Solutions for Energy Efficiency Development

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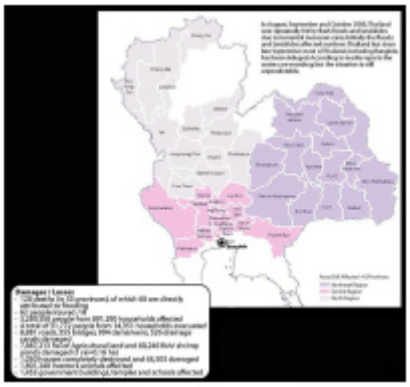
ABSTRACT

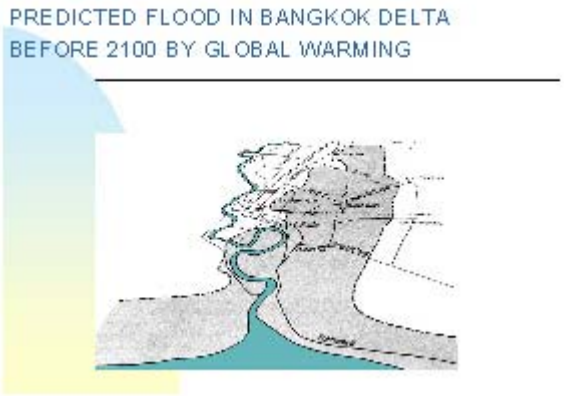
Energy is the world resource, and consuming energy in the most effective way is the responsibility of all nations, since the impact is global. This paper provides an overview of the current Energy Efficiency programs and development, as well as trend for future development.

Most of recent Energy Efficiency programs are focussed on Demand side, such as lighting, air-conditioner, refrigerator, motor, VSD etc. and are implemented in the market of ***government buildings and residential****. It is obvious that Supply side is an upstream process and actually provides higher energy efficiency yield. However, Demand side controls power users directly and tame their habit for better use of energy.*

Energy Efficiency program should be implemented both on ***Supply side and Demand side in parallel****.*

BACK GROUND





Thailand has been accepted as one the Asian countries that has been success in Energy Efficiency program. The responsible authorities are National Energy Policy Office **(NEPO)** and Department of Alternative Energy Development and Efficiency (**DEDE**, previously called DEDP). Another organization that has been known for the success of **labeling program** on air-conditioner, refrigerator, and promotion of **compact fluorescent** and thin fluorescent tube as well as first **ESCO** program is Electricity Authority of Thailand (**EGAT**), Demand Side Management Office (DSM).

DEDE has defined list of **designated building** on factory and commercial building, who have to provide Preliminary **Energy Audit** report for DEDE approval, and further on Detailed Energy Audit and Implementation Plan. Designated buildings are those that have 1000 kW or 1075 kVA electricity connection or consume energy more than 20 mMJ/year. However, most of the designated buildings have not implemented energy plan as recommended in the energy audit.

The Implementation of energy plan was mostly in government buildings, since the government projects were subsidized by the Energy Fund. Most of the energy efficiency measures were the replacement of split type air-conditioner and lighting.

DEDE has not satisfied with the previous Energy Efficiency outcome, and seeking for further program to accelerate the future Energy Efficiency outcome. DEDE also emphasized more on Government + Private participation. The recent key program is the launch of 2000MB **Energy Revolving Fund** on Jan 30,2003. The Energy Revolving Fund will be managed by selected commercial banks, and

selected financial institution. Each project loan shall not exceed 50MB and interest rate shall not exceed 4%, with agreed default rate of 7.5%. It is likely that additional Energy Revolving Fund will soon be approved by the Board of Energy Fund, since the first lot of fund has high demand of loan.

Before the revolving fund program, DEDE have also launched **Subsidy Program.** The program provides 30% subsidy for 11 standard measures, such as high efficiency light, electronic ballast, VSD, high efficiency motor, heat exchanger.

DEDE has recently been put more interest on the supply side, especially on **Co-generation. Alternative energy, and Bio-fuel.** DEDE has recently promoting Energy Services Company (ESCO).

NEPO has not been success to promote R&D, and submitted requests fund for R&D have not been able to be approved. There are several requests on R&D for Residential. Previous R&D's on Energy Savings house have not been well accepted.

Solutions have been quested. Sometimes, a lot of time and money have been spent without a success. **Meanwhile, the solutions are so near that they could not be seen.**

Market sometimes confused, because supplier has only tried to sell their product as individual solution. Several solutions are not right, such as ceramic coating and window reflecting film.

Individual solution is good for residential market as standard measure. However, **Integrated solution** should be applied for industrial and commercial market.

The following examples could be such solutions. These solutions are my conclusion from extensive studies and experiences. To me, these suggestions that I put in here are **" Proven Technology".** Only remember this date, and later you will find whether I am right.

The word " Proven Technology " has been used in government procurement, and most of the time means that the technology should be in use for more than 3 years. It is not cope with fast changing technology, obviously in computer and controls technology. The 3 years old Computer, Mobile phone, CD player is waste. Actually, there is no new principle technology anymore, world is almost saturated. New products are mere development of previous proven product.

In the field of energy efficiency, it is the field of innovation, and only **innovation can speed up the Energy Efficiency to slow down the impact on the world environment.**

Government office can not handle Energy Efficiency Program alone because of government process by nature, and success can only be achieved by **" Public + Private Participation** "

Also to me, **there is no absolute solution**, and new solutions will continuously replace previous solutions. I also fond of **"Hybrid Solution",** since the hybrid provides chance of extracting best solution component to become a more final perfect solution.

SOLUTIONS FOR SUPPLY SIDE

It has been controversy when the government wants to build power plant or dam. Recent cases such as Bo-Nok and Hinkrood project, which are coal-fired power plant, have no solution. The built Pakmoon Dam created a lot of controversy. Therefore, the EGAT governor has the new policy to upgrade the existing power plant to cope with the forecasted demand after next 5 years. EGAT is now upgrading the old South Power Plant, which is fuel fired thermal plant.

Total electricity production is about 16,000 MW, and about half has been produced by natural gas fired gas turbine. Natural gas comes from gulf of Thailand, and also from Myrnma, and from Malaysia by Thai-Malaysian pipeline which is underway. With these sources of natural gas, Thailand power production on natural gas will be increased, since natural gas is cheaper than fuel oil and is clean.

Most of the gas turbine power plants are running below 50% energy efficiency, and there are opportunities to increased the efficiency to 80% or higher by Co-Generation or Combined Heat and Power System. This increment opportunity is a very high magnitude for Energy Efficiency.

As a hot and humid country, there is also opportunity to increased output of gas turbine by 10% with Inlet Air Cooling System.

These Technology, clearly indicate that, there are available technologies that could improve energy efficiency on the supply side, as well as increased the electricity production capacity.

Co-Gneration or Combined Heat and Power (CHP)

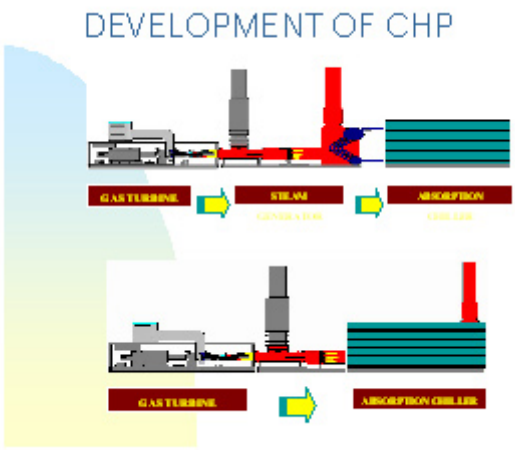
CHP has been implemented in several Industrial Estates and factories for more than a decade. However, not so many projects are real CHP, with more than 70% energy efficiency. There is no CHP in commercial development, and the only first project in Thailand is the new airport, Suvarnabhumi International Airport.

Development of Co-generation started from simple combined cycle, with 40-50% energy efficiency. This level of efficiency has been investigated that higher energy efficiency is now available. There are references in a gypsum factory that has 97% energy efficiency, when they recover gas turbine waste heat for the production process. Latest project – Bangkok Produce Factory has almost 85% energy efficiency.

The present design of the new airport Co-generation system is expected to have 62% energy efficiency. This level of efficiency has been questioned by academics, since modern CHP is normally provide more than 75% energy efficiency.

Like the early CHP projects in Malaysia, such as KLCC, KLIA and PutraJaya phase 1, recovery of gas turbine waste heat use Heat Recover Steam generator (HRSG) and steam absorption chiller. The design with steam boiler require water, waste water treatment, steam condensate return, auxiliary boiler has high construction cost. PutraJaya phase 2 has already changed to direct fired absorption chiller to yield better return on investment.

Future Building Combined Heat and Power (BCHP) has no steam system, and waste heat from gas turbine go directly into direct fired absorption chiller. The BCHP system is much more compact and cost effective, with over 80% energy efficiency. When the absorption chiller is co-fired, the chiller can run independently without running the gas turbine.



Inlet Air Cooling (IAC)

Isothermal condition of gas turbine is normally below 20 C or 15 C. Running gas turbine engine at average 30 C in Thailand produce lower MW output and lower heat rate. Therefore, there is opportunity to increase power production and heat rate by cooling the inlet air to the gas turbine to 15-20 C.

There are 2 methods of considering IAC:

1. **MW Gain**
   In term of MW gain, IAC normally cost $200/kW, while a new power plant cost $800-1000/kW. Therefore, it is obvious that investment on IAC is more cost effective. However, gain is limited at 10% of existing capacity, in order not to disturb existing electrical component.
   There are 2 ways of IAC – Evaporative Cooling and Chilled Water Cooling. The latter is more suitable for tropical country as Thailand, with high humidity. Chilled water is produced by recovery of waste heat from gas turbine to direct fired absorption chiller.
2. **Heat Rate Gain**
   When inlet air approaching Isothermal condition, it is also approach the optimum efficiency. Therefore, the Heat Rate will be improved, possibly 2-3% depend on gas turbine characteristics. This improvement is significant, and can yield high return within 3-4 years.

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SOLUTIONS FOR DEMAND SIDE

Besides, the present DEDE programs and measures, there are still opportunities to achieve the Energy Efficiency outcome at high magnitude. Residential sector is one of large electricity consumption, and so far the newly built houses are far from energy saving house.

Commercial developments are designed as they used to be with little concern on energy efficiency design. The meaning of sustainable building is still far away.

The following examples indicate that there are realistic opportunities to increase Energy Efficiency outcome beyond the existing programs.

Energy Saving House

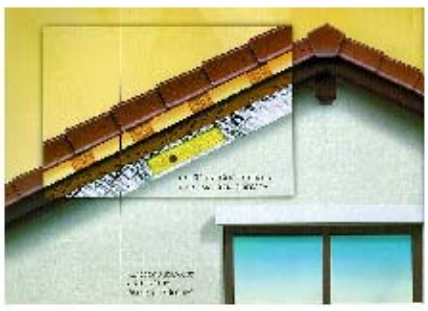
There are wide ranges of solution to build a energy saving house. There are several example of Energy Saving House in many place of the world. Concept approach could be lead to Zero Energy House or even Energy Production House. But those are good only for display but not the real house for mass production. Housing construction are not following that concept. Therefore, there is no real Energy Efficiency outcome.

To gain the Energy Efficiency outcome, the concept approach should be able to be applied by housing owner and contractor, and could normally live in according to normal Thai life style.

Average income married employee live in 100-150 sq.m. Individual or Town house. These houses accounted as millions. Air-conditioning units have been used for bed room basically, since the parents and children are out of the house most of the day. Though, the living room might as well have the air-conditioning unit, but the operating hour is not much.

With this known Thai life style. The bed room sector should be well designed with **"Cold box concept"** and efficient air-conditioning system. The living room, dining sector should be designed with **" Passive Cooling"**, and allowed for air-conditioning when sometimes needed. Therefore, the upper floor of the house, which are bed room should be designed with Cold box concept, while the lower floor, which are the other common rooms should be designed as Passive cooling. This approach could be seen as a " Hybrid "

Cold box design treats room as a box with is well insulated like a cold box. Therefore, size of window and opening are limited. Construction of cold box is simple, basically apply insulation, both thermal and vapor insulation.



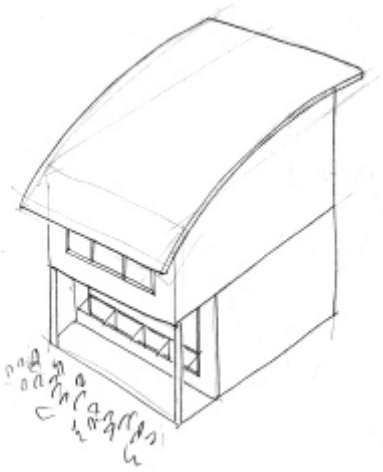
Insulation is the best method to protect heat. For example, when roof is well insulated, ceiling may not be further required to prevent heat.

Upper floor of a town house with insulation and no ceiling.

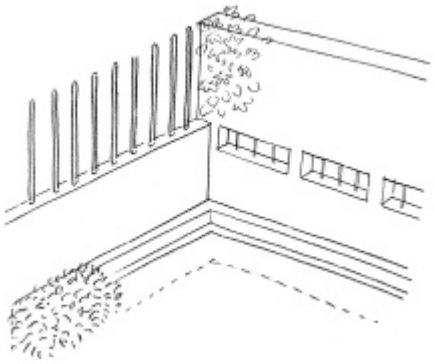
Passive cooling treats room with good ventilation, and does not strictly limit size of window, and will have several openings. Construction of passive cooling requires experiences. For example, the design of ventilation window, location of window and openings, use of landscape, height of room, ceiling, wall, floor finish and color.

Example of well shading. Trees are also excellent outdoor shading devices.

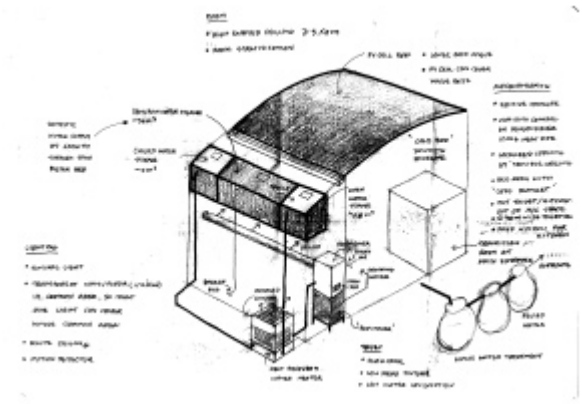
It is clearly see here that the 2 sectors of the house have totally different approach, due to different nature of occupancy.



Example of ventilated window, which allows air intake at low level. This design is also very good to protect noise from neighbor. Shrub acts as air-filter.



Example of ventilated fence, and how to turn hot block wall fence to cool mass fence.



Example of zero energy house design.

District Cooling System (DC)

When there is a project with group of buildings, District Cooling System or DC should be implemented. DC concept approach could reduce capacity of cooling plant and electrical connected load by half because of load sharing and diversity.

District cooling system reduces capacity of central air-conditioning plant, normally 30-40%, and suitable for multi-function complex, such as large commercial complex. Size of transformer and electrical substation also reduce accordingly. In term of need of building power plant, the need will also be reduced, which means less investment burden to National power production.

Central air-conditioning plant normally has predetermined heat rejection, whereby distributed air-conditioning plant normally causes ambient heat. This is a serious problem in down town and CBD, which become heat island and hot climate around buildings environment.

Shinawat University uses District Cooling System.

Fresh Air Unit for Air-conditioning System

In modern building, air-conditioning load consume half of the energy to run the building. Fresh-air cooling load could be as high as 50% of the air-conditioning cooling load, or equivalent to 25% of building energy consumption. Even energy for lighting is not as high. While, lighting saving has been always put as a key energy efficiency measures, control of fresh air should as well be considered as a key measure.

Thailand is constantly hot and humid. Therefore, infiltration has significant impact on Indoor air quality.

Proper air-conditioning should have the following characteristics:

1. Positive room pressure to control infiltration.
2. Provide transition zone between building outdoor and indoor to control room pressure, and use transition zone for occupant to adjust body temperature.
3. Provide Fresh air unit or Outdoor air unit to control amount of fresh air according to IAQ sensor, as well as treats outdoor air from varied outdoor condition to controlled neutral air.
4. Provide fresh air duct system to distributed and control of fresh air to each room or zone.
5. Fresh air valve would be recommended to control amount of fresh air to each room or zone.
6. Air to air heat exchanger could supplement fresh air unit to capture coolness from exhaust air for fresh air.
7. Fresh air unit should be placed in the best fresh air intake location to avoid street and other pollution Polluted outdoor air will affect Indoor air quality and consume energy to treat polluted outdoor air.

Modern Fresh air unit or Outdoor air unit

SUMMARY AND DISCUSSION

These solutions are example, which would be accepted for future energy promotion program, and could produce better Energy Efficiency outcome and lead to future Sustainable Development. These technologies are proven, and similar information could be easily found on several web-site, including DOE web-site. The reader could well evaluate whether the proposed solutions are realistic and valid.

As being said, sometimes solutions are so near, and simple.

One may ask why NEPO, DEDE or EGAT do not have these solutions. Well, it is certain that if they do not have these or other solutions now, they will have them soon, since they are necessary to accelerate the Energy Efficiency outcome.

It would be a challenge to see these developments from this date.

BIOGRAPHY

Mr. Kecha Thirakomen is the managing director and Vice chairman of EEC group of companies, and is one of the largest Engineering firm in Thailand. He has more than 27 years experiences in design and construction in field of M&E. He was chairman of mechanical technical committee of Engineering Institute of Thailand (EIT) 2000-2001, chairman of fire safety technical committee of EIT 1999-2002and presently the treasurer of EIT. He was the president of Mechanical and Electrical Design and Consulting Engineer (MECT) 2001-2002. He was the president of ASHRAE Thailand Chapter 2001-2002. In 1998, he received an award from the ministry of Science and Technology as excellent engineer in energy efficiency, and was appointed as a judge in Asian Energy Efficiency Award. He has also been a guest lecturer in building technology in 5 leading universities for several years. He wrote papers and publishing books on M&E, Air-conditioning, Fire Safety as well as monthly technical magazine “ Technique Magazine”.