International Journal of Scientific Engineering and Science
Volume 1, Issue 12, pp. 74-81, 2018. ISSN (Online): 2456-7361

CLIMATE CHANGE POLICY IMPLEMENTATION: An Ocean PD Game

Jan-Erik Lane[1], Florent Dieterlen[2]
[1]Fellow with Public Policy Institute, BELGRADE; Address: 10 Charles Humbert, 1205 Geneva; 559 A, 3rd Floor, Thuya Street, 9th Quarter, Yangon. Myanmar
[2]Independent Scholar, Geneva

Abstract— *The UNFCCC's COP23 meeting in Bonn this fall failed to hand down an implementation plan or set of management strategies for putting the COP21 TREATY from Paris 2015 into practice. Global warming is picking up speed, but anti-global warming policy implementation is lacking, despite the fact that the chief objectives have been enacted. The problematic here is the nature of a common pool regime (CPR) like the COP21Agreement: it is an ocean PD (prisoner's dilemma) game. Here, we examine the defection option against the COP21 Treaty. Several nations may be tempted by reneging.*

Keywords— *Global decarbonisation, COP21 Treaty: Goal I, II and III, compliance against defection, common pool regime, PD game.*

I. INTRODUCTION

We face a cause for alarm, as information now tells us that China, the biggest emitter of CO2s, will not succeed to halt it's the rise in its CO2s in time. Instead, it counts upon some 3 per cent increases the nearest years – see Figure 1.

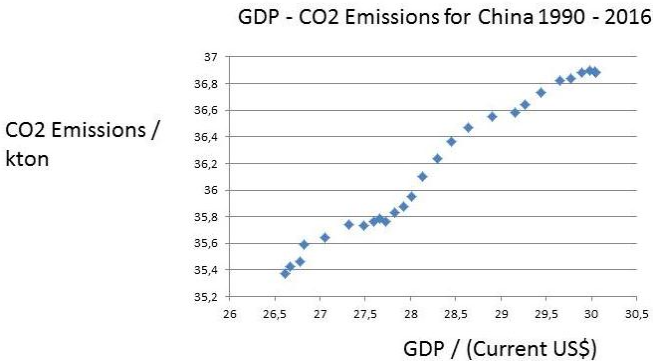

Fig. 1. China: GDP and CO2s: y = 0,46x, R² = 0,98

China has officially declared that it intends to meet both COAL I, halting the increase in CO2s by 2020, and GOAL II, reducing CO2s by some 30 per cent up to 2030. But promises and intensions are one thing, real life developments another matter – the gist of a PD game about promises and their fulfillment. All countries in this CPR can at any time renege, as the US has already done. If China too defects, then we have Hawking irreversibility, meaning climate change reaches a point of temperature rise making global warming unstoppable.

China promises to reduce is GHGs, especially the lethal pollution in Beijing. However, it also has great plans for future energy demands! It is true that China moves aggressively into new power sources: solar, wind and atomic power. Yet, its ambitions for air traffic, car markets and the New Silk Road are daunting.

II. GLOBAL DECARBONISATION

All countries in the world have formed a common pool regime (CPR) to save the atmosphere from more GHGs, focusing only upon the CO2s. The global decarbonisation plan includes: Halting the rise if CO2s by 2020 (GOAL I); Reducing the CO2s by 30-40% by 2030 (GOAL II); Complete decarbonisation by around 2075 (GOAL III); Decentralised implementation under international oversight, financial support and technical assistance. Only one country in the world – Uruguay – is near GOAL I and GOAL II. Some countries have lately had stalling or even decreasing CO2s, but many other remain on the upward sloping curve.

Globally, the energy-emissions conundrum stems from the necessity of consuming energy in all forms of economic activity in order to have affluence or welfare. There is a close link between GDP and CO2s over the recent decades (Figure 2).

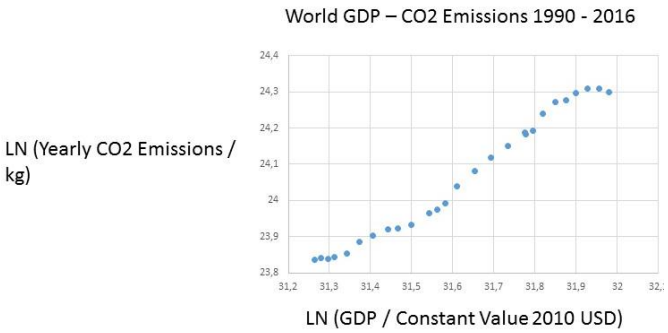

Fig. 2. Global GDP-CO2 link: y = 0,75x; R² = 0,98
Source: See references

Burning fossil fuels is today essential for both survival and wealth, being vital to poor and rich countries. If energy consumption is reduced, economic recession and mass poverty would follow rapidly as well as of course also unemployment writ large with social unrest. Planet Earth consumes simply far too much energy from burning the fossil fuels – see Table 1.

TABLE 1. Energy 2015 (Consumption in Million Tons of oil equivalent)

	Total	%
Fossil fuels	11306,4	86,0
Oil	4331,3	32,9
Natural Gas	3839,9	23,8
Coal	3839,9	29,2
Renewables	1257,8	9,6
Hydroelectric	892,9	6,8
Others	364,9	2,8
Nuclear power	583,1	4,4
Total	13 147,3	100,0

Source: BP Statistical Review of World Energy 2016

More energy gives higher economic growth but also more CO2s (Figure 3). If countries prioritize fossil fuels induced socio-economic development, they will defect in this ocean PD game of CPR as COP21, causing Hawking irreversibility.

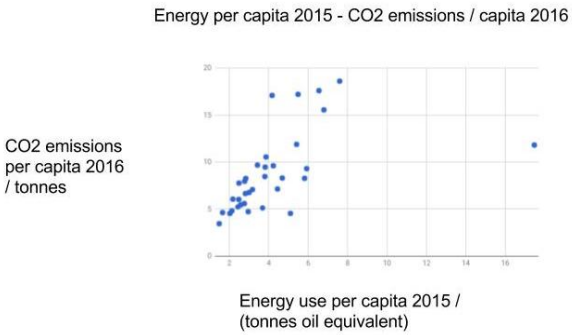

Fig. 3. Energy and CO2s per capita
Sources: see References

III. UNFCCC, IPCC AND G20 GROUP OF NATIONS

The UN bodies, the UNFCCC and the IPCC, have many meetings have huge participation, besides some 190 governments, drowning in massive transaction costs. After so many global meetings, an agreement was finally reached in 2015 – The Paris climate accord or COP21 Treaty. But the next two reunions failed to deliver anything. As of now, there is no plan for implementing the climate global accord, nor any management strategy or idea how to set up the *Super Fund* - 100 billion $ per year.

The adequate group of countries for handling decarbonisation is the G20 set of big nations, together with international shipping and international aviation responsible for some 80 of the CO2 emissions. Greenhouse gas emissions are huge in large state population wise with a medium to high affluence. In the G20 group of countries, we have *inter alia* China, India, Indonesia, Brazil, Saudi Arabia, Turkey, Iran, South Korea, Japan, Australia, Russia, USA, Mexico and Canada as well as Germany. Can these countries fulfill the global decarbonisation Treaty? Will they do so? One country has already defected in this ocean PD game that plagues this CPR. Will these other big polluters comply? I doubt so. Without their compliance with global decarbonisation, climate change become unstoppable – Hawking's irreversibility.

Conca (2015) and Vogler (2016) have shown how the Great Powers in the G20 group of nations manipulate the UN bodies and UN arenas to basically delay concrete action against global warming. Since the G20 states are to be held accountable for more than 2/3rds of all greenhouse gases, they should assume full responsibility for both decarbonisation and the funding of the Super fund. What are waiting for?, ask economist Stern (2015), calling global warming worst externality of economic history (Stern, 207). The major players in the world: G20 governments.

IV. DEFECTION STRATEGIES

The nature of promises, like the COP21 objectives goal I, II and III, was revealed by Thomas Hobbes in Leviathan from 1651, stating that it involves a game with two stages: first the words, second the fulfillment of the words or not:
(Q1) "Covenants, without the sword, are but words and of no strength to secure a man at all."
(Q2) Words are wise men's counters, they do but reckon by them; but they are the money of fools."

There is no sword available under public international law to enforce decarbonisation. Only good will respecting the integrity of promises plus selective incentives will be decisive for the implementation of GOAL I, GOAL II and GOAL III. The decarbonisation promise is a complex one, involving two different parts: Allocation: to reduce the consumption of fossil fuels according to the global plan; Funding: to set up and fund a giant Super Fund to create selective incentives for poor and developing countries to implement the global plan. The phenomenal sum of 100 billion $ per year has been mentioned no less than for 10 years.

The new theory of asymmetric information puts cheating and opportunistic behaviour the centre of a Hobbesian approach to global governance covenants and word promises. Thus, defection from a huge CPR concerning a giant resource in open access – the atmosphere – with open access can occur in many forms: Reneging ex ante on allocation: making unrealistic promises; Reneging ex post on allocation: overstating accomplishments; Reneging ex ante on funding: not actually paying one's due; Reneging ex post on funding: corruption or embezzlement.

As Hobbes declared, words may be the tongue of fools, promises made may be called void because of unforeseen circumstances. China had promise to halt CO2 augmentation, but less hydro power is blamed for the call for more coal power and CO2s anew. With so many participants in this CPR and so much money promised, the risks of dishonest management must be high. Too many members in a CPR imply heavy transaction costs. G20 must be called upon to act in order to implement goal I, II and III.

V. OCEAN PD GAMES AND SELECTIVE INCENTIVES

The temptation to defect from an open access CPR increases with the number of participants. They prefer the SQ to any sacrifice, individual rationality defeating collective rationality, or Pareto optimality. To handle cheating and opportunistic behavior, the CPR may employ selective incentives, providing each member of the COP21 Treaty with special incentives to comply with goal I, II and III. Thus, they would be paid for decarbonisation – the Super Fund! This solution to the ocean PD game problematic requires oversight and continuous control of the management of objectives in each country.

Let me substantiate these points, derived from the general analysis of PD games, with a few concrete examples from the variety of countries or economies. I divide them in poor countries, take-off economies (Rostow, 1960), catch-up economies (Barro, 1992) and advanced countries. These country distinctions play a role at the meetings of UNFCCC, as all except mature economies will ask for money from the Super Fund. After all, carbonization has been a preoccupation of the mature countries for decades, if not centuries.

Volume 1, Issue 12, pp. 74-81, 2018. ISSN (Online): 2456-7361

Emerging economies (take-off, catch-up) would be very sensitive to trade-offs between decarbonisation and socio-economic development or economic growth.

VI. Take-Off Economies

Several countries in the world have recently started the process of industrialization and urbanization, moving out of poverty and the dominance of agriculture. They emphasize the need for energy in order to develop fast. Typically, they rely upon fossil fuels, especially coal, stone or wood coal. They will only endorse decarbonisation, if supported by the Super Fund to move into atomic power or renewables like solar and wind power.

In general one may say they are likely to renege, if they cannot find alternative sources of funding is not forthcoming.

India

One may date India's take-off point in time to around 1990, when a heavily regulated economy with socialist planning was transformed into a market economy. Economic growth has since been impressive, but the needs are gigantic from a rapidly increasing on average poor population. Thus, following the approach by Rostow (1960), one must date the take-off point for India to its market transformation with a stock exchange in Mumbai.

From India's side, the position has been clearly stated (Ramesh, 2015): socio-economic development keep up its pace to deliver services to the millions without electricity and the large part of poor people. Coal will be used, if necessary. Figure 4 captures the link between GDP and CO2s.

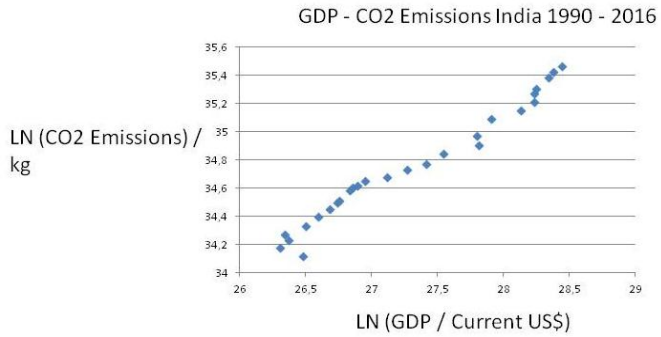

Fig. 4. GDP and CO2s: y = 0,55x, R² = 0,97

The upward sloping curve is strong for Indian emissions, following its stunning expansion economically. And India will not accept a trade=off between growth and CO2s, putting the emphasis upon electrification of all households and poverty uplifting.

Can and will India honour its dearboniisation promises? Not without foreign assistance! Look at the present pattern of energy consumption (Figure 5).

Fossil fuels, especially coal, dominate totally. In India, biomass is charcoal, more polluting than coal itself. India is completely out of tune with the COP21 objectives.

The Indian government engages much in energy planning with foreign expertise – see Indian Energy Outlook from 2015 by IEA. One scenario is portrayed in Figure 6.

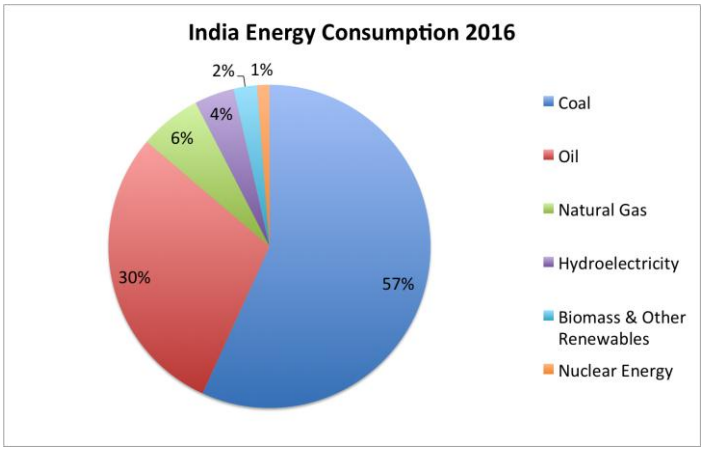

Fig. 5. India now

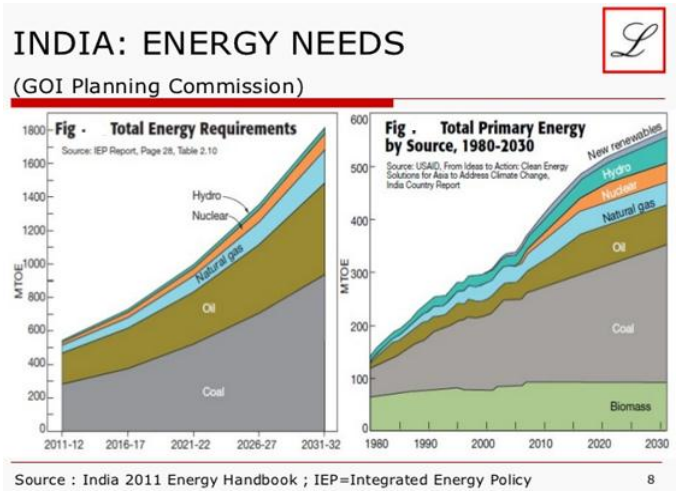

Fig. 6. India – the future
https://www.slideshare.net/objectivecapital/india-growing-energy-needs-to-fuel-growth

This enormous hoped for expansion in energy demand is not in agreement with global decarbonisation plans. To reduce c coal and charcoal India needs atomic and solar power. Hydro power requires safe access to water, which global warming may undo.

Indonesia

Like India, Indonesia is planning its energy policies in cooperation with international experts, like e.g. IEA. It has gone through a rapid expansion of its energy production since its take-off data in the 1990s, when Suharto's cronyism regime was done away with. It exports considerable amounts to gas.

Indonesia, being a giant nation with economic growth and enormous forest burning, displays a strong upward trend in CO2s – see Figure 7.

What makes Indonesia so important for the implementation of global decarbonisation according to the COP21 Treaty is not only is mega size in population, but also its rain forests in Kalimantan and Sumatra. The government has not been able to protect these global lungs, as they are cut down and burned for agriculture. This amounts to a tragedy of the commons writ large.

International Journal of Scientific Engineering and Science
Volume 1, Issue 12, pp. 74-81, 2018. ISSN (Online): 2456-7361

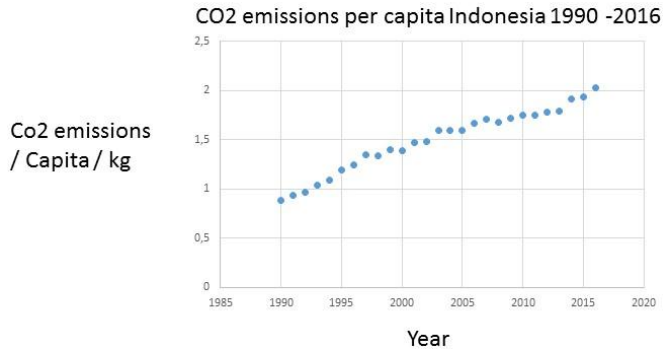

Fig. 7. Indonesia

The planning of the expansion of the energy sector – Figure 8 – shows little regard to COP21 objectives.

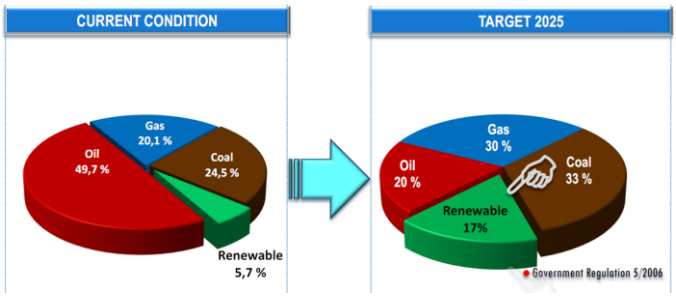

Fig. 8. Energy mix

Source: http://blogs.vertcaptech.com/2014/01/06/renewable-energy-potential-indonesia/#.Wh_p6lWWbIU

It is true that renewables are planned to increase, but so is coal. Together with forest emissions, Indonesia has to renege.

Iran

Iran has been a sleeping giant for decades due to political and religious turmoil. It nourishes its large and fast growing population with oil and gas energy to 100%. To avoid further CO2 augmentation, it must turn to COP21 and follow its deearbonisation plan: GOAL I and II (Figure 9).

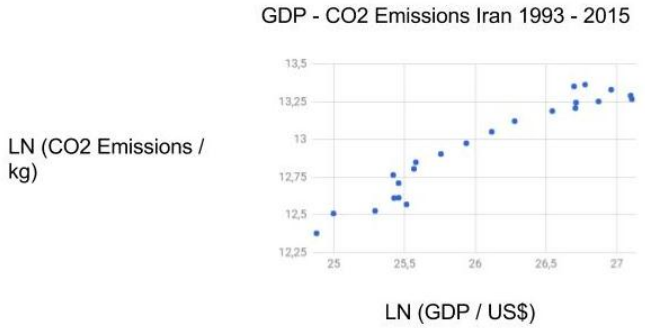

Fig. 9. Iran GDP-CO2s

Coming out of isolation and representing increasing Shia power in the region, Iran must be paid attention to, both politically and economically. It has the capacity to decarbonise, using nuclear and renewable energy. This would require though more of stability in this region and internationally with the US.

Catch-Up Economies

One proper subset of emerging economies are the catch-up nations, who started long ago a take-off but now wants to close the gap to the mature economies. They are very hungry for energy.

Brazil

Even if Brazil is a promising country and will always be so (de Gaulle), it is interesting when compared with Indonesia. It is as giant big a country, aiming to be a regional leader. And it harbours the other lungs of Planet Earth – the Amazons. The big difference economically is that Brazil had an early take-off period in the 1920s, but economic decline in combination with authoritarianism led to a huge set-back for Latin America in the 20th century. The attempts with socialism succeeded nowhere, but only stimulated fascist responses. Today, Venezuela is a new tragedy of failed state intervention.

Brazil has enjoyed a most positive economic development since the 1990s, when democracy was re-established. As the GDP has increased strongly up until 2015, so have the CO2s augmented sharply (Figure 10), pushed of course by the burning down of the rain forests, or logging parts of it for agriculture.

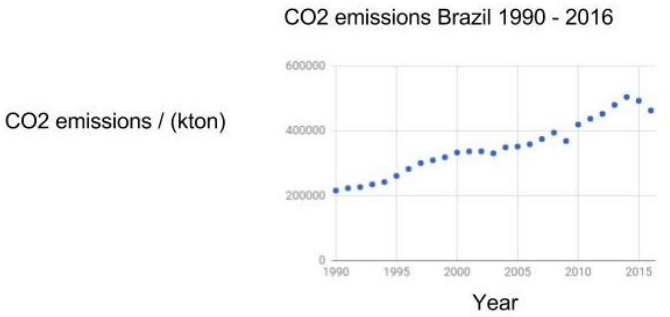

Fig. 10. Brazil

As the Brazil economy has stagnated recently, CO2 growth has stalled. However, the plans for energy are stunning – see Figure 11. In a time frame of 10 years or less, energy consumption is to be doubled. Can it be done without destroying the Amazons and increase global CO2s?

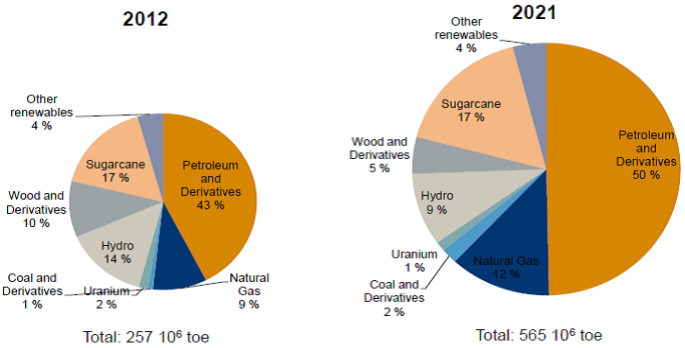

Fig. 11. Brazil – now and the future

Source: https://www.linkedin.com/pulse/focus-renewable-energy-technologies-brazil-luca-gautero

Energy provision is different from Indonesia's fossil fuel reliance, as Brazil has hydro power and biomass energy. It uses a lot of petrol but little coal. The worry about Brazil is the

Volume 1, Issue 12, pp. 74-81, 2018. ISSN (Online): 2456-7361

enormous expansion plans for energy. Involving also exports to other LA countries.

It seems as if hydro power would decline in importance, but that hides the planned double expansion. Dams have been built in the Amazons, and much more is planned. Together with the cutting down and burning of the rain forest for agriculture, one may predict the demise of the Amazons before 2050, like Boneo and Sumatra.

To fulfill its COP Treaty obligations, Brazil must invest more in solar power. According to the world energy reports, the country has a modest solar power plan, which is strange given its huge territory with so much sun.

Mexico

Another major catch-up economy in LA is Mexico, which like Brazil is an oil and gas producer. CO2 emissions, like in the rich Middle East countries, tend to be high in countries with heavy oil and gas production. Mexico enjoyed an early take-off start point in the 20th century, but economic and political instability decreased the potential of the country. However, NAFTA meant a new start together with a democratic regime. Thus, Mexico pursues a catch-up strategy, using its vast oil and gas reserves – Figure 12.

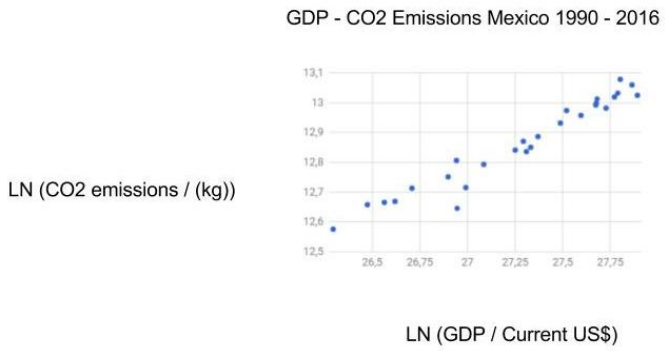

Fig. 12. Mexico

The rise in average affluence in Mexico has been a success story, even if the benefits from NAFTA are contested. One cost is apparent in Figure 9, as it documents that Mexico has become a major polluter.

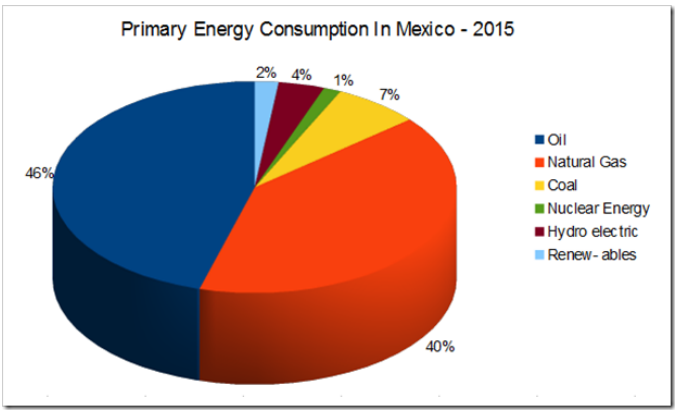

Fig. 13. Mexico's energy mix now

But the country has very ambitious plans to change this. First, we look at the present energy mix in Figure 13. The fossil fuel dependency today is close to 100 per cent. But the plan is to accomplish a major transformation that would make the country fulfill the global decarbonisation goals.

In the plan below, Mexico shows it is one of the first countries to take the COP21 Treaty seriously (Figure 14).

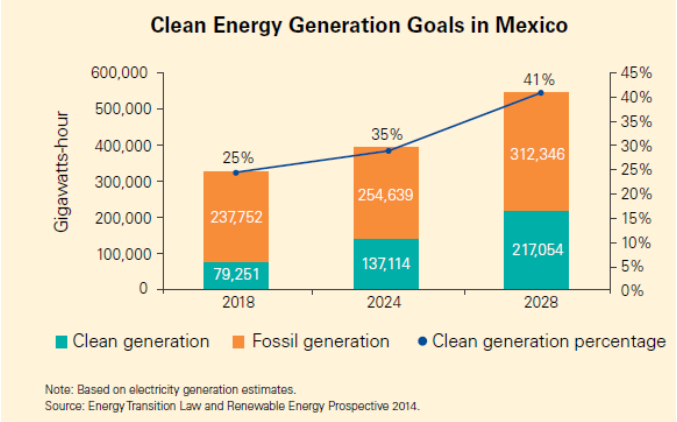

Fig. 14. Mexico's energy plans

The 2028 vision could violate GOAL II in the COP21 Agreement, as it stipulated 30-40 % CO2 reduction by 2030. Mexico is moving into solar power, which is its future.

Saudi Arabia

The Middle East is carbonized to nearly 100 per cent. And none of them could fulfill GOAL I AND GOAL II without a major energy transformation. See Saudi Arabia's CO2s increase in Figure 15.

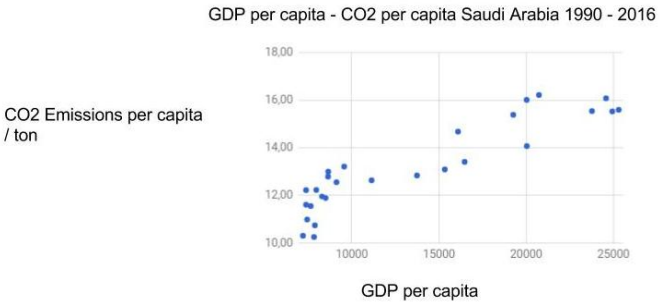

Fig. 15. Saudi Arabia' GDP-CO2s link

Saudi Arabia only uses oil and gas. And why not? Yet, as partners in the COP21 club with its CPR of decarbonisation, also the Saudis must change. To fulfil GOAL I and II, the new Saudi ruler has outlines an ambitious transformation plan, involving the turn to renewables and atomic power. It also involves the construction of cities, entirely energized by non-fossil energy sources. The Saudis can pay for all these magnificent plans, but global warming may make life in the Gulf difficult to support, as temperature rises and air conditioning fuels climate change.

Mature Economies

One should not believe that mature economies can or will implement COP21 objectives. Although several of the large rich countries have halted the CO2 increase, they certainly

International Journal of Scientific Engineering and Science
Volume 1, Issue 12, pp. 74-81, 2018. ISSN (Online): 2456-7361

have to do much decarbonisation so reach the GOAL II. Let us look at two mature economies with large emissions.

South Korea

South Korea has moved from a Third World to the set of OECD rich nations in a period of 50 years, with the take-off point after Japanese colonialism. The extreme economic growth has been based upon massive imports of energy sources, like natural gas and oil as well as coal. The outcome appears in Figure 15 with massive CO2 emissions.

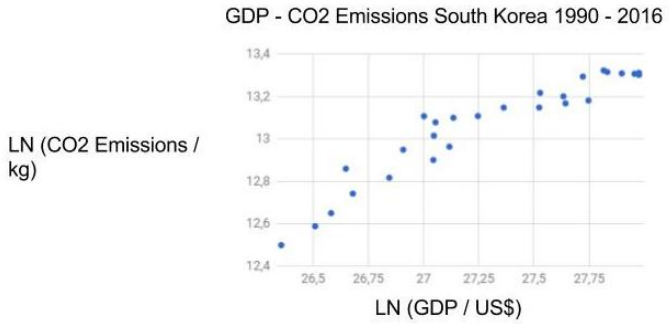

Fig. 15. South Korea

The South Korean leaders have understood that 80 per cent dependency upon fossil fuels is not in agreement with the global hope for decarbonisation. They bet on nuclear power, given the country's advanced technology assets. But the new government has revised these plans for many atomic power plants. Figure 16 shows the electricity generation picture, where nuclear power is to be reduced proportionately in the 1920.

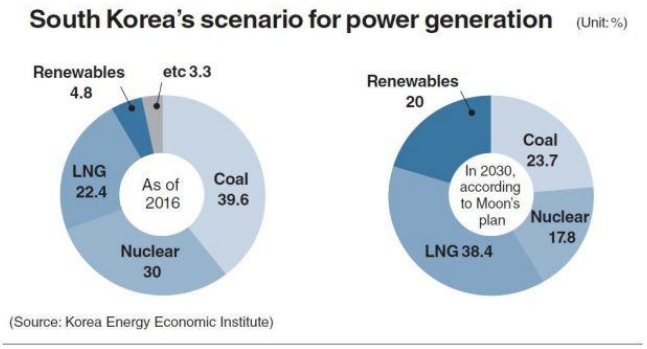

Fig. 16. South Korea's electricity now and in the future

Instead, the government now bets upon LNGs from abroad, transported in gigantic ships. But these plans violate the GOAL II of the COP21 Treaty. And international shipping is one of the worst sources of CO2s. It seems as if South Korea will have to defect, as it provides a small role for renewables.

Australia

Australia has always been negative to global decarbonisaion, a least according to the prevailing attitude among its leading politicians. This stance reflects the country's total reliance on fossil fuels at home for energy, as well as its giant exports of fossil fuels to other countries, especially in the Asia-Pacific region. Figure 17 present a picture the most addicted to fossil fuels country in the world.

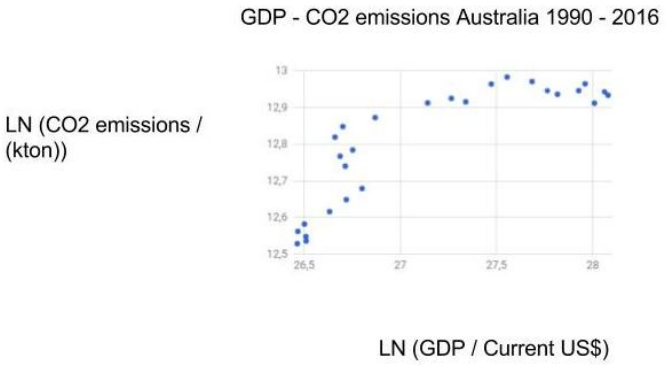

Fig. 17. Australia

Without a major energy policy reversal, Australia will be forced to renege upon COP21. "Our future lies in keeping increasing living standards", says PM Turnball, but more important for mankind is a stable environment, generally speaking.

Canada

Canada enjoys massive amounts of hydro power, which will last as long global warming does not result in water shortages. It also invests heavily in wind power. But its great dependence on oil sands is not conducive to decarbonisaion. The oil sand business is very dirty, polluting and expansive with pipeline to the US. Figure 18 would not pass GOAL II.

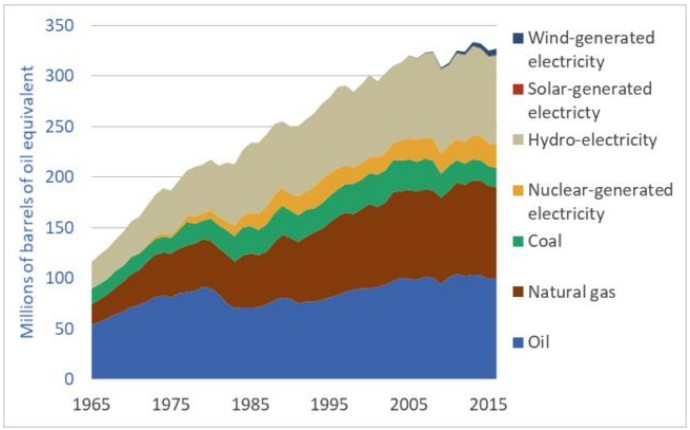

Fig. 18. Canada energy mix
Source: http://www.darrinqualman.com/canadian-energy-use-data/

Poor Countries

Poor countries have huge GHGs, only when they are quite large. Small poor countries do not matter so much. Egyp is somewhere inetween. Egypt that has neither much hydro power or oil assets like a few other Arab neighbours, but the emission trend is clear. It has a huge population with high unemployment and mass poverty besides a certain level of political instability, resulting from religious conflicts and wide-spread corruption. But surely it has electricity from inta giant Assuam dam and the Nile? No, it does not count for very much, where most people live in the Nile delta (Figure 19). Egypt burns first and foremost gas from own fields.

International Journal of Scientific Engineering and Science
Volume 1, Issue 12, pp. 74-81, 2018. ISSN (Online): 2456-7361

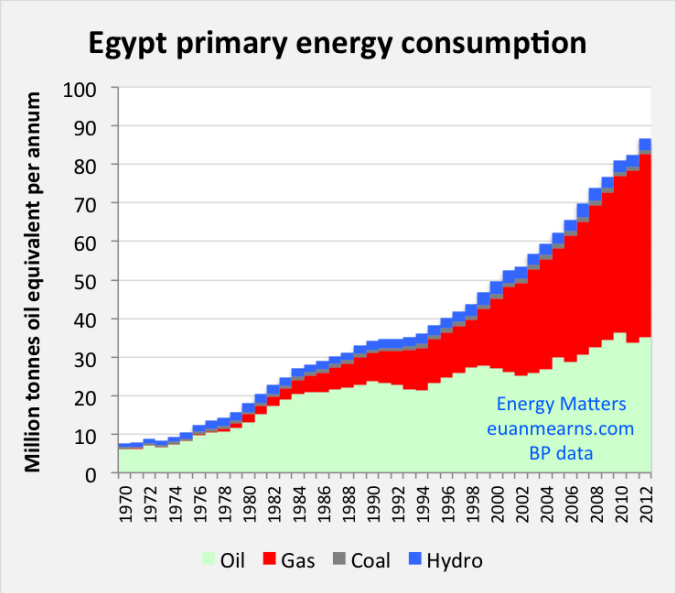

Fig. 19. Egypt's energy mix

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

As Egypt relies upon fossil fuels, it has massive CO2 emissions, the trend of which follows its GDP (Figure 23).

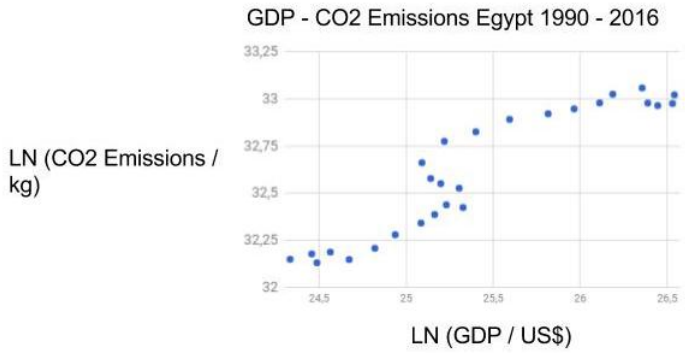

Fig. 20. GDP-CO2 for Egypt: y = 1,02x; R^2 = 0,99

It will be very difficult for Egypt to make the COP21 transformation, at least without massive external support. But where to build huge solar power plants in a country with terrorism, threat or actual?

VII. Solar Power

Table 2, using the giant solar power station in Morocco as the benchmark, estimates how many would be needed to replace the energy cut in fossil fuels and maintain the same energy amount, for a few selected countries with big CO2 emissions?

TABLE 2. Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: (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 plants needed for 40 % reduction
United States	26 - 28[i]	2100	3200
China	none[ii]	0	3300
South Korea	37	260	280
India	none[ii]	0	600
Japan	26	460	700
Brazil	43	180	170
Indonesia	29	120	170
Canada	30	230	300
Mexico	25	120	200
Australia	26 – 28	130	190
Russia	none[iii]	0	940
Canada	30	230	300
Mexico	25	120	200
Philippines	70	70	40
Saudi Arabia	none[ii]	0	150
Algeria	7 - 22[iv]	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
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
Iran	4 – 12[iv]	22	220
Kazakhstan	none[ii]	0	100
Italy	35[v]	230	270
Sweden	42[v]	30	30
United Kingdom	42	310	300
Germany	491	550	450
France	37[v]	210	220
Argentina	none[ii]	0	80
Uruguay	none[ii]	0	3
Chile	35	25	30
World	N/A	N/A	16000

Notes:
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

VIII. Conclusion

Recently, the study Climate Science Special Report: Fourth National Climate Assessment (USGCRP, 2017): was published in Washington, enquiring into the global warming consequences for especially the US but also the world. This major report shows without a reasonable doubt that global warming is linked primarily with the anthropogenic causes of greenhouse gases, especially CO2s. Methane emissions are now on the increase, as the permafrost melts. Below is Florent

Dieterlen's calculation of the rise of methane emissions (Figure 21)

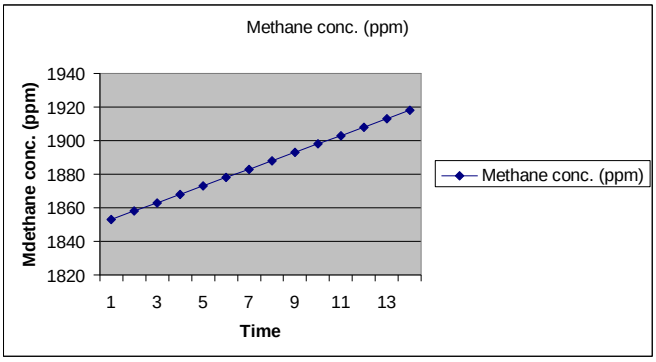

Fig. 21. Methane emissions in Dieterlen's projection
Source: see references

With methane emissions rising, it is all the more urgent to considerably reduce CO2 emissions. Any decrease in methane concentration is improbable, due to: Agriculture emissions, as the temperature increase the metabolism of microbes in rice agriculture; Wetlands emissions do not diminish with the microbial chemical activity on increase; Fossil fuel production especially LGN; Forests diminish in the tropics, resulting in a decrease in animal or vegetal resources. Global warming will turn into *chaos* at the Hawking irreversible point in time:
- sharp temperature variations at various locations on planet Earth, like the North and South poles,
- grave sudden impacts, like permafrost melting releasing methane,
- powerful positive feedback lopes, like methane emissions augmenting the speed of temperature rise, which in turn melts more ice, making for ocean acidification, and huge land losses,
- with all resulting in jumps in the Keeling curve.
- to develop *chaos modelling* of how global warming impacts upon storms and wild fires, as well as dramatic increases in sea level rises.

REFERENCES

SOURCES: ***Solar power***
Paris 2015: Tracking country climate pledges. Carbon Brief, https://www.carbonbrief.org/paris-2015-tracking-country-climate-pledges
EDGAR v 4.3.2, European Commission, Joint Research Centre (JRC)/PBL Netherlands Environmental Assessment Agency. Emission Database for Global Atmospheric Research (EDGAR), release version 4.3.2. http://edgar.jrc.ec.europe.eu, 2016 forthcoming
CO2 Emission Reduction With Solar
http://www.solarmango.com/in/tools/solar-carbon-emission-reduction

GDP sources:
World Bank national accounts data - data.worldbank.org
OECD National Accounts data files

GHG and energy sources:
World Resources Institute CAIT Climate Data Explorer - cait.wri.org
EU Joint Research Centre Emission Database for Global Atmospheric Research - http://edgar.jrc.ec.europa.eu/overview.php
UN Framework Convention on Climate Change - http://unfccc.int/ghg_data/ghg_data_unfccc/time_series_annex_i/items/3814.php
International Energy Agency. Paris.
Energy Information Administration. Washington, DC.
BP Energy Outlook 2016.
EU Emissions Database for Global Research EDGAR, http://edgar.jrc.ec.europa.eu/
World Bank Data Indicators, data.worldbank.org
British Petroleum Statistical Review of World Energy 2016
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. World Bank Data Indicators, http://data.worldbank.org.
Fred Pearce, http://e360.yale.edu/features/methane_
Dlugokencky and Kuniyuki: NOAA ESRL https://www.esrl.noaa.gov/gmd/ccgg/trends_ch4/

LITERATURE
Asian Development Bank (2015) Southeast Asia and the economics of global climate stabilization. Mandaluyong City, Philippines: Asian Development Bank,
Barro, R.J. (1991). Economic Growth in a Cross Section of Countries. *The Quarterly Journal of Economics*, *106*(2), 407-443.https://doi.org/10.2307/2937943
Barro, R.J.,&Xavier,X. Sala-i-Martin. (1995). *Economic Growth*. McGrow Hill.
Barro, R.J.,&Xavier,X. Sala-i-Martin. (1992). Convergence. . Convergence. *Journal of Political Economy*, *100*(2), 223-251.https://doi.org/10.1086/261816
Climate Science Special Report: Fourth National Climate Assessment (USGCRP, 2017)
https://assets.documentcloud.org/documents/4174364/Climate-Science-Special-Report-2017.pdf)
Rostow, W. W. (1960). *The Stages of Economic Growth: A Non-Communist Manifesto*. Cambridge: Cambridge University Press.
Conka, K. (2015) Un Unfinished Foundation. The United Nations and Global Environmental Governance. Oxford: OUP.
Kaya, Y., and Yokoburi, K. (1997) Environment, energy, and economy: Strategies for sustainability. Tokyo: United Nations University Press.
Ostrom, E. (1990) Governing the Commons. Cambridge: Cambridge U.P.
Ramesh, J. (2015) Green Signals: Ecology, Growth and Democracy in India (2015). Oxford : Oxford University Press.
Sachs, J.D. (2015) The Age of Sustainable Development. New York: Columbia University Press.
Stern, N. (2007) The Economics of Climate Change. Oxford: OUP.
Stern, N. (2015) What are we waiting for? Cambridge, MA: MIT Press.
Vogler, J. (2016) Climate Change in World Politics. Basingstoke: MacmillanPalgrave

[i] The United States has pulled out of the deal
[ii] No absolute target
[iii] Pledge is above current level, no reduction
[iv] Upper limit dependent on receiving financial support