries with an energy mix of both fossil fuels and modern renewables would have a better chance to succeed in implementing the COP21 goals, especially when they have a large experience of hydro and nuclear power. Yet, countries differ much in their energy mixes, from Uruguay with almost no reliance upon fossil fuels to the oil producing Gulf States that rest almost entirely upon fossil fuels.

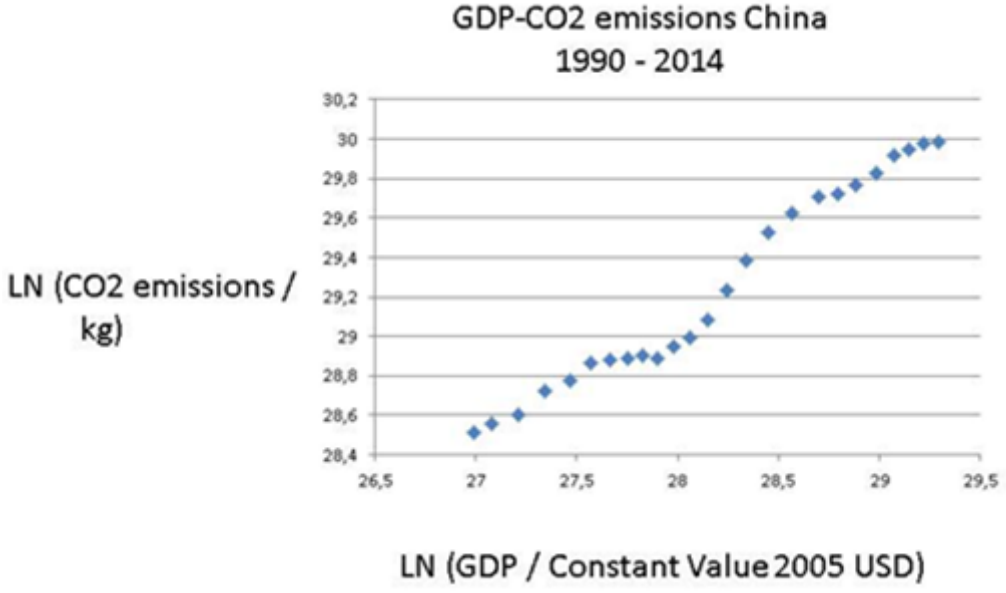
## 5. Middle Income Economies in Asia

Several countries in Asia adhere to the label "emerging economies". Here, I look at China, Indonesia, Thailand and Malaysia as well as Iran.

***China***

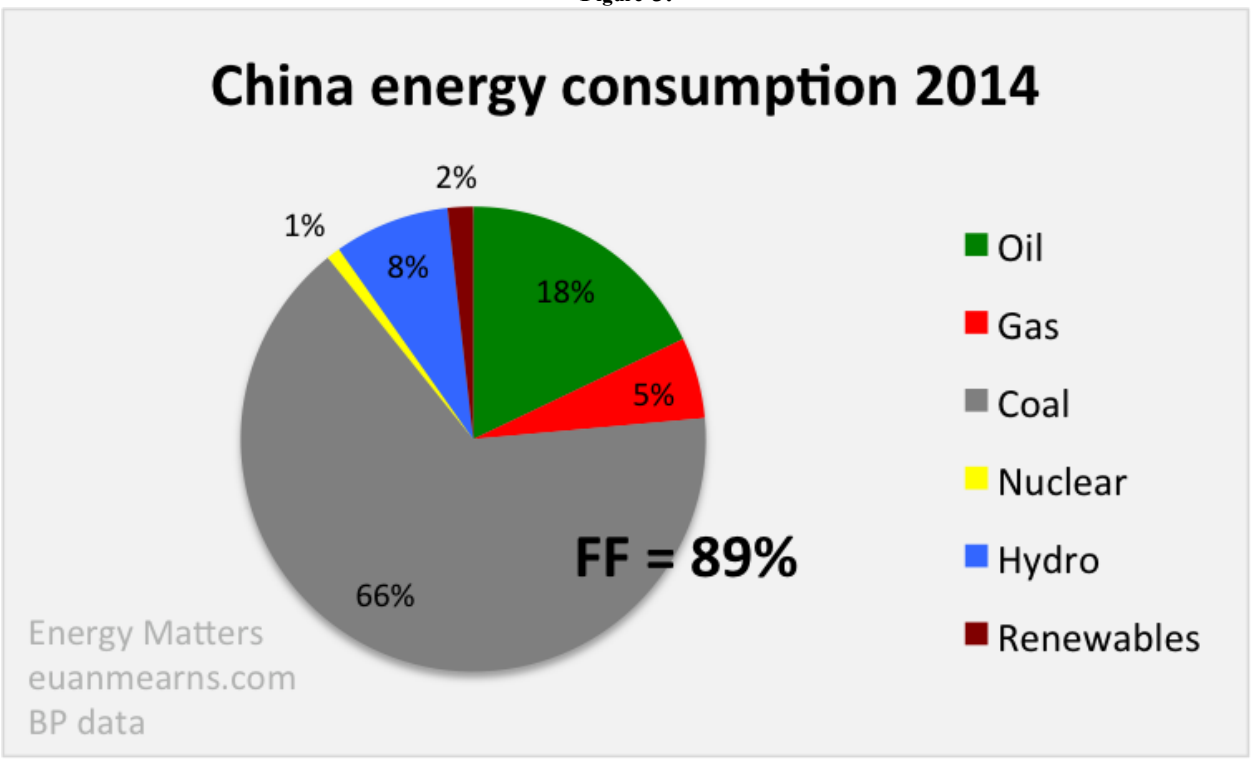
One finds that the emissions of CO2:s follows economic development closely in many countries, like China, South Koreas and most Latin American countries. The basic explanation is population growth and GDP growth – more people breathing and searching for higher life style. Take the case of China, whose emissions are the largest in the world, totally speaking (Figure 2). Interestingly, China has begun a fundamental change of its energy policy in 2015, reacting to mostly domestic demands for cleaner air and environment.

**Figure-2.** CHINA: LN (CO2/ Kg and LN (GDP / Constant Value 2005 USD) ($y = 0,7x$; $R^2 = 0,97$)




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 (Figure 3), which is now up for overhaul.

**Figure-3.**




**Source:** http://euanmearns.com/china-post-industrial-revolution

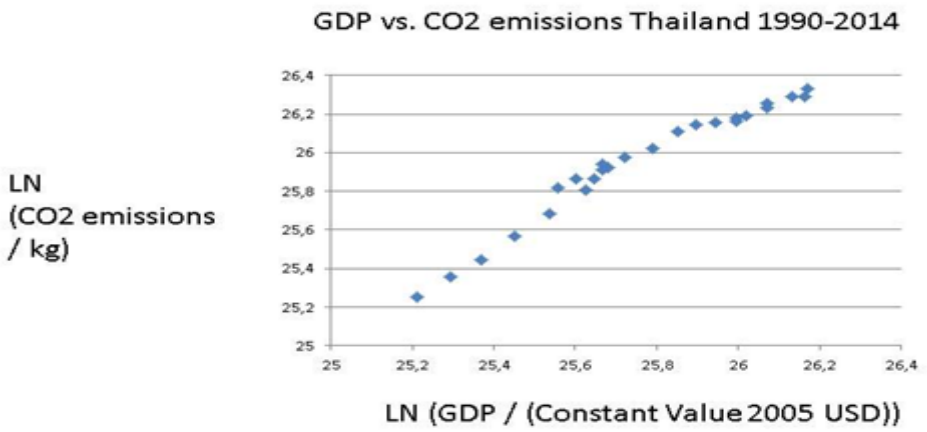
Almost 70 per cent of the energy consumption comes from the burning of coal with an additional 20 per cent from other fossil fuels. The role of nuclear and renewable energy sources with the exception of hydro power is very small indeed. This energy mix makes China very vulnerable to demands for radically cutting CO2 emissions: use other energy sources or massive installation of highly improved filters for carbon capture? It is true that China has turned to wind power, solar power and nuclear power massively recently, but the task of achieving a 40% reduction is enormous. China evidently hopes to respect its COP21 commitments while still enjoying an economic growth rate of above 5%, but it is realistic? New coal plants have actually been opened recently, replacing out-dated old ones in order to propel growth.

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 like the rich Gulf States cut most or the biggest aggregate polluters, like emerging economies China, India and Indonesia for instance? At COP21 this issue about redistribution was resolved by the creation of a super fund to assist energy transition and environment protection in developing counties, as proposed early by economist Stern (2007)

***Thailand***

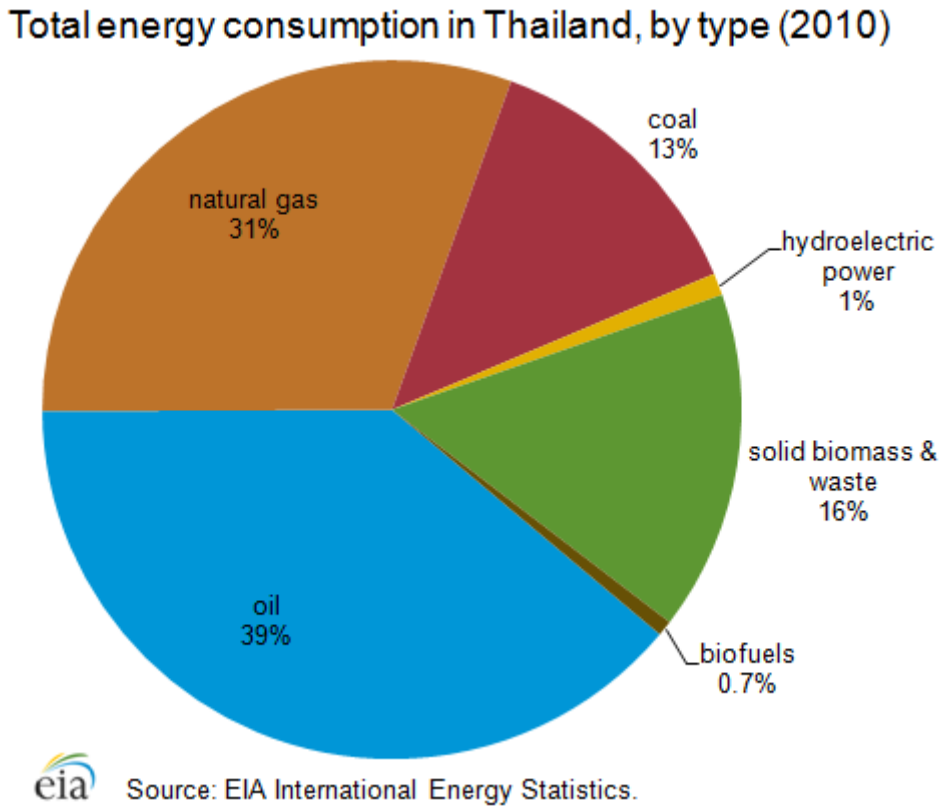
One may guess correctly that countries that try hard to "catch-up" will have increasing emissions. This was true of China and India. Let us look at three more examples: Thailand, Malaysia and Iran – all emerging economies. Figure 4 begins with Thailand that has become a major car producer.

**Figure-4.** Thailand ($y = 1{,}07x$, $R^2 = 0{,}96$)



The CO2 emissions in Thailand are quite high, reflecting the economic advances in South East Asia. The trend is up and up. Can it be reversed without serious economic impact? Figure 5 shows the energy mix of this dynamic country, economically.

**Figure-5.**

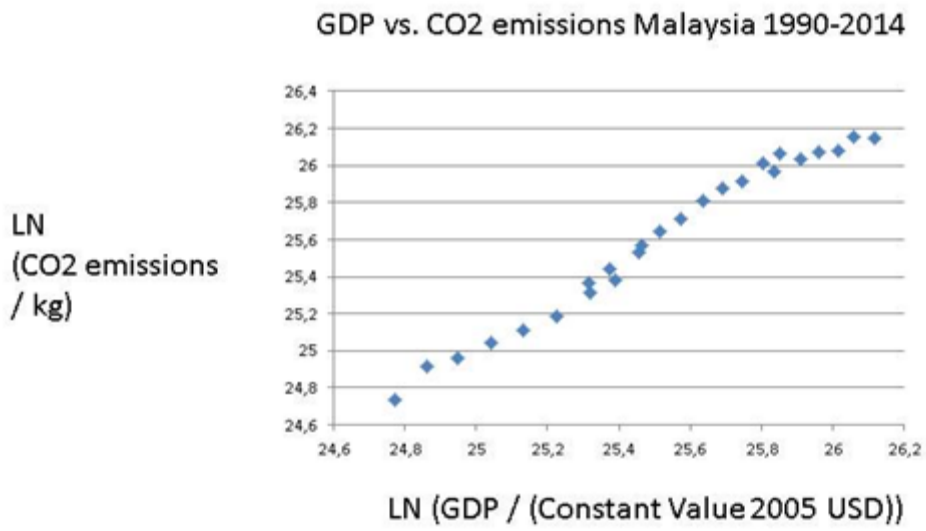



The reliance upon fossil fuels is high, or over 80% of energy consumption coming from the burning of coal, oil and natural gas. Hydro power is marginal, but bio-energy plays a major role, but it is really not carbon neutral. Thailand needs to come up with far-reaching reforms of its energy sector in order to comply with COP21 objectives.

***Malaysia***

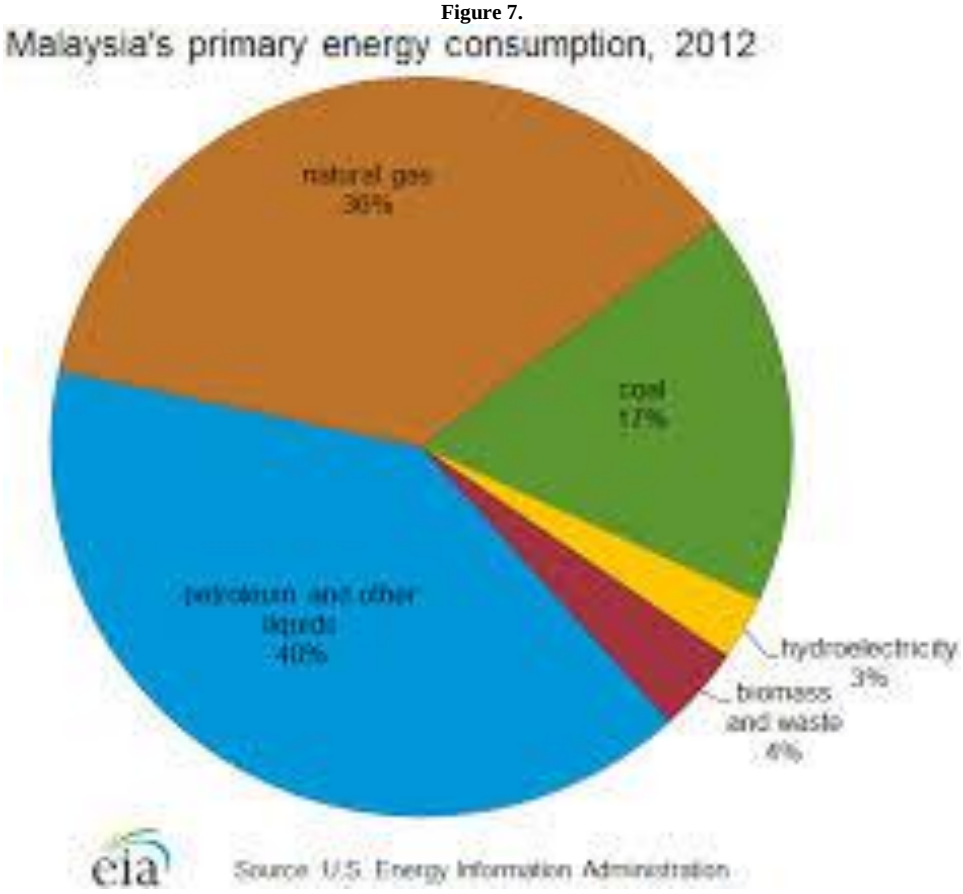
The overall situation – fossil fuels dependency – is the same for Malaysia as for Thailand. And the CO2:s are high, following the GDP trend (Figure 6).

**Figure-6.** Malaysia ($y = 1{,}13x$; $R^2 = 0{,}98$)




Yet, Malaysia employs energy of a very mixed bag (Figure 7), but still its emissions augment in line with economic development. There may be a planning out of the growth trend in emissions recently, but Malaysia use very little of carbon neutral energy sources. There is hydro power, but the country must move to solar and wind power rapidly.

**Figure 7.**

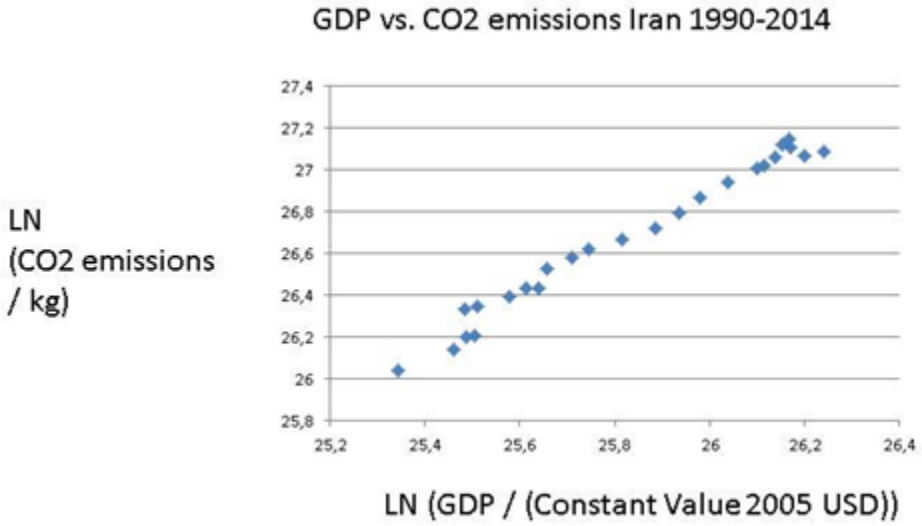



Renewables are not a major element in the energy consumption mix of Malaysia, as fossil fuels dominate, but not coal luckily.

***Iran***

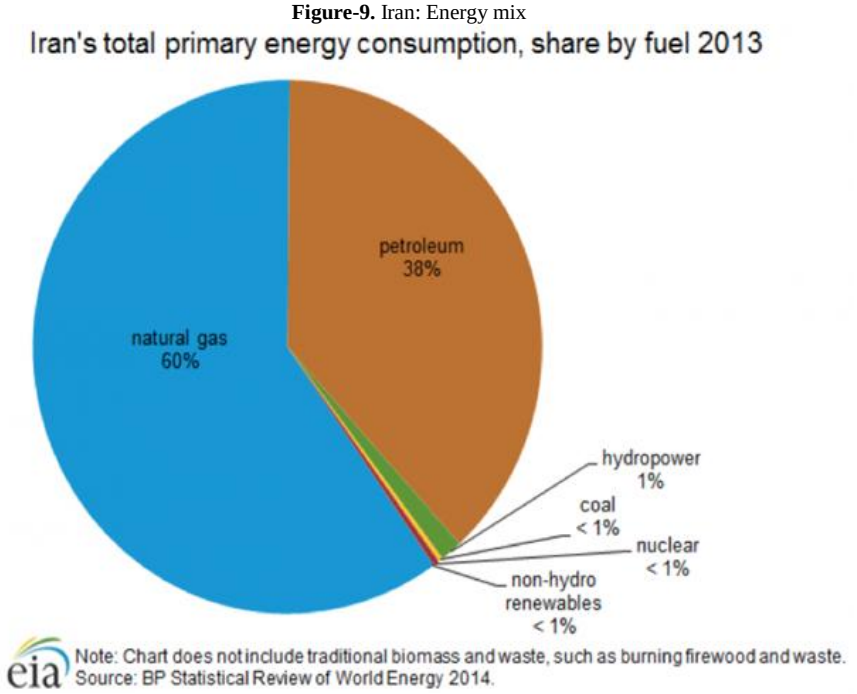
Countries may rely upon petroleum and gas mainly – see Iran (Figure 8). CO2 emissions have generally followed economic development in this giant country, although there seems to be a planning out recently, perhaps due to the international sanctions against its economy.

**Figure 8.** Iran: GDP-CO2 ($y = 1{,}2229x - 4{,}91$; $R^2 = 0{,}98$)




Iran is together with Russia and Qatar the largest owner of natural gas deposits. But despite using coal in very small amounts, its CO2 emissions are high. Natural gas pollute less than oil and coal, but if released unburned it is very dangerous as a greenhouse gas. Iran relies upon its enormous resources of gas and oil (Figure 9).

**Figure-9.** Iran: Energy mix

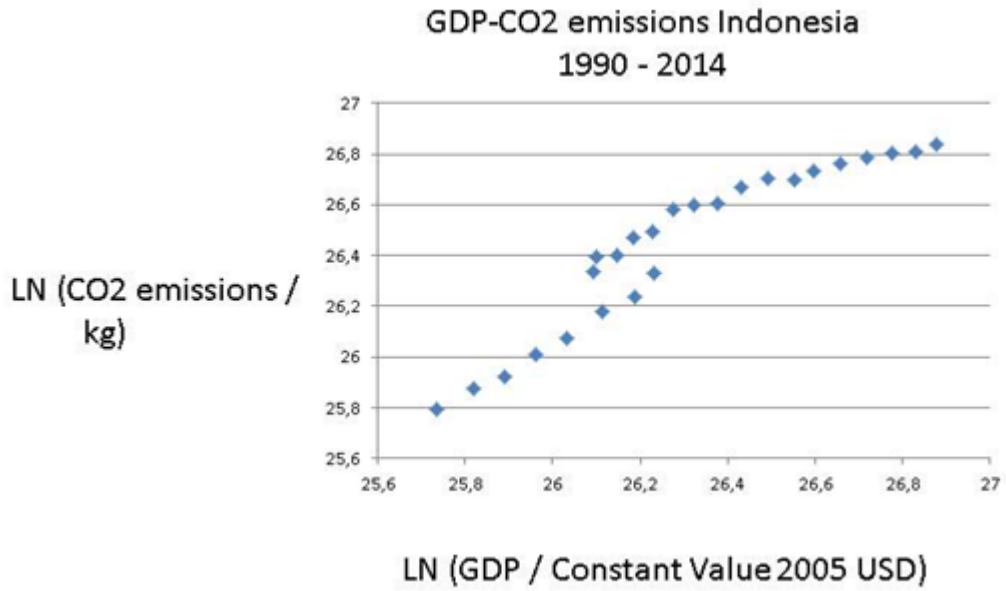



Iran needs foreign exchange to pay for all its imports of goods and services. Using nuclear power at home and exporting more oil and gas would no doubt be profitable for the country.

***Indonesia***

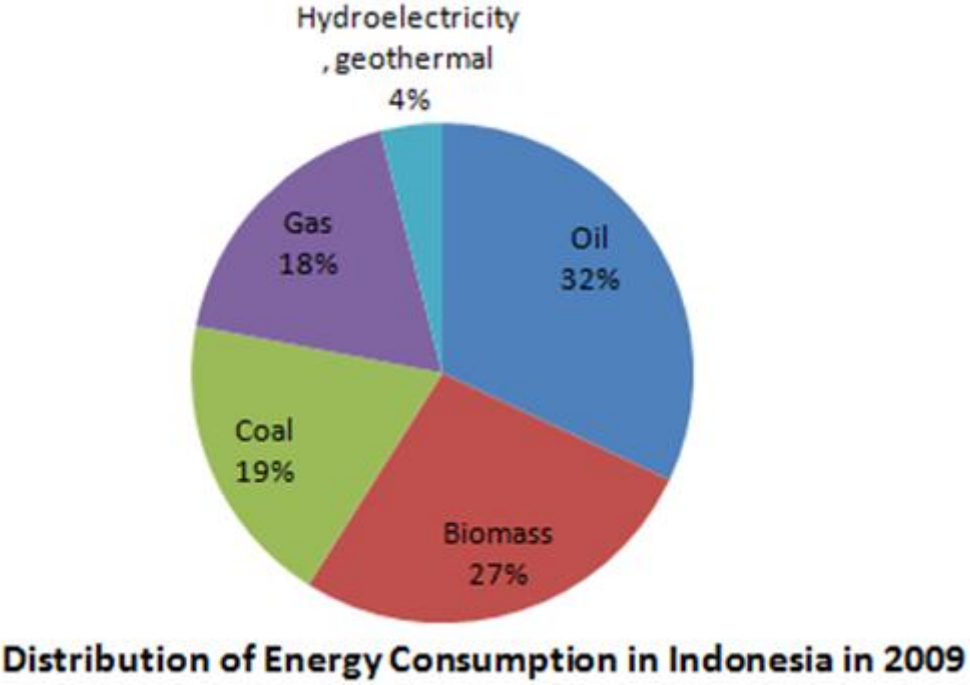
One may guess correctly that countries that try hard to "catch-up" will have increasing emissions. This was true of China and South East Asian countries. Let us look at three more examples, like e.g. giant Indonesia – now the fourth largest emitter of CO2:s in the world (Figure 9).

**Figure-9.** INDONESIA: LN (CO2 / Kg and LN (GDP / Constant Value 2005 USD)




Indonesia is a coming giant, both economically and sadly in terms of pollution. Figure 9 reminds of the upward trend for East Asia. However, matters are even worse for Indonesia, as the burning of the rain forests on Kalimantan and Sumatra augments the CO2 emissions very much. Figure 10 presents the energy mix for this huge country in terms of population and territory.

**Figure-10.** INDONESIA: Energy mix




**Source:** (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. One can be sure that it is mostly a question of tradition renewables – wood, charcoal – and they pollute a lot.

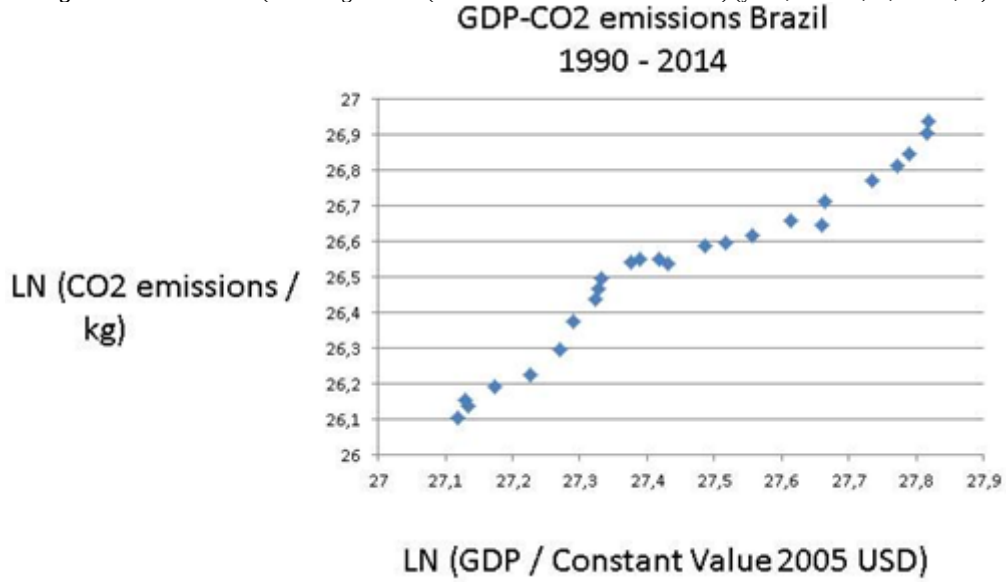
## 6. Emerging Economies in Latin America

One may pick the two countries with the largest CO2 emissions, Brazil and Mexico, to show that completely different energy mixes may still result in a close match between GDP and CO2:s.

***Brazil***

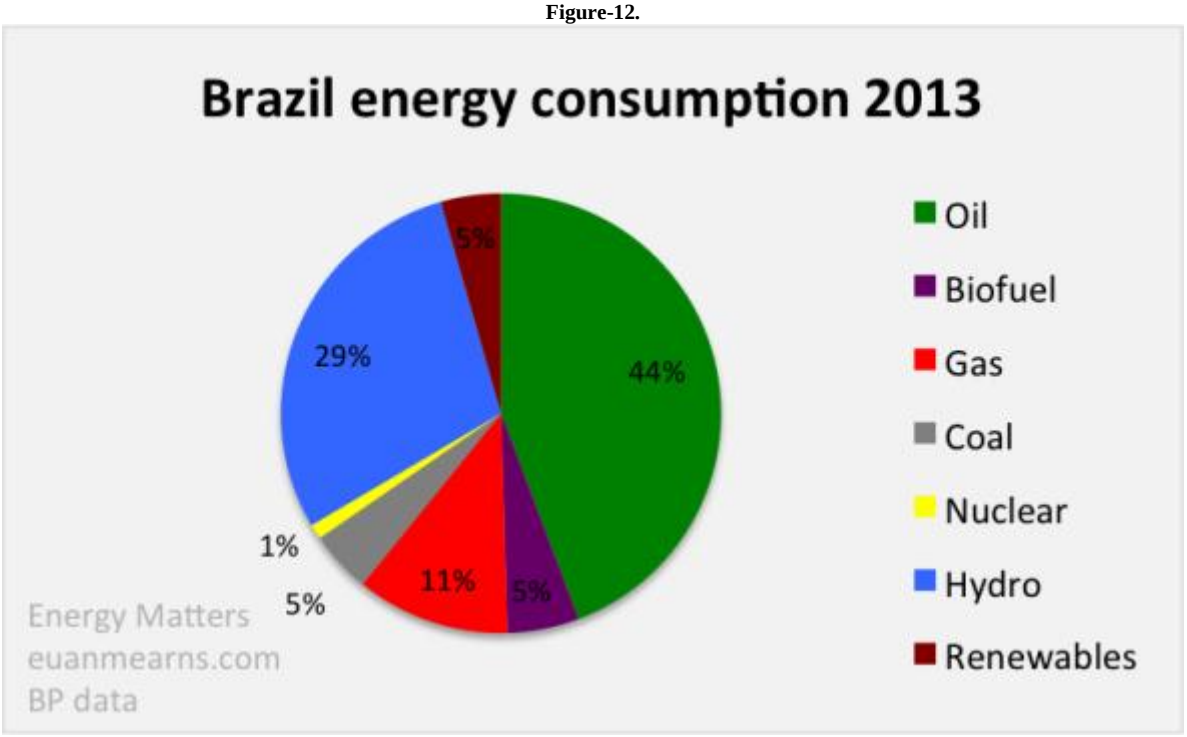
Let us now look at the ethanol country *par preference*: Brazil. Figure 11 shows a considerable levelling out of total emissions, but it is followed by huge increases, mirroring the GDP development.

**Figure-11.** BRAZIL: LN (CO2 / Kg and LN (GDP / Constant Value 2005 USD) (y = 1,029x - 1,72; $R^2$ = 0,95)




Brazil employs most modern biomass in the world - ethanol, but the emissions stay at a very high level, which is a reminder that renewables may also lead to CO2: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. Yet, global warming reduces the potential of hydro power, and Brazil has very little nuclear power (Figure 12). 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.

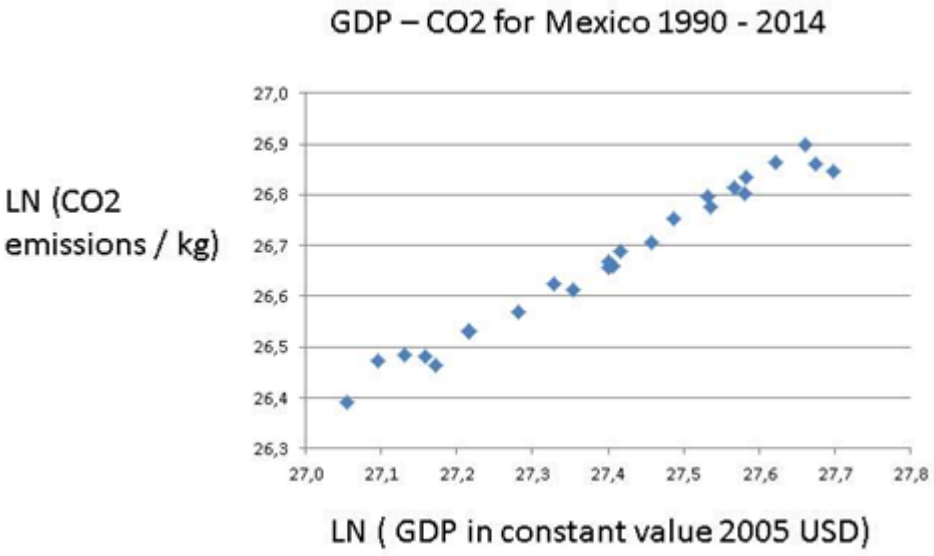
**Figure-12.**




***Mexico***

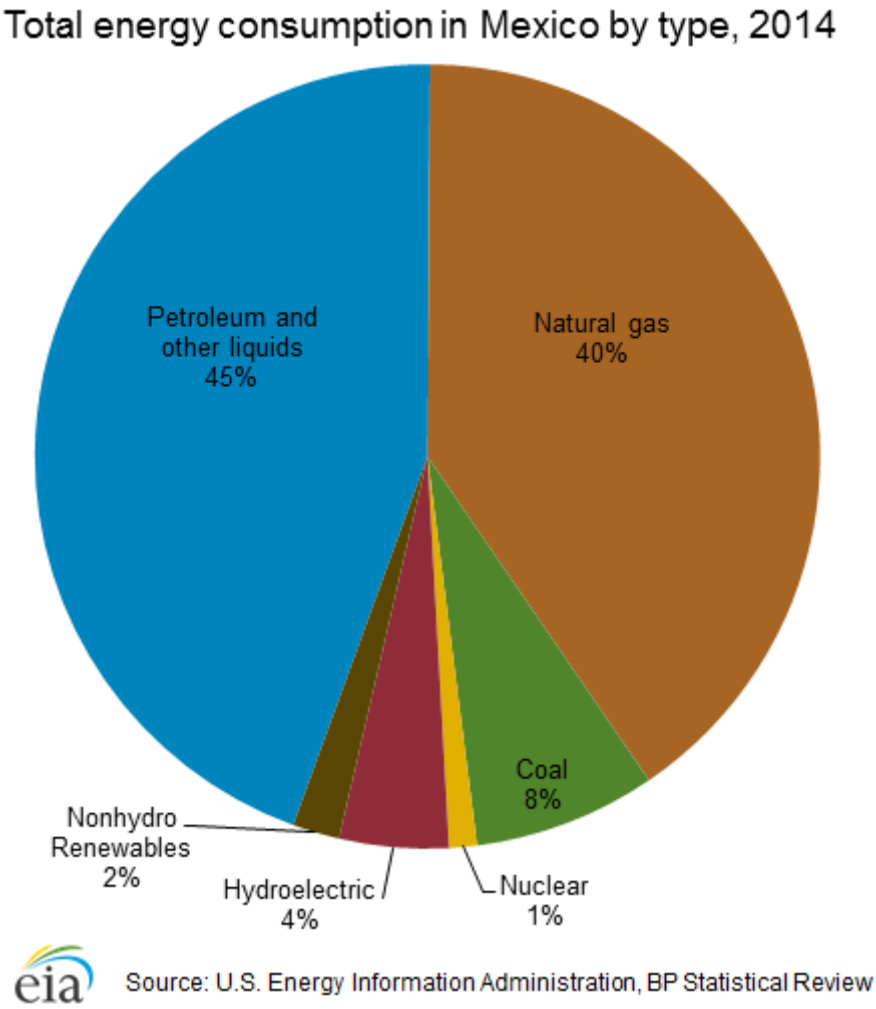
One would expect to find huge CO2 emissions in this large emerging economy with lots of oil production. Countries like the Gulf States have massive CO2:s because they drill and refine oil and natutal gas. For Mexico holds the following situation (Figure 13).

**Figure-13.** GDP-CO2 in Mexico (y = 0,77x; $R^2$ = 0,98)




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

**Figure-14.** Energy mix for Mexico




Few countries are so deependent upon fossil fuels as Mexico (Figure 14). One find the same patter with the oil exporting Gulf States. The Mexican government must start now to reduce this dependency, by for instance eliminating coal and bringing down petreoleum, instead betting upon solar, wind and nuclear power. Mexico will face severe difficulties with the 40% reduction target in COP21. It has a fast growing population with many in poverty and an expanding industry sucking electricity. Can economic growth and decarbonisation go together here?

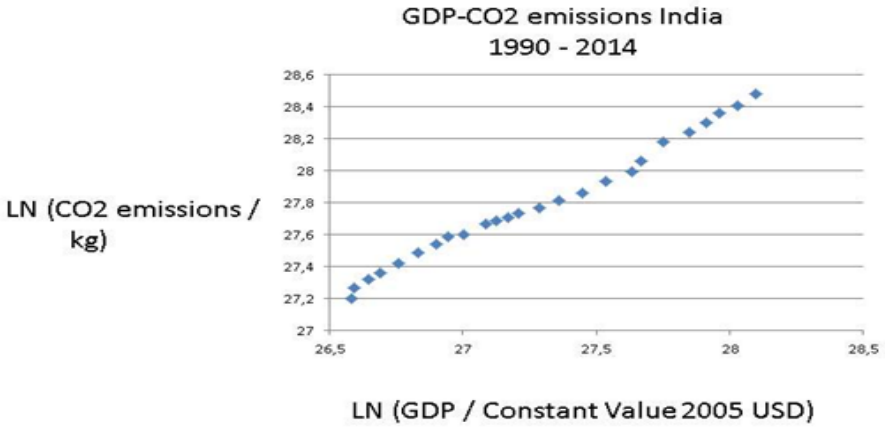
## 7. Poor Societies

I believe most "*emerging economies*" rely much upon fossil fuels, like the examples above or like Algeria, Egypt and South Africa. Bur how about some "*poor economies*"?

***India***

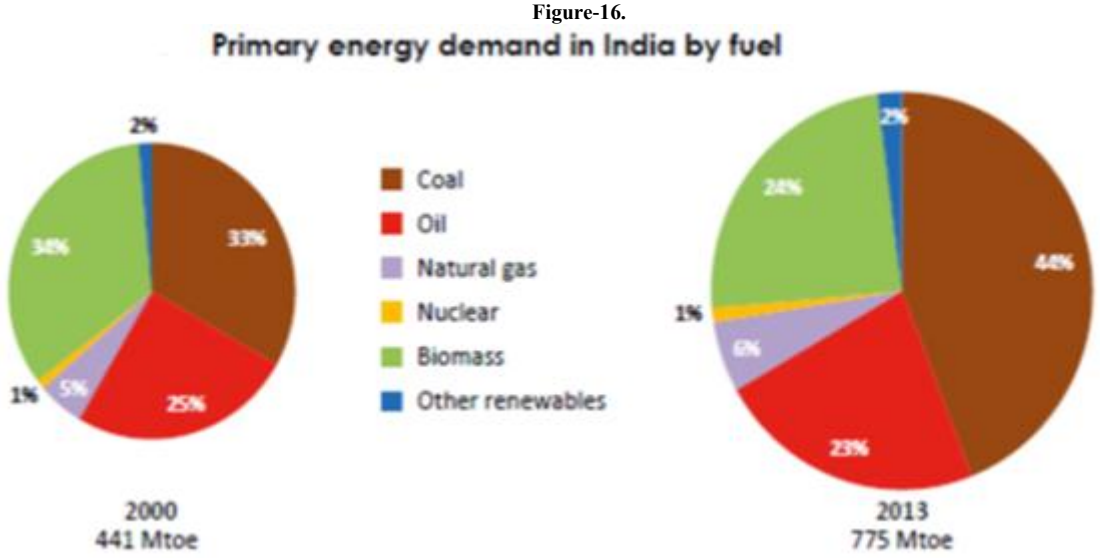
India is even more negative than China to cut CO2 emissions, as it is in an earlier stage of industrialization and urbanization. Figure 15 shows the close connection between emissions and GDP for this giant nation.

**Figure-15**. INDIA: LN (CO2/ Kg and LN (GDP / Constant Value 2005 USD)



India needs cheap energy for its industries, transportation and heating as well as air-conditioning (Figure 16), meaning it aims strongly at electrification. From where will this power 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 7 shows its energy mix where renewables play a bigger role than in China. However, the renewables in India may lead to deforestation and considerable pollution.

**Figure-16.**

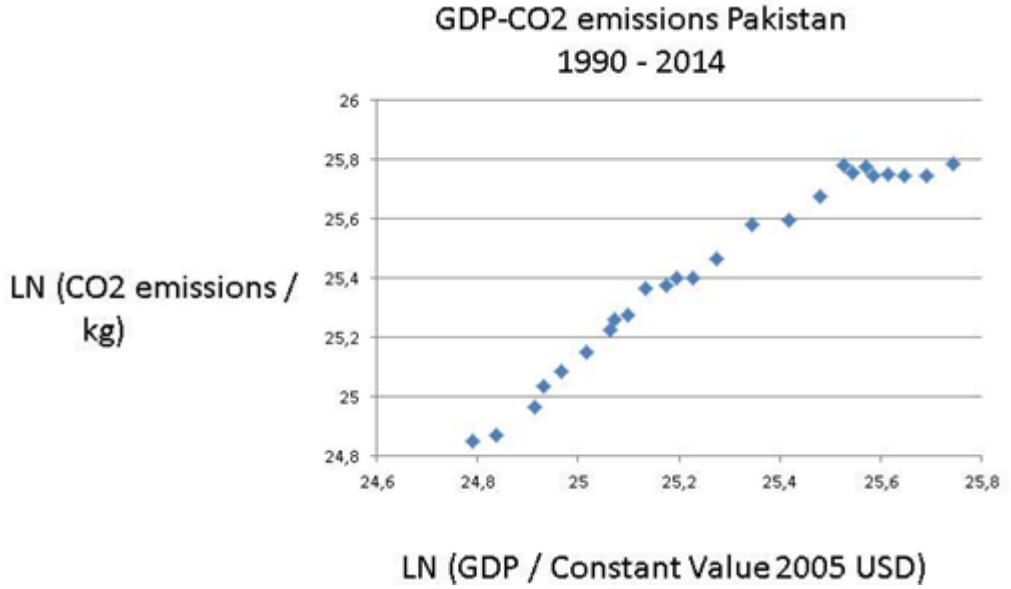



Source: http://www.eia.gov/beta/international/analysis.cfm?iso=IND

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 much 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 – water shortages - and nuclear power meets with political resistance. Interestingly, India uses much biomass and waste for electricity production, which does not always reduce CO2 emissions. India's energy policy will be closely watched by other governments and NGO:s after 2018. The constant tension between the demand for economic growth on the one hand and environmental protection on the other hand is sharply portrayed in Ramesh (2015).

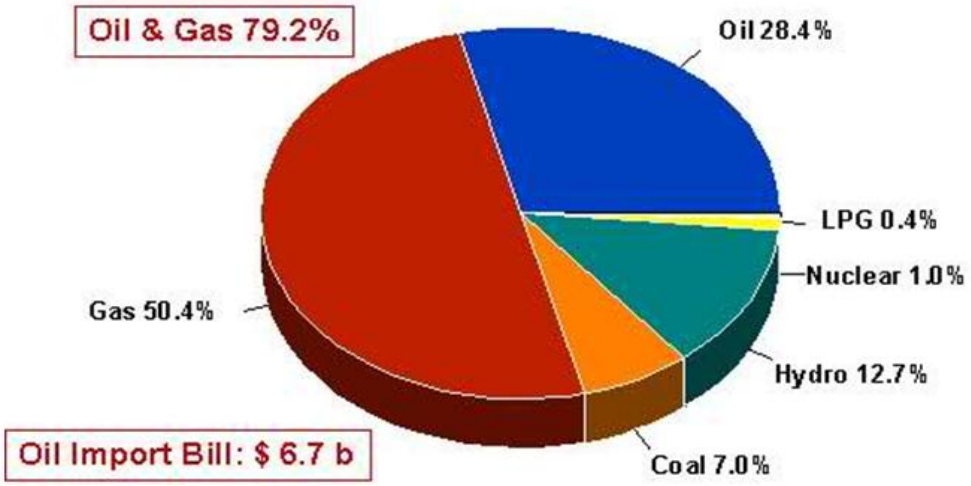
The same upward trend holds for another poor developing country with huge population, namely Pakistan (Figure 17).

**Figure-17.** PAKISTAN: LN (CO2 / Kg and LN (GDP / Constant Value 2005 USD) (y = 1,05x - 0,97; $R^2$ = 0,96)




The amount of CO2 emissions is high for Pakistan, viewed as aggregate. Pakistan is mainly reliant upon fossil fuels, but not coal among them (Figure 18). Actually, it has a rather mixed bag of energy sources.

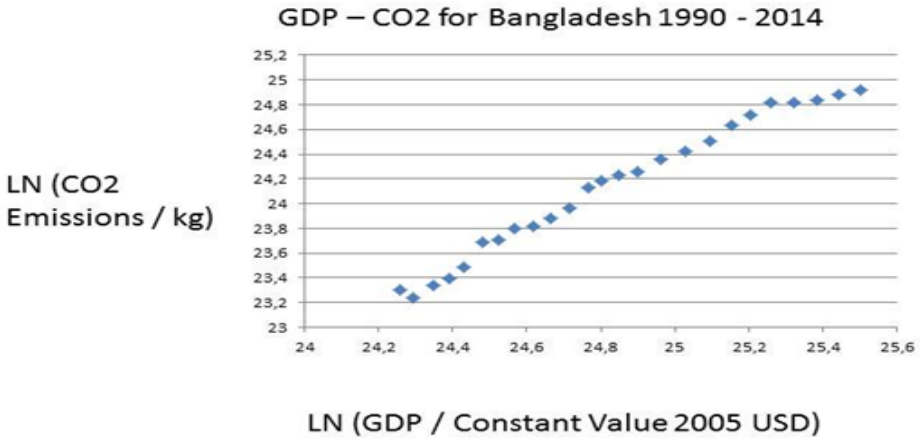
**Figure-18.** Pakistan Energy Consumption 2009 (by ShoXee: http://i27.tinypic.com/2h6cyag.jpg)




But Pakistan employs a considerable portion of hydropower – 13 per cent – and a minor portion of nuclear power. Can it further develop nuclear and hydro power, or start using solar power on a large scale

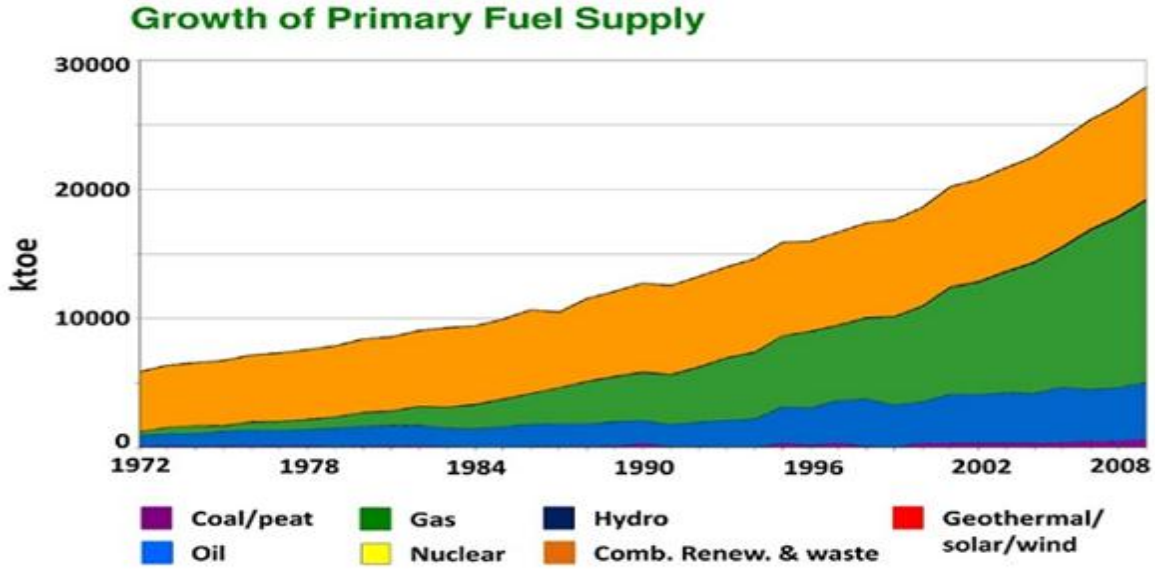
Moving on to another giant nation in South Asia, Bangladesh, we find an entirely different set of conditions for implementing COP21. Figure 19 shows that the major GHC of CO2:s follows economic development closely.

**Figure-19.** Bangladesh (y = 1,43x , $R^2$ = 0,98)




Yet energy consumption is based on a different energy mix, compared with India. Figure 20 pins down the large role of traditional renewables like wood, charcoal and dung as well as the heavy contribution of oil and gas. Bangladesh needs external support for developing modern renewables, like solar, wind and geo-thermal power sources.

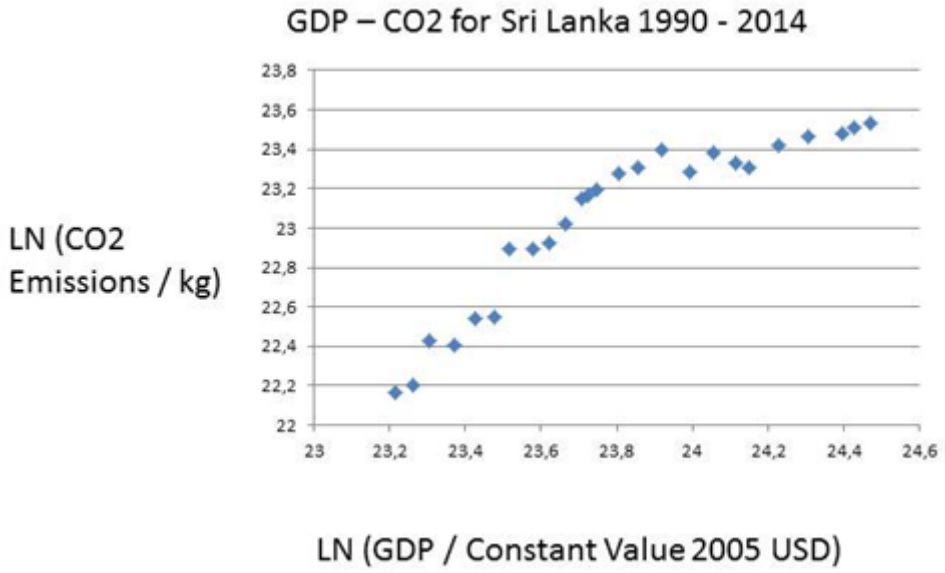
**Figure-20.**




**Source:** Energy Scenario in Bangladesh from 1972-2008 (Orange: Biomass, Green: Gas, Blue: Oil)

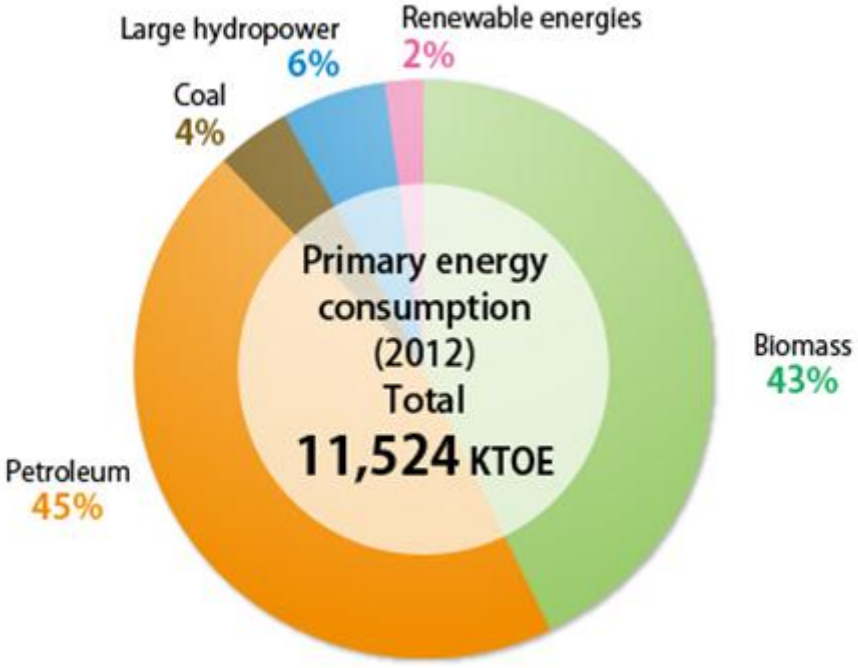
When examining small but populous Sri Lanka, one sees again the strong connection between GDP and CO2:s – see Figure 21. It seems that the CO2:s was halted in their expansion for some time, but now they increase again.

**Figure-21.** Sri Lanka (y = 1,03x, $R^2$ = 0,84)




In this island state, the dominant energy source is traditional renewables, which leads to deforestation and CO2 emissions on a large scale (Figure 22). It has been argued that the forest will grow up again, eating the carbon emissions. But it is mainly wishful thinking, as climate change and draughts make forest rehabilitation difficult.

**Figure-22.** Sri Lanka




**Source:** Primary energy consumption in Sri Lanka (2012);http://www.info.energy.gov.lk/

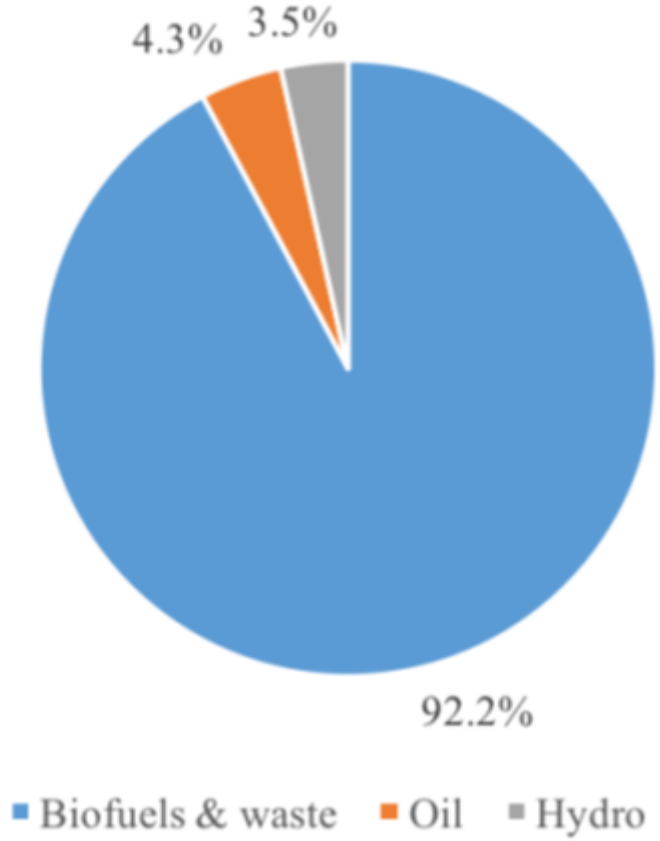
## 8. Traditional Renewables in Poor African Countries

A general teent in the climate change debate is that renewables should be preferred over non-renewables. Yet, this statement must be strictly modified, as there are two fundamentally different renewables:

1. Traditional renewables: wood, charcoal and dung. They are not carbon neutral. On the contrary, employing these renewables results in severe pollution, not only outside but also insidea household;
2. New renewables: solar, wind, geo-thermal and wave energy that are indeed carbon neutral, at least at the stage of functioning.

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

**Figure-23.** DR KONGO

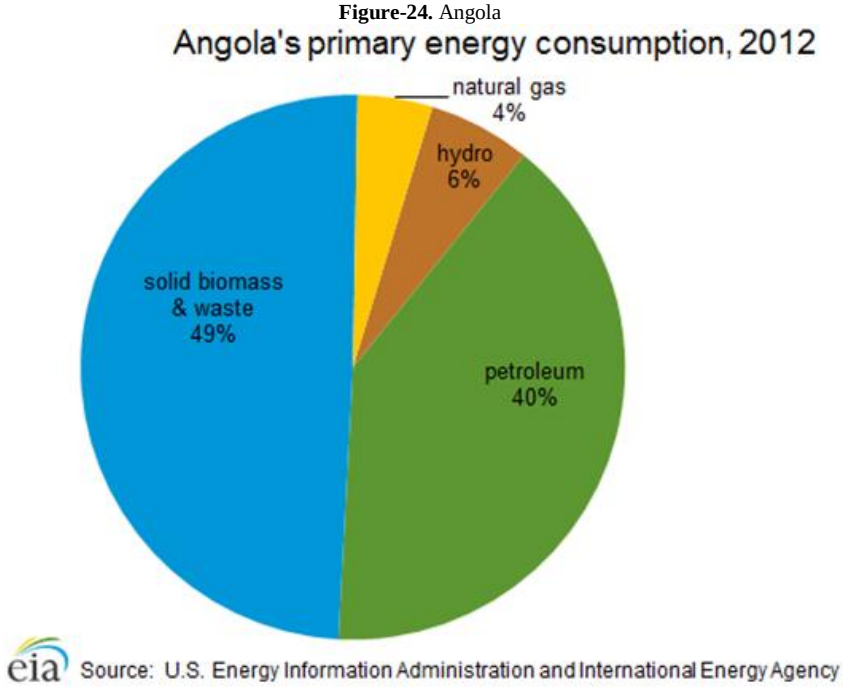



**Source:** Democratic Republic of Congo - Energy Outlook, Kungliga Tekniska Hogskolan

One notes how little of hydro power has been turned into electricity in Kongo, but economic development and political instability, civil war and anarchy do not go together normally. At the same, one may argue that an extensive build-up of hydro power stations would pose a severe challenge to the fragile environment in the centre of Africa. Kongo can now move directly to modern renewabes like solar power.

This enormous reliance upon traditional renewables is to be found also in Angola and Nigeria, although both have access to both hydro power and fossil fuels. Figure 24 describes the energy mix for Angola.

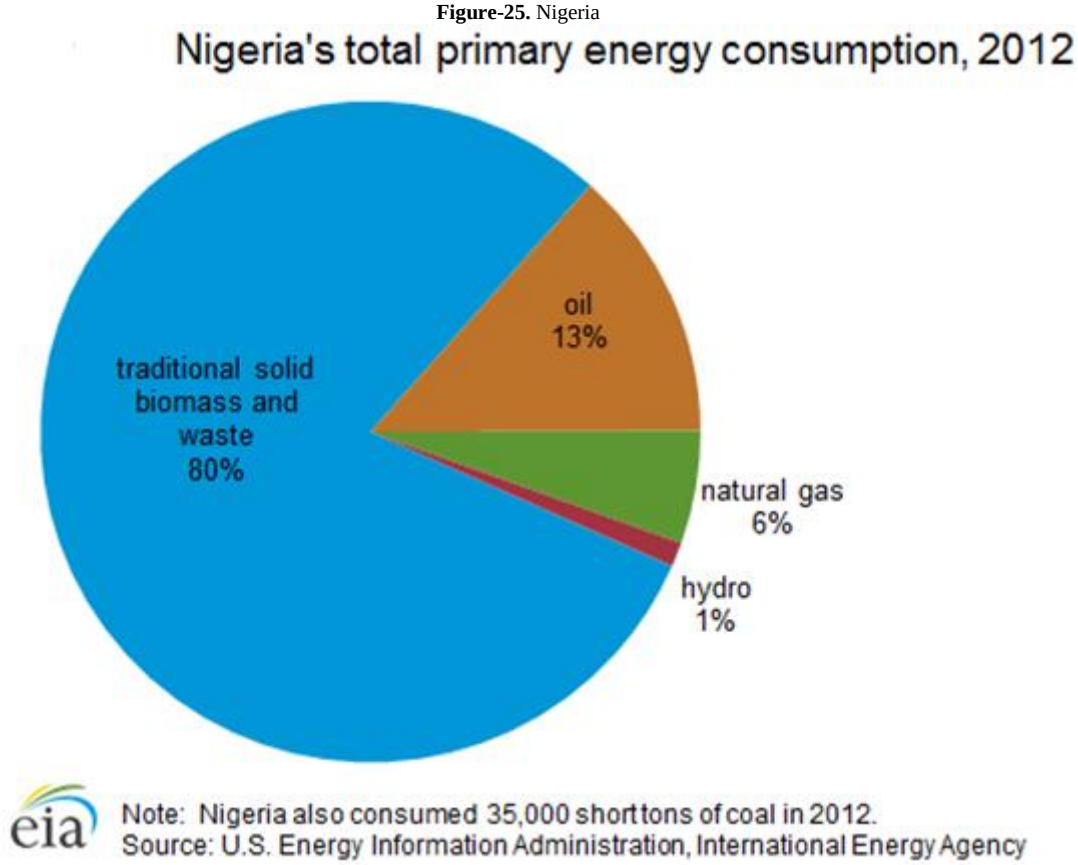
**Figure-24.** Angola




Angola like Kongo has suffered from long and terrible civi war. In the mass of poor villages, energy comes from wood, charcoal and dung – all with negative environmental consequences. Angola has immense fossil fuels – oil and

gas, but the political elit family may prefer to export these resources instead of using them for electricity generation. Giant Nigeria has a resembling energy mix – see Figure 25.

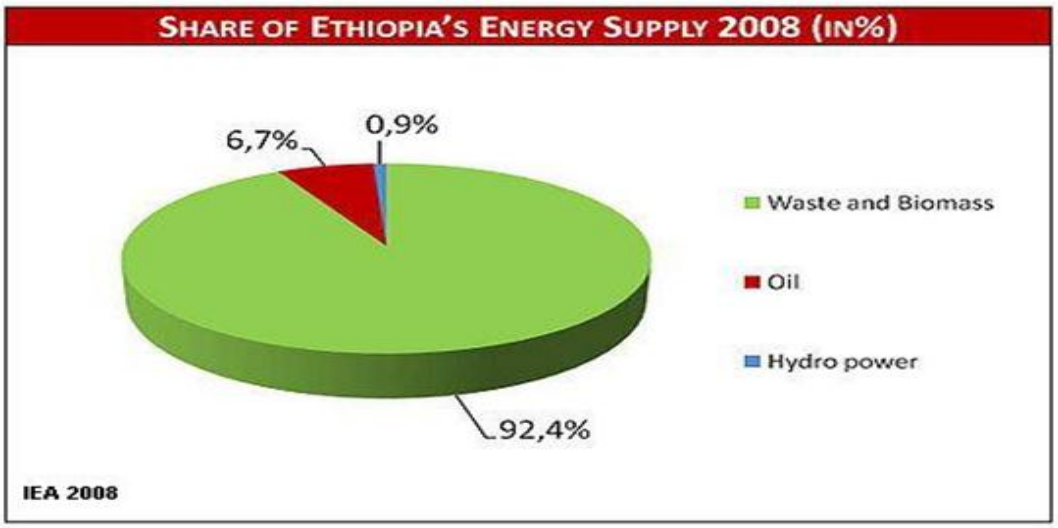
**Figure-25.** Nigeria




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

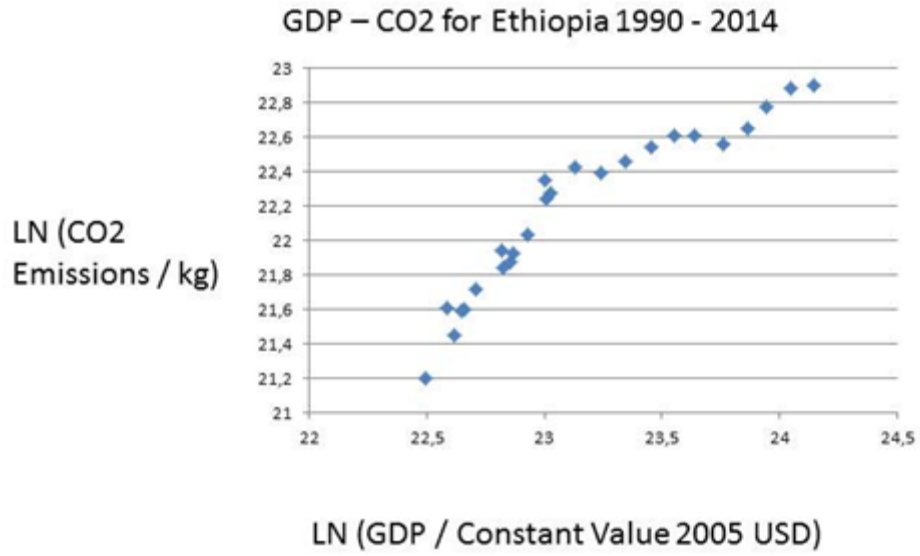
Surely, both Ethiopia and Sudan would want to utilise the great Nile river for their electricity consumption. However, Egypt wants to have a SAY over the energy planning of these two countries up the river. Thus, far many rounds of negotiations have resulted in the construction of only a few power plants, a few in Sudan (Merowe Dam, etc) and one another huge in Ethiopia – Grand Etiopian Renaissance Dam. The problem is the common pool of the Nile, where one country, Egypt, may find that the water level has shrunk too much for its own needs, electricity or irrigation. Actually, the risk of draughts is a real one for all countries trying to exploit the Nile. Sudan is dismally poor with deep-seated internal conflicts ethnically. How to move to large solar panel plats in a country with so much political innstabilyi resulting huge numbers of death from domestic violence? The reliance upon traditonal renewables is so high in neighbouring Ethiopia that electrification must be very difficult to accomplish over the large land area. Figure 26 displays a unique predicament.

**Figure-26.** ETHIOPIA: Energy mix



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

**Figure-27.** Ethiopia: GDP and CO2: y = 0,90x, R² = 0,88

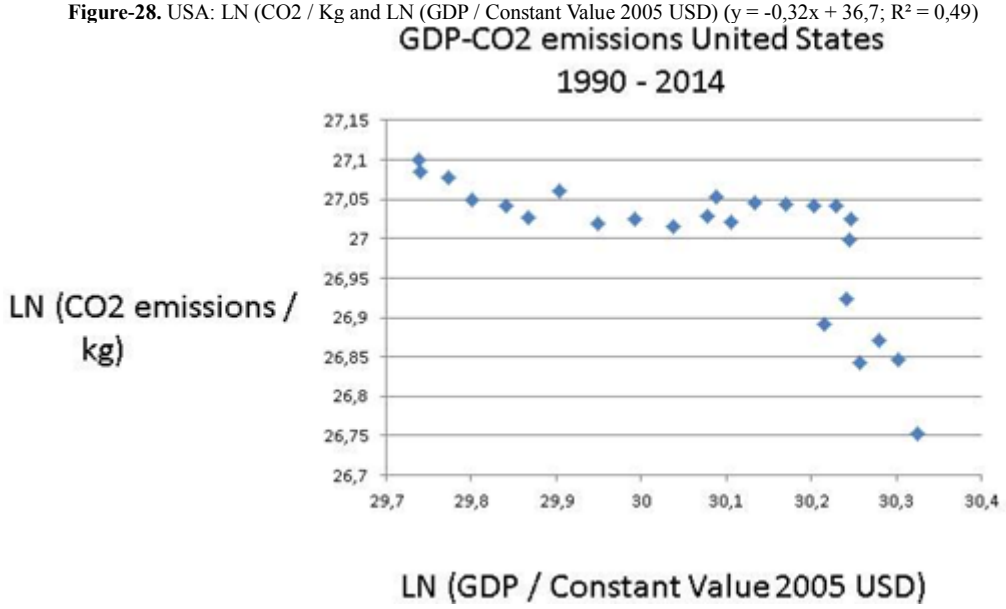



The zest with which Ethiopia is pursuing its control over water resources becocomes flly understandable, when Figure 27 is consulted. Whar we aee is the same smooth linear function plotting CO2:s upon GDP, as is obvious in countries based upon fossil fuels – see below. For Ethiopia, to comple with COP21 goals is goint to pose major challenges, especially if economic development is not going to be reduced. The country needs massive help, both finacially ad technologically.

## 9. Mature Economies

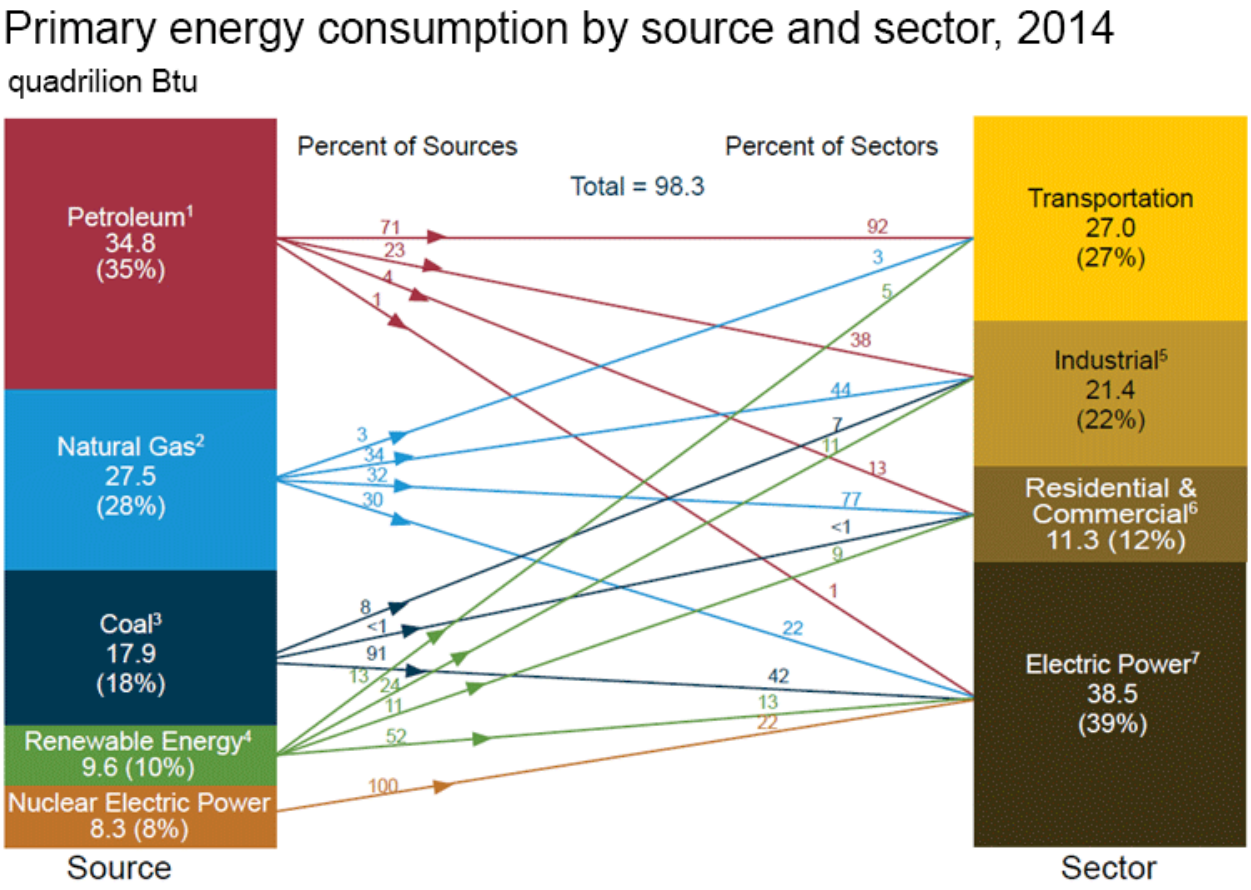
For most countries hold that their emission of CO2:s increases, as well as augments with the GDP. However, there are a few notable exceptions of decreases that are worth mentioning, i.e. among the mature economies. We start with the US (Figure 28).

**Figure-28.** USA: LN (CO2 / Kg and LN (GDP / Constant Value 2005 USD) (y = -0,32x + 36,7; R² = 0,49)




Recently, the level of CO2 emission has been reduced significantly in the US. It reflects no doubt partly the economic crisis that began 2007, but the US remains the second largest polluter in the world. The reduction reflects that the US can draw upon a mixed bag of energies including nuclear and hydro power, with solar power expanding rapidly (Figure 29). Per capita CO2:s is of course very high for the USA. As the economy now starts to accelerate, emissions are bound to go up again, unless solar power stations multiply dramatically over the country.

**Figure-29.** Energy mix in the US




Endnotes:
[1] Does not include biofuels that have been blended with petroleum—biofuels are included in "Renewable Energy."
[2] Excludes supplemental gaseous fuels.
[3] Includes less than -0.1 quadrillion Btu of coal coke net imports.
[4] Conventional hydroelectric power, geothermal, solar/photovoltaic, wind, and biomass.
[5] Includes industrial combined-heat-and-power (CHP) and industrial electricity-only plants.
[6] Includes commercial combined-heat-and-power (CHP) and commercial electricity-only plants.
[7] Electricity-only and combined-heat-and-power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public. Includes 0.2 quadrillion Btu of electricity net imports not shown under "Source."
Notes: Primary energy in the form that it is first accounted for in a statistical energy balance, before any transformation to secondary or tertiary forms of energy (for example, coal is used to generate electricity). • Sum of components may not equal total due to independent rounding.
Sources: U.S. Energy Information Administration, Monthly Energy Review (March 2015), Tables 1.3, 2.1-2.6.

The US is still heavily dependent upon fossil fuels, or some 80 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 CO2:s may meet with firm resistance from the Republican House of Congress, which may oppose the COP21 Agreement. However, solar power should be attractive in many US states, both in micro use in households and large plant use.

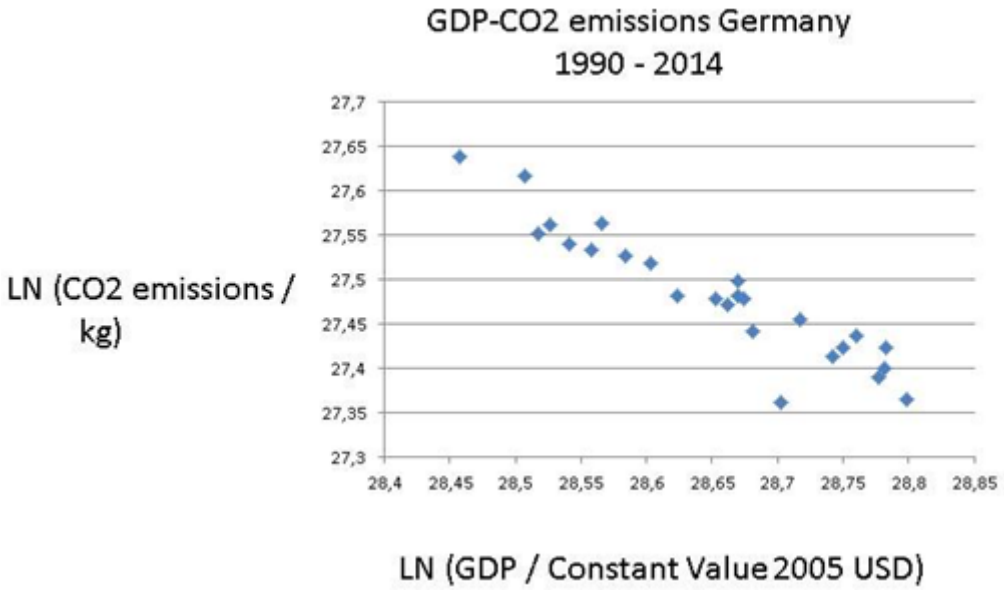
The advent of shale oil and gas has changed the entire energy markets, lowering the price of oil most substantially. This implies not only that there will be no Hubbert peak oil for the world, but also that switching to renewable energy source will be extremely expensive, relatively speaking compared 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 in a wide sense is extremely 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 fuels.

***Germany and France***

Another interesting country is the largest EU economy, namely Germany. Figure 30 shows a marked decrease in CO2 emissions.

**Figure-30**. GERMANY: LN (CO2 / Kg and LN (GDP / Constant Value 2005 USD) (y = -0,69x + 47,3; $R^2$ = 0,88)



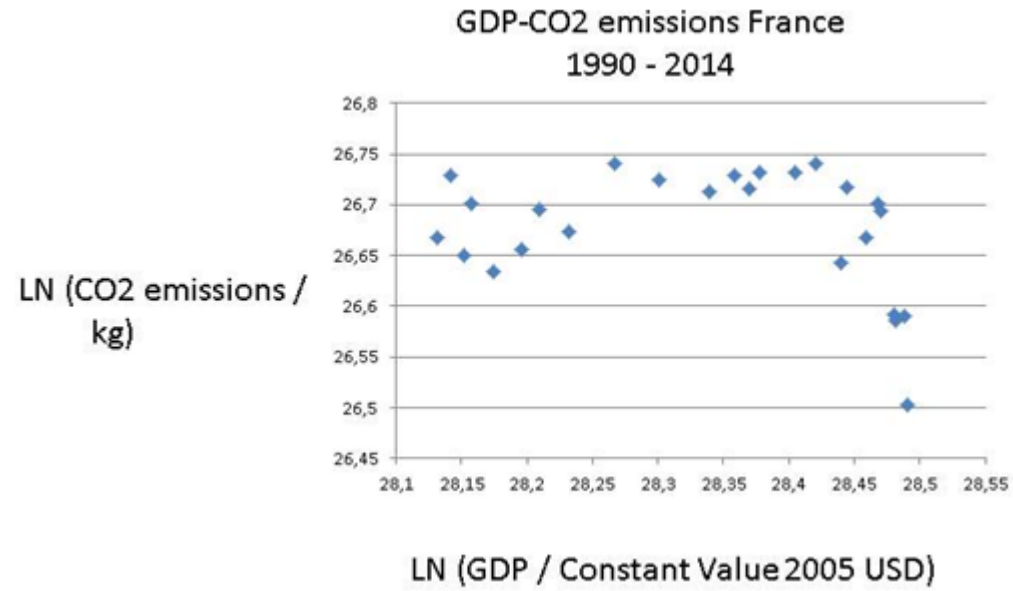

The German data shows an impressively consistent decreasing trend, which is not to be found with many countries, if at all. How come that Germany has succeeded in a short time span to reduce CO2:s? Germany needs massive amounts of energy for industry and transportation, but it has decided to phase out nuclear power. Can really the domestic employment of renewables satisfy this giant's demand for electricity (Figure 22)? German energy policy – *ENERGIWENDE* – is spectacular comparatively speaking, but it also appears risky indeed.

It is true that nuclear power and renewables has made it possible for Germany to decrease its CO2:s much, but the country is still dependent upon fossil fuels, especially coal and oil – almost 60%. What will happen with the nuclear power stations are phased out in 2022 is that most likely the CO2 emissions will start going up again. To replace nuclear power with solar and wind power on a truly massive scale will be difficult to say the least. Already, Germany uses more coal from Columbia and gas from Russia.

The German energy policy is causing much stir, because the losers – nuclear industry and coal power interests – want compensation that will run into billions of dollars, if not more.

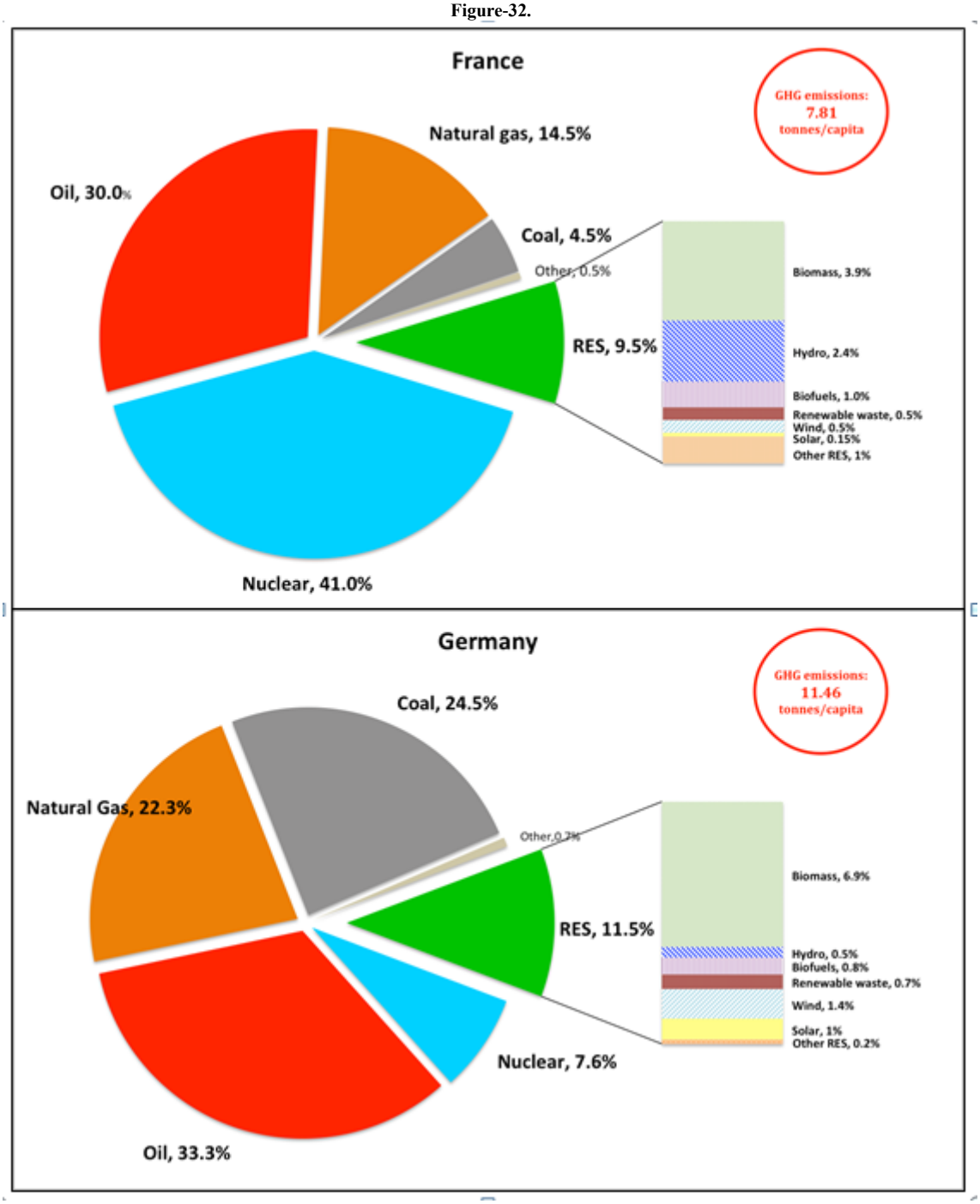
Interestingly, also France has like Germany managed decarbonisation to some extent (Figure 31). It reflects its unique energy mix, relying much upon nuclear power in a comparatively unique way.

**Figure-31. France** (y = -0,13x + 30,4; $R^2$ = 0,08)




Yet, France has decided to diminish its reliance upon nuclear power. But how will it be replaced by other sources of energy? Figure 32 infroms about the reliance upon fossil fuels in France and Germany too.

**Figure-32.**




**Source:** http://blog.iass-potsdam.de/2015/05/energy-transition-france-following-in-germanys-footsteps/

As underlined, no other country in the world employs nuclear power to such an extent (Figure 32), allowing France to avoid lost of CO2:s. But the Green movement's criticism of nuclear power is based upon entirely different argument than the wish to decarbonise economy and society. Actually, doing both – decarbonisation and de-nuclearisation – may prove difficult for France. The French energy sector – EDF and AREVA – has suffered immensely from lower energy prices and scepticism about nuclear power, requiring massive state support.

## 10. Conclusion

The findings from this small comparative research into the conditions for implementing the COP21 objectives for all countries in this century shows that it is doubtful whether global ecology governance can pull this effort off. Concerning the key objectives, we find:

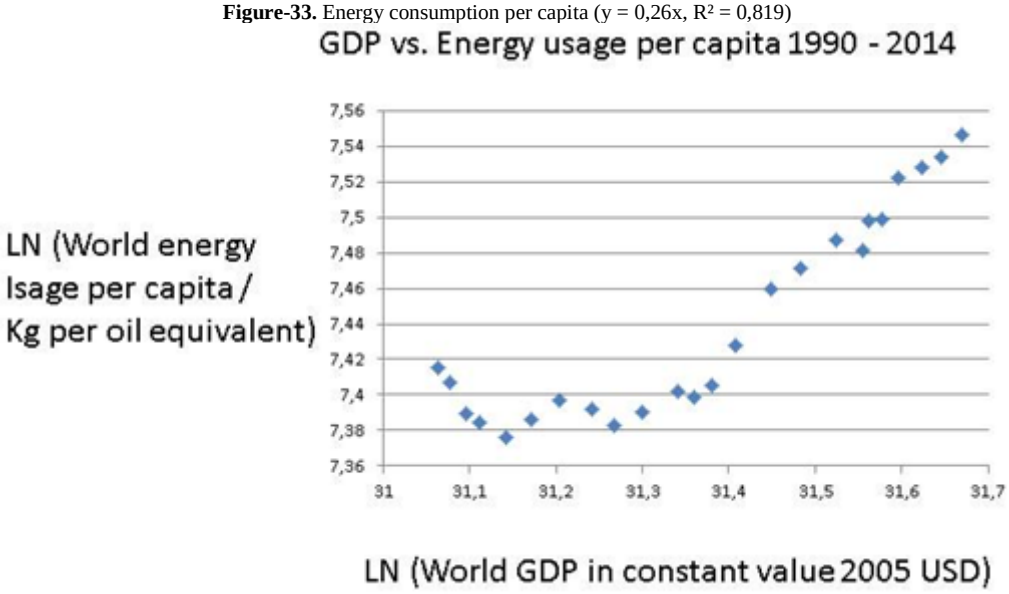
1. Halting CO2 increases by 2020 will be hard to come by for emerging and poor economies; their populations are growing dramatically with increased demand for electricity and petroleum. Most poor nations rely upon traditional renewables, which produce CO2:s.
2. Hydro power may be punished by global warming itself, as rivers dry out and glaciers melt away. Atomic power is feared, which fear is often exploited politically.

3. Mature economies can certainly reduce their dependency upon fossil fuels even more, but turning to solar, wind and geo-thermal power sources requires huge investments and lots of land.
4. Exploiting biomass, one must always remember that only modern biomass reduces CO2s. But how about food to human beings?

It is quite obvious that the so-called Third World needs massive financial assistance to reduce CO2:s by 40 per cent in a short span of some 10 years. The ultimate of a carbon free economy, or "sustainable development" (Sachs, 2015a;2015b) is a *figment of the imagination* of utopians. Energy is vital to all human efforts or to the survival of the human race. As human beings continue to grow fast, men and women cannot refrain from employing fossil fuels or traditional renewables, betting only upon solar, wind and geo-thermal energy or water and atomic power, at least not within the short-time span of COP21.

Energy is the key in the global warming ptocess. It is expected to increaqse some 50-100 per cent dutin this century of uncertainty about the future of the human race. Energy with total decarbnisation not only in the FIRST but also the Thirld world+

**Figure-33.** Energy consumption per capita (y = 0,26x, R² = 0,819)




The world populaion keeps increasing and so the demand for energy. It looks very worrisome for the GHG emissions.

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