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THE MAKING OF GREEN BUILDINGS: VIABLE PATHWAYS TO CURB GLOBAL WARMING IN MALAYSIA

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ABSTRACT: The idea of the Green Building approach is receiving increasing attention in Malaysia as an effective way to reduce energy use, greenhouse gas emissions, sick building syndrome, and the overall environmental impacts of development patterns. However, the approach has not yet created a freestanding paradigm yet: The fear that green buildings might increase construction costs tremendously makes it hard to sell to private developers or government agencies despite their undeniable advantages for the environment and thermal comfort. The aim of this article is to create awareness of potential measures how to counterbalance global warming for the building industry in Malaysia. Hence, this paper describes an array of viable pathways that can contribute to curb global warming in Malaysia. Because green building assets became of recent interest in Malaysia and is important in mitigating global climate change, it is beneficial to analyse the over 30 years old Western experience and literature for insights that could help formulate a Malaysian approach and later a paradigm. The method of the research presented here is to set a robust framework bound for future research experiments over the next 2-3 years in order to determine the best materials and energy supplies for greener buildings. The results, if successfully proven, might boil down to the fact that concepts of green buildings can be devised for mid- and low cost buildings. Our recommendation or suggestion is to further research in all 8 areas mentioned below, and to show-case affordable green buildings by upcoming experiments.
KEYWORDS: Green buildings, viable pathways, global warming, Malaysia

❖ INTRODUCTION

It took mother earth 350,000 years to develop her primary energy resources, like oil, gas and coal. Within just the past 100 years, 50% of this irreplaceable potential has been used up forever. This development causes dangerous global warming: The alternative that mankind still has is deploying renewable green energy which is more distinguished and often requires a higher investment. It has to be decided case-by-case, however, if pay-off periods can be achieved, or if the only gratuity is by sustaining the planet. Renewable energy as an integrated concept can help to decrease global warming and sustain our environment at the same time.

If only the so-called developed countries fulfill their plans and reduce primary energy consumption by 50% till the year 2050, the temperature on the earth will still rise by an unprecedented 4 C centigrade causing the sea level to rise by a multiple of meters. Never since known disastrous man-made catastrophes still might occur by a growing number (Weimann, 2009), only if the developing countries are enabled to practically join the bandwagon of green technology decreasing global warming by the same proportion as the developed countries as supposed by 85% less CO_2-emission, it might be possible to curb the rise of the temperature to “only” 2 C by the year 2100 (Schellenhuber, 2009).

Over the past recent years, a high-tech developing country like Malaysia has become sensitive and proactive towards green topics. It finds itself at a significant turning point to turn green ideas into practice: The so-called developed countries in the north, with their energy potential being far more restricted, have already devised a wide variety of energy regulations and renewable technologies that might be adaptable.

With the political framework created by the 10th Malaysia Plan, the Green Building Index, and the self-commitment of saving 40% of CO_2 emission till 2020, Malaysia can be on the spearhead of the development to embark on viable environmental survival strategies (MEGTW, 2009). What is badly needed is a ground-breaking strategy in order to fight the ever-growing gap with the menacing increment of another expected 36% of new world-wide CO_2-emission till 2050, if the situation persists and nothing happens.

❖ THREATS AND OPPORTUNITIES

During the past years, different Green Building Approaches have created an influx of references, journals, exhibitions and conferences. However, after the world-wide climate conference in Copenhagen December 2009 disillusion took hold: *"We … recognise that the accord reflects a true political willingness to combat climate change. However, it remains unclear how this political willingness will translate into concrete steps"* (Peter, 2009)..

One year after the conference, we can look into ways how threats can be translated into opportunities and derive an array of measures to green the built environment:

The threats. Malaysia belongs to those developing countries with one of the highest increments of CO_2-emission since 1990 (Hugh, 2008). Unlike in Western countries, where energy rules and regulations in the developed counties have been in place since 1978 (Germany), the CO_2-emissions in Malaysia have steadily increased from 1990 till 2006 by 226%. In tandem with comparatively high wealth, this is still one of the highest growth rates worldwide (Anon, 2007). Before the economic crisis 2008/09, there was no end: Still in 2007, the primary supply of commercial energy grew by 6.6 percent to register at 72,384 ktoe compared to 67,878 ktoe during the previous year (Anon, 2007). 30% of the global warming in Malaysia is due to residential, and another 26% are caused by industrial energy consumption incl. housing energy consumption.

The opportunities. Malaysia is the hinge and hub to experiment and to expand green technology as it is the heartland between India and China, with these populations which will dramatically contribute either to increased global warming or its downsizing during the whole century. Besides creating awareness, energy regulations are still in their infancy in other countries. Therefore, step by step as stipulated and subsidised by its government, Germany has managed to reduce its primary energy consumption by 18% since 1990 and, like Malaysia, the ambitious targets look into another 40% CO_2-saving by the year 2020. As mentioned above, the country put in its own action framework into the 10th Malaysia Plan and further developed its GBI including non-residential buildings in June 2010.

❖ NINE PILLARS OF CO_2-SAVING

Due to the global necessity echoing in the political support, the chances are uniquely good for green buildings. Generating energy in order to provide comfortable temperature is the biggest energy consumer. As the building is the authors' home-ground, we will restrict this article to green buildings. The following considerations are dedicated to the housing industry, for which technology can commute traditional constructions into green buildings or new ones can be constructed that are considered CO2-saving by the time of their inception. Traffic issues, and other significant sources of global warming, will not be subjected here. The green building system we propose considers an open scale of 7 system elements that can be situationally tuned as pillars into the green building of the future:

#1. First and foremost, **environmental-friendly construction** is the main prerequisite for a green building, which may adopt to energy concepts later (2.-7). The problem for most non-green "red" buildings which were simply constructed the Northern way is that their thick concrete and brick layers along with thin single glazing are not insulated at all. Therefore, quite expensive air condition is required which cools the air and decreases the humility. This is like a vicious circle, though: the less insulation, the more we need air condition. Conversely, if we were to find proper insulation material, we could save tremendous costs of energy and hereby insulation. Proper insulation of walls, the roof and the windows is probably the easiest and cheapest idea that might be implemented in many existing and new low-cost houses. It must start out with **positioning, wall material and construction**, if possible planting of natural creepers together with green roofs and it might end up with more sophisticated insulation material. In order to achieve the same insulation effect of a 2cm thick German thermo wall, 103 cm of traditional concrete or brick stones have to be used. Local experiments of light walls with cavities implementing the so-called sandwich principle have proven that the room temperature during a normal sunny morning reaches already comfortable 25 C without the usage of any air condition (Norizal, 2000). However, what might still left to be resolved during the influx of rain, is the humidity issue (like in the case of the building located at the Malaysian Green Technology Centre).

The **insulation of windows** is a related topic with far-reaching effects (Sieberath, 2010). A European entrepreneur in Shah Alam has saved 30% of the air condition energy costs by implementing simple double-glazing alone with a pay-back period of 3-4 months and extremely low maintenance costs for annual cleaning purposes (Wagner 2010a). **Green roofing**, the planting of grasses and plants on rooftops, is an extremely effective method for reducing the heat island effect common in cities due to black roofs.

McPherson (1994) explains that "vegetation can mitigate urban heat islands directly by shading heat-absorbing surfaces, and indirectly through evapotranspirational cooling" (McPherson 1994). Green roofs not only cool cities during the summer through evapotranspiration but also insulate buildings during the winter. In addition to a decrease in outside air temperature, there are energy savings in the summer and winter as well. A huge city like Chicago installed a green roof on its city hall building in an attempt to deal with the heat island effect and encourage other building owners to do the same (http://urpl.wisc.edu/ecoplan/content/lit_climate.pdf). Chicago's results have been promising. On the surface of the roof top the temperature has been reduce by up to 78 degrees during the summer months. These results were confirmed by Malaysian studies (Abdul Malek *et al.,* 2009)..

#2. Tradition: before engineers and businessmen from developed countries ever colonialised Malaysia with concrete and brick buildings, and equipped them with fans and later air condition systems, we can find lots of home-grown master pieces how to build nice and cooler traditional kampong houses. They can be considered "green" and "passive houses", as the only energy consumption required was the building process itself with little maintenance work required. As they were built with timber, the CO2-energy balance of their life-cycle was equalised by replanting trees. Unfortunately, the open kampong house principle does not work any longer in rural areas because of pollution, the threat of burglary and other man-made impacts. Following the global trend, millions of non-green buildings were built the European and American way, and after the colonial buildings with their strong and therefore cooling walls, the new light-weight concrete style could not adopt to thermal comfort necessities in the tropical environment in Malaysia. In 2011, there is no turning back the wheel of the history of building physics as kampong houses do not produce thermal comfort as required. However, basic concepts on positioning, architecture and insulation can be studied, but only a few can be exactly implemented in concrete and bricks houses.

#3. Solar energy. The sun is our worst enemy for thermal comfort, but at the same time for green buildings she can become our best friend in two ways:

a. With **photo-voltaic energy** non-green buildings can be cooled down and become greener. This is a widespread, but not satisfactory answer. A country like Malaysia, which is blessed with double as much solar efficiency as Germany, seems to be poised to utilise the sun in order to do proactive energy saving and curb global warming (Asian Solar, 2010: 16f.). This strategy echoes in successful experiments: 50% of the National Green Technology-building in Bangi (formerly known as Centre Pusat Tenaga National (PTM) is created by the sun. However, what does photo-voltaic energy do under cloudy conditions when we look at the efficiency of solar panels dropping by 70%? What if there are days or weeks of haze? And how to gain energy during the night time when the sun is not shining? We will have to utilise batteries which costly in addition to the nonetheless expensive solar panels. Based on our own yet unpublished simulation, the pay-back period in West Malaysia for a photovoltaic system may take 21 years. In Sarawak it might be only 7 years due to the fact that electric energy is private, not being subsidised by the government causing triple the price (Epia, QCells 2010).
b. The cheaper and nonetheless effective alternative is **solar-thermal energy**. As in Arab countries with the sun shining the whole day long, it can also be turned into a freestanding energy system becoming the sole source of energy production as for huge townships of 500,000 inhabitants like in Cairo/ Egypt.

Unlike photo-voltaic, these systems can, but do not necessarily produce electrical energy, as they just heat up water or a related fluid. This water again, as a simple application, can be used to supply the warm water supply for showers (Dena, 2009).

Conclusion for solar energy: It is worth while thinking about photo-voltaics (PV), but it might be expensive for many cases, unless owners really can be convinced to invest their money the way they do for a long-term life insurance. Compared to that matter, according to 30 years experiences in Europe, PV is considered a bit risky because for some reasons their life expectancy is not yet fully proven. Finally, according to experts, PV in cold Mid-European countries is only (!) viable because of government subsidies implemented first in Germany when the Green Party was in power. Effective April 2010, they will be slowly abolished due to the fact BECAUSE they are quite expensive. In Malaysia, still lots of experiments with a technology double as viable as compared to countries of its origin will be made, and its highly likely that this energy will be one strong, but not the only pillar for green energy concepts of the future.

#4. Biomass is another great green tropical alternative to utilise green energy (DENA, 2009). Malaysia can dispose at the world's biggest palm oil plantation to do so. Biomass was started in projects like in Kajang Metro Jaya as a CDMP (clean development management project). Produced surplus of energy can be sold on the energy market and pushed back into the Tenaga Nasional system. Therefore, Kajang Metro Jaya is one of the first viable local Biomass-Energy producers. At an investment of 2 Million Euro by Biomass of a palm oil plantation the Return of Investment is already predicted after a running period of 5 years. The problem of biomass is not its viability, but its scarceness. A supplement of biomass based on a similar principle of heat usage by incineration plants is the waste-heat plant for industrial areas with estimated pay-back periods (e.g. in combination with solar thermal energy) of only 3-4 years (Solarnext, 2010).

#5. Water as a green energy for housing in the future might not only be confined to big dams in Pahang and Sarawak to generate electricity. It also accounts for at least two more potential applications, cooling by water and rainwater harvesting.

a. **Water cooling.** Compared with traditional air condition systems, whose capacity is merely based on using an electrical cooling agent, cooling with water is pushing water through an electrical gadget instead and could hereby save up to 90% of the current AC systems. However, in a tropical country like Malaysia, neither the ground water nor the sea water can be considered cold. Unfortunately, with only one or two exceptions of precipitated locations, the required deeper layers of the ocean are too far away both from Peninsula Malaysia and from Borneo to render a viable stand-alone seawater cooling system. The same inaccessibility is accountable for waterfalls from the hillside with a midday temperature of 25 C (Wagner, 2010). Further research in these areas in 2011 will determine, in how far deeper layers of ground water, lakes with e.g. at Mines Resort which is one of the deepest lakes throughout the country or artificial water injections below well insulating layers can trigger the usage of water cooling.
b. **Water consumption:** As by now, in Malaysia water is still considered very cheap, but in the future the prediction is that one day it will be very expensive. By individual rain water harvesting and the utilisation of water wastage usage of evaporated air condition humidity an entrepreneur saves 18 cubic meter a day. According to his tropical experiment, a tank with a maximum capacity of 32,000 litres of water is equipped with a filter and served for a green collection of rain water from the roof. By utilising only 1/4 of the plant's roof this system provides more then enough to replenish the tank and enabled 2 days fully independent operation. The only additional support was a cheap water pump, and the pay-back period was just a few months. However, we must precaution ourselves, if water is deployed during peak dry seasons, and the natural balance in urban areas could be out of range (Wagner, 2010a).

#6. Geothermal. Another important technical innovation that can decrease the effects of global warming comes from mother earth itself. **Geothermal** is not about drilling deep holes to receive energy from 2000m below ground level. It is based on the idea deducting 3-4 degree C of the soil-near water in order to turn it into electricity that can be utilised for the purpose of clean comfortable ventilation and cooling. The principle easily can be adopted in tropical countries, as one requirement is the soil's humidity. Together with research institutes in Germany, we have gone through experiments over the past decade and found that this source of global warming killer is widely unknown in developing countries, but might be applicable (Bohne, 2010). In countries throughout the colder hemisphere a box with the size of a refrigerator is enough to heat or cool down the energy in an industrial building of 2000m^2 with a cost-saving of more then 70% compared with traditional oil-, coal- or gas-driven energy solutions (Sanner, 2005). What the investment costs are concerned, the pay off rate in cold countries is in the region of 10-12 years with maintenance costs much lower and a life-expectancy much higher for primary energy systems. As the prerequisite is to have soil with high humility, tropical counties like Malaysia could be poised to run through such experiments to determine whether or not layers in the ground can be found or created that are significantly cooler than the surface temperature. Conversely, if the temperature becomes hot soon like in the case of hot springs, this geothermal energy can also be easily utilised. Again, in tandem with insulation, geothermal expertise has yet to prove at what time period and at which risks they are more viable then the air condition systems at decreasing costs and an estimated CO2-energy savings of 90%. However, the effect is tampered by the fact that the ground temperature of the required water will not gain a comparable ROI like in Europe.

#7. LED-lights can be put either as bulbs or tubes, both with a life expectancy of 8-12 times higher compared with traditional lighting units. They are the easiest way to demonstrate the supremacy of green technology on one count by just replacing the traditional bulb or tube by the LED-device. No mechanic or engineer is required at all. However, additional wiring might be required to gain a maximum height of 10 feet, as the LED light's performance might be not efficient enough once placed above and beyond. On the second count, just exchanging existing bulbs or tubes could boost every aware household to become a bit greener, as the energy consumption is only 25-40% of a traditional light (SILQ, Opulent Penang). The costs of purchasing are 12 times higher as for traditional sets (for a tube: 190 RM for LED compared with 12 RM for the conventional one). On the third count, an amortisation period of 6 years has to be taken into account. Due to its innovative recentness, the life expectancy of LEDs has not yet been tested fully (claim 15,000h for tubes and 40,000h for bulbs), and some of them appear to be too weak in illumination at all, or they loose their strength (327 lux for tubes) through the course of time.

In a country like Germany, within in a staggered grace period from 2009 – 2016 all existing conventional lighting systems will not be longer available on the market, and the road is clear for utilising 60-75% energy-saving LED-sets solely (Sufni, 2010). A striking example for implementation are LED Traffic Lights. If all red traffic lights are converted to more efficient LED (light-emitting diode) fixtures, a city like Chicago hopes to prevent the release of 1,400 tons of CO2 due to their increased energy efficiency and longer life (http://urpl.wisc.edu/ecoplan/content/lit_climate.pdf).

#8. One of the strongest energies especially catering for green buildings is the **wind**. As a long term trend, rapid market growth has been reported. In its both leading countries, Germany and the USA, the development points at an annual increment of 10-15% (Dena, 2009). By 2020, more than 18.8% of onshore plus 6.2% offshore of the overall German energy consumption will be generated by wind power plants (Agentur, 2010). If set up in the fitting environment with enough and consistent influx of air blow, wind energy is economically viable and will create an alternative compared to the traditional non-renewable energy production. If this barrier can be overcome by the selection of suitable locations, there are just tremendous investment costs and a lack of awareness deemed to be the prevalent stumbling blocks hindering countries from implementing wind power strategies, especially off-shore.

#9. The latest off-spring of the renewable energy family is the sky. It poses an ever unexploitable source. The „**Open Radiance Cooling System**"(short ORCS) is a system to gain cooling energy in a passive way, by heat exchange between a circulating thin water film on the roof and the environment during the night (Kranl *et al.,* 2003). An engineered water storage, a pump and cool water tubes inside the building in combination with the roof's circulation pipes connected to an underground water storage add up to a simple but already very effective ORCS. Along with proper insulation, ORCS presents a cheap and easy to build cooling system, which with an energy consumption of only 15% compared to traditional split air conditioning systems is far more energy efficient. The material required is available on the local market, and rain in a tropical climate is abundant to regain the evaporated water amount naturally. The potential of ORCS for a tropical country like Malaysia is high as we found out with the data referred to above by simulation, compared with conventional cooling by split-driven air-condition systems, the pay-back period is in the region between 5 and 7 years (for small units with 60 m2) and only 2 years (for a bigger unit with 300 m2 (Spang, 2010).

❖ THE WAY FORWARD

In his address at the climate change conference one year ago, Malaysia's Prime Minister Sri Dato Najib Abdul Rahman announced Malaysia's agreement to reduce its carbon dioxide emission to 40% by the year 2020 compared to the 2005 levels, subject to assistance from developed countries (http://thestar.com.my/news/). Back in Malaysia, he presided an energy commission and announced 191.5 B under the "Malaysia, Together We Prosper"-programme. Hereby, the public can make use of a soft loan amount MYR1.5B just for any green technology activities in Malaysia (Waei, 2009). With the seven modules above, we are looking forward to conduct research-driven experiments in the near future to assist both to bring down global warming up to those ambitious 40%, and being competitive at the same (The Star, 2009). As a university for the bottom billions, with research pertaining the 8 items above, USM's School of Housing, Building and Planning will focus on systems affordable for the bottom billions.

❖ GENERAL CONCLUSION

There are many ways that Malaysia can reduce its emissions of greenhouse gases and waste heat. The aim of this study was to create awareness of potential measures on how to counterbalance global warming for the building industry in Malaysia with a detailed analysis of an array to sort out viable pathways. By Western experience and literature; we can foresee a shift of paradigm for the Malaysian housing industry, as global warming is an irreversible trend. This trend echoes in the endeavours of the government to play a vital and active part in order to bring down CO_2 emission by 40% till 2020. Our contribution was meant to set a robust research framework bound for future experiments, hopefully enabling research institutions in tandem with the green policy makers to make required changes for the housing industry happen.

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