EGAT's *Thaitanic*

Why Thailand Should Not Go Nuclear

Detailed 75 page report with map showing where nuclear power generating plants may get placed along Thailand's coast. Includes suggestions for better energy planning.

EGAT'S THAITANIC

SECOND EDITION - includes discussion of Japan's Fukushima Nuclear Power plant – which has hit by the double whammy earthquake/tsunami of March 2011 – which happened awhile after the first edition of this booklet was published.

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FOREWORD: Like many countries worldwide, Thailand is having to take a serious look at future projections of its electricity needs. It has some natural gas reserves on its territory, but those reserves are not expected to be robust for the long term. Thai authorities import natural gas from Burma – and import electricity generated from hydro from Laos.

There is a belief among some Thai politicians and business leaders that nuclear power plants are inevitable for Thailand. They appear so determined to join the nuclear club, that objective perspectives take a back seat. In this text, we'll articulate several reasons why nuclear power plants would be a mistake for Thailand.

So as not to appear all 'gloom and doom,' we'll also clearly show alternatives. Top of those options is 'concentrated solar.' Near the end of this text are thumbnail descriptions and contact info for a couple dozen companies which are at the leading edge of solar technology. Some of those companies have already been engineering and building municipal-scale power generation plants. Prices for solar generated Kilowatt/Hours (Kw/Hr) are coming down dramatically, as efficiency rates are going up to unprecedented levels (up to 79%). In contrast, nuclear power generation is nowhere near such numbers for cost or efficiency.

How Thailand meets its future energy needs is an important issue, and the consequences of decisions made today will have repercussion for decades in the future. Indeed, with the prickly issues of nuclear waste, and plants that will eventually have to be decommissioned, dire repercussion could go on for thousands of years.

Some reading this may wonder, or may even take offense - that a foreigner has the audacity to stick his big nose in to Thailand's business. I feel compelled to speak out, not as a citizen of a country, but as a person in the world. I've resided in over a dozen countries, and have been residing in Thailand for an eighth of a century - as long as a quarter of its citizens. I care for the Thai people no more or no less than I care about people from other countries I'm familiar with. I felt compelled to compile this text out of concern, mainly for future generations of Thais, but also for the effects nuclear power plants could have on Thais living today, and the possible adverse affects upon their neighbors.

Thailand has a small land mass, with no part more than a couple hundred Km from a neighboring country. If a worst case scenario befalls one or more Thai nuclear plants, the radiation will not discern between Thais and non-Thais, and radiation certainly gives no heed to national boundaries.

CHAPTERS:

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1. Being an Activist can be Hazardous

The Electricity Generating Authority of Thailand **(**EGAT) is the state enterprise under the Thai Prime Minister's Office that is responsible for electric power production and transmission. EGAT's activities encompass the development, construction, operation of dams, reservoirs, power plants of various types, transmission system and substations; the production of lignite and its by- products; formulating policies concerning the production and sales of lignite. It's primary function is to provide and sell electricity to people and entities in Thailand.

Being a government owned and state-run enterprise, EGAT is not beholden to shareholders and answers primarily to the ruling elite based in Bangkok. It pays lip service to the general public only to further its agenda. The Thai general public is rather malleable. With a land mass and population similar to France, Thailand is nevertheless a patriarchal society, and their school system is based on learning by rote. In essence, every Thai is indoctrinated to do as they're told - by elders and authorities, and they learn early on - to never complain about inconveniences.

Just one true example which took place on a long-haul passenger train. All its windows were tightly shut. As the hours passed by, the air within got increasingly dank and unbreathable. The Thai passengers may have been aware of this, but they didn't mention it to authorities. The lone farang (foreigner) in the coach asked around, "can we open a window and get some air in here?" Her queries to fellow passengers and train hostesses alike - garnered variations of; 'mai pen rai' (what does it matter) to "mai dai pleean" (cannot do anything to change the situation). Finally, in desperation, the farang woman opened a window. It's not known whether she was scolded by the train staff, but at least she and her fellow passengers breathed easier.

In my own little way, I'd like to carry the spirit of that outspoken woman to the nuclear debate in Thailand. Many Thai citizens will believe whatever EGAT tells

them with barely a second thought. A relatively small portion of Thais may become aware of the serious drawbacks to building nuclear reactors in Thailand – but all but a few of those more aware citizens will likely opt to sit on their hands with the realization that it's futile to try to counter 'the powers that be.' Plus, Thais know that environmentalists get murdered in Thailand.

More than once activist has been snuffed out for daring to speak out against the establishment. Just as often, Thai law enforcement and their legal system is ineffectual in catching and prosecuting perpetrators.

Case in point: There was a young activist in the south who was generating awareness about the mangrove forests being cut down to make way for shrimp farms. He was telling residents there that when the farms got too polluted and no longer yielded shrimp, the farmers would leave the scarred area behind with no rehabilitation or replanting – and go on to the next mangrove area. He was murdered. Another young activist was murdered in a different part of the south due to his efforts to draw attention to the drawbacks of building an oil pipeline. When people started listening, the oil corporation bosses knocked him off.

In sum; if a citizen challenges 'big money' power brokers in Thailand, he/she can be killed and there will be scant follow up by law enforcement. Indeed, there are hitmen for hire throughout Thailand, and the going rates (and the hitmen themselves) are known to villagers – who accept it as another fact of life (and death).

Below is a list of 20 environmental activists who were murdered during the five years of Thaksin's reign as PM. It's doubtful that any of the assassins or the people who hired them have ever been formally identified or charged with murder, or as accomplices to murder. Influential and wealthy people are often behind murders-for-hire, and such people are untouchable in Thailand.

Here is the list, culled from the Nation newspaper;

1. Jurin Ratchapol: Killed January 30, 2001 because he took action against encroachments into a mangrove forest by influential people in Phuket.

2. Suwat Wongpiyasathit, leader of Rajathewa community: March 28, 2001: Was murdered after campaigning against a garbage disposal project that produced foul smells and water pollution. She was shot dead a day before she was due to speak to a Senate committee on the environment.

3. Narin Bhothidaeng, former chairman of Khao Cha Ang Klang Tung conservation group in Rayong. Killed on May 1, 2001 because he led villagers to protest a rock grinding plant run by a national politician.

4. Pitak Tonewut, former president of the Nature and Environment Conservation Student Club at Ramkhamhaeng University: Killed on May 17, 2001 because he led villagers to oppose the building of a stone mill that encroached on a forest conservation area in Nakhon Sawan province.

5. Chaweewan Peeksungneon, Nakhon Ratchsima's Naklang Tambon Administrative Organisation (TAO): Killed June 21, 2001 for obstructed the bidding for construction projects by the TAO which favored local wealthy and influential people.

6. Somporn Chanapol, leader of Kradae river basin conservation group in Surat Thani: Killed July 2001 for protested a dam construction project that obstructed the Kradae river.

7. Kaew Pinpanma: killed in April 2002 over a land dispute in Lamphun province.

8. Boonsom Nimnoi: killed in September 2, 2002 because he protested the construction of a chemical factory in Petchaburi's Baan Leam district.

9. Preecha Thongpan: September 27, 2002: Was shot dead after campaigning against a wastewater treatment project in Nakhon Sri Thammarat's Tung Song district.

10. Boonrit Charnnarong: Killed December 15, 2002 because he protested against illegal logging by forestry officials in Surat Thani's Tha Chana district.

11. Boonyong Intawong: Killed in December 20, 2002 because he protested against a rock grinding plant run by a local influential figure in Chiang Rai's Wiengchai district.

12. Khampan Suksai, deputy chairman of the Ping River Basin Conservation Group: February 1, 2003: Killed when he tried to prevent an important person from encroaching into community forests.

13. Chuan Chamnarnkit: Killed February 4, 2003 because he campaigned against drug use in Nakhon Ratchasima.

14. Samnao Srisongkram, chairman of Pong river conservation club:
Killed May 25, 2003 because he protested against a paper mill.

15. Somchai Neelapaijit, human rights lawyer: Last seen on March 12, 2004: Kidnapped and killed by government agents because he was the defense attorney for five Muslim militants suspected of involvement in the January raid on an Army base. He also was defense attorney for three suspected Jemaah Islamiyah terrorists, and was involved in cases against a proposed gas pipeline in the South.

16. Chareon Wataksorn: Killed June 21, 2004: Led successful campaign against building of power plant at Bo Nok. Filed petition with interior minister and National Counter Corruption Commission accusing wealthy people of bribing local administrative organization officials to agree to sale of a 53rai plot of land. In 2001, he had received an honorary doctorate degree.

17. Luechai Yarangsi, president of an environmental group in Lampang, was shot but survived.

18. Boonsom Nimnoi, a community leader opposing a Phetchaburi plantation, was killed in September 2002.

It's a sobering list, not least because most of the murdered activists were bright young university graduates – and also because they were all protesting peacefully. A decent thing to do would be to erect a memorial to acknowledge their sacrifices. Have each murdered person's name shown, along with their hometown's name and a brief mention of their cause. In Thailand, if a woman wears a spaghetti strap blouse, or if a farang is caught tossing a cigarette butt on a trash-strewn Bangkok sidewalk, she can be fined. In contrast, a wealthy contractor who hires a hitman to knock off a young person – is left untouched. At worst, the hired thug may get a reprimand, but the big boss ordering the hit is essentially untouchable – even if the whole community knows his identity.

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2. Feasibility Study with Foregone Conclusion

EGAT announced near the end of 2007 that they are allocating 138,000,000,000 baht (over 43 million dollars) to conduct a feasibility study to see whether nuclear power plants are the best option for generating Thailand's future electricity needs. To add legitimacy to the study, they got the Thai government to form a proxy entity called Nuclear Power Development office (NPDO) to stand alongside. Since EGAT is a government enterprise, it's run differently than a corporation. One of those differing ways is to allocate vast amounts of money for a campaign to produce a foregone conclusion. Actually, it's similar to what a private corporation would do, though a corporation would call it 'marketing,' whereas EGAT calls it a 'feasibility study.'

"Building a nuclear power plant is unavoidable for Thailand."
EGAT governor Kraisi Kanasuta.

Tara Buakamsri, a Greenpeace campaigner, says, "Amongst many fast-tracked decisions taken by the erstwhile military-government, the approval of 1.38 billion baht to study nuclear power generation by Mr. Piyasvasti Amranand (former energy minister), on his last day in the office, is a huge waste of money and will not adequately address the real issue of energy security."

Those in the highest echelons of Thai government want nuclear power. They've already expressed that desire unequivocally. The reasons are manifold and will be discussed later. The point here is that the allocation of 1.38 billion baht is a complete waste of taxpayer/ratepayer's money, because it's earmarked for a result that's pre-ordained. Actually, much of the money will get spent on high quality printed brochures which will likely be distributed nationwide. Another sizable portion will get spent on TV and radio ad spots.

Why all the expensive brochures and TV spots? The answer: To convince the Thai public that nuclear is the best option to meet Thailand's future electricity needs. To get an idea of how easily the general Thai populace is swayed by publicity: Just after the turn of the century, there was a nationwide election. One party spent gargantuan amounts on printing slick campaign posters which they hung everywhere. Nearly every one of the millions of concrete power poles throughout Thailand had a

poster hanging from it (which is technically illegal, but who cares when the hanger is rich and powerful?). The other party had a much smaller number of posters hung. Guess who won the election? It's a no-brainer, the party with the steamroller campaign won handsomely.

One party made all sorts of promises, having to do with forgiving debts, and offering nearly free health care. No matter that when that party won, the debt forgiveness plan went awry and hospitals closed for lack of funds. All that mattered was saying what need to be said to get elected.

One party had a giant campaign that paid village headmen to pass payments down to voters. Some observers say that the vote-buying was the most effective policy of all – and it certainly cemented the well-funded party's avalanche of votes. The nuclear 'debate' within Thailand will involve money also – lots of it - and there's no mystery who will have the most baht to spend to pursue their agenda.

Where does the money come from? The 1.38 billion baht for the 'feasibility study' which EGAT **(Electricity Generating Authority of Thailand**) is allocating to the newly formed NPDO (Nuclear Power Development Office)? Perhaps that's a two or three pronged question. For starters, how much is Thai government (taxpayers), and how much from EGAT's rate-payers. It's not from corporate coffers because EGAT is not a private corporation, so the 'feasibility study' will be paid for by the public, either through taxes and/or through higher electricity bills.

EGAT won't ask corporate bidders to contribute to their campaign to market nuclear, at least not openly. Since the money EGAT will be spending is government money, then there's scant incentive to get creative with the financing of their 'feasibility study' or any other expenses. Plus it takes more effort to solicit cooperation from outside corporations, and EGAT would likely rather take the course of least effort.

If EGAT's proposed 'feasibility study' were really looking at the feasibility of nuclear, it would, by definition, look at other electricity generating options. There has been, and will continue to be some lip service paid to some alternatives, yet the conclusion is foregone – the boys at the top all want nuclear, so any mention of alternative options will be like window dressing – in order to make it appear they're being objective.

Update on this topic, winter 2011

The data below was garnered from the web site:
http://rbdweb.nstda.or.th/rbdweb/download/1-Nuclear.pdf
and is the conclusion of EGAT's feasibility study:

Thailand's Nuclear Power Plants Feasibility Study
Thai Professionals Conference (TPC 2010) / Monday, June 5, 2010
Apisit Patchimpattapong, Ph.D. - Nuclear Engineering Division
Electricity Generating Authority of Thailand (EGAT)

The study concludes that Nuclear Energy Production for Thailand will be;

>>> reliable
>>> low and stable cost
>>> no greenhouse gases emissions

Results of a survey taken among Thai citizens, gauges what % of those questioned would approve of nuclear power development:
- in Thailand 64 / 32
- in their province - 32 / 59
- In their community - 24 / 66

Feasibility Study by Burns and Roe Asia, Ltd. (Oct 2008 - May 2010)

Dr. Kurujit Nakornthap, Deputy Permanent Secretary, Ministry of Energy, Thailand

Here is one succinct quote which was included in the study:
"Nuclear power has an excellent safety record"
Source: H-Holger Rogner, Head of Planning & Economic Studies Section, Department of Nuclear Energy, IAEA, 2010

The report goes on to mention: "At present, Public information program to promote nuclear energy is being developed by Subcommittee on Public Information and Public Participation and EGAT's working group on Public Communications. TV/Radio ad campaigns (including use of recognized Thai personalities on talk shows, etc), mailings (e.g., with electric bills), websites, newspaper and etc are considered as the effective media tools to communicate with the public. The program contents include the benefits of providing future electrical generation i.e. economic benefits (competitive cost of electricity), reduced green house gas emissions, and greater security of supply."

Ken's note: in other words, a greater publicity campaign needs to be waged by boosters of nuclear power in Thailand, including using celebrities to appear on mass media campaigns.

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Eight months before Japan's Fukushima was breached, Thailand's EGAT published a summary of their 175 million baht 'Feasibility Report' for whether Thailand should go nuclear. The whole thing, of course, was a farce, as the recipient (Burns and Roe Asia, Ltd.) of that money knew beforehand what Apisit Patchimpattapong PhD and other heads of EGAT wanted to see. The actual money agreed upon could have been 200 million, with EGAT heads possibly pocketing the difference. The public won't know unless there's an inquiry.

The overall summary of that report states: "Nuclear power is reliable, low and stable cost, and emits no greenhouse gases."

I wouldn't be surprised if Thai ratepayers/taxpayers, who are partial owners of EGAT, bonded together to slap a class action lawsuit against EGAT and Burns and Roe - claiming malfeasance in their collusion on that expensive bogus report. That 175

million baht was a clear waste of money by a public owned Thai company - on a ruse that fooled nobody. 'Malfeasance' is a strong word, but applicable in this case, as it means, "an act by a public official that is legally unjustified or harmful to his constituents." If EGAT goes ahead and builds the five nuclear power plants it wants, then 'harmful' will be too soft a word for what might happen if one or more of those plants were commandeered and/or breached.
Source: Bangkok Post's Postbag, April 17, 2011

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175 million baht is an interesting number. When Thai government authorities dole out large government contracts, there are rarely finalized numbers like 175. It's more likely the amount offered was 200, but somehow 25 million baht 'got lost in the shuffle'. Was there 25 million Baht paid 'under the table' to the prestigious US nuclear engineering firm which was chosen (via a no-bid process) to write the report? Us little people will never know, because if there was a bribe, it would have been covered up and denied as much as possible, by 'the powers that be.' And don't expect any investigation on the matter.

When the head of Thai Tourism (TAT) got in trouble for accepting bribes (for allegedly enabling a US couple to arrange a Cinema Festival in Bangkok), it was US authorities who broke the story. Thai authorities didn't even know there were improprieties involved, and wouldn't have pursued an investigation or compelled any Thai VIP wrongdoer to face justice for something like that. Similarly, the Thai representative to FIFA was accused of cruising for a bribe for his vote on which country would host the World Cup. Would Thai authorities have unearthed that transgression? No. After it was alleged, would Thai authorities be expected to investigate and/or pursue disciplinary action against the alleged perpetrator? No.

This is Thailand, where 'face' rules, and 'mai pen rai' is the watchword.

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3. Which Sites?

Part of the 1.38 billion baht will supposedly get spent on deciding where the four best sites are for building nuclear reactors. This is obviously a sensitive issue, because even out-of-the-loop Thais acknowledge that there are safety concerns with nuclear. However, if jobs are on offer, then safety concerns will likely take a back seat. In other words, if a site were picked that was near X village, and the residents of X were convincingly told there would be lots of jobs on offer, then it's quite likely that most residents would look upon the new plant favorably. Thailand is a country in flux. It's easy to move from one area to another. So even if a resident of X had worries about living in the shadow of a nuclear reactor, she might not mind moving elsewhere.

EGAT and the NPDO, with their government money and backing, can both be expected to carry out a splendid publicity campaign. It wouldn't be surprising to see

popular music bands and celebrities brought to the town, and heaps of great publicity for nuclear get offered to residents of village X and surrounding regions.

Nor would it be surprising to hear about under-the-table pay-offs to village headmen, promises of public work improvements, and perhaps even direct payments to villagers. All Thai politicians know how affective such actions have been for political campaigns, so it's only a slight adjustment to apply such skills to boosting nuclear power plants.

For practical reasons, all nuclear sites will have to be near copious supplies of water. The water will be needed for cooling the reactors. Salt water from sea can be used indirectly, though there are environmental drawbacks. The water being pumped in will have to be filtered, and the powerful non-stop pumping action, in and out, will have adverse affect on sea life. Clam and barnacle eggs could get through the filters and bollox up the pump, the valves, and piping systems. The zebra clam came to America's Lake Michigan in the ballast of a tanker. The ensuing problems with clam-infested municipal and factory pipes has caused damages there in the billions of dollars.

Thailand has many Km's of coast, including a few islands. Some islands and stretches of coast are obviously not on EGAT's short list. Anywhere near Krabi, Hua Hin, Phuket, Chon Buri/Pattaya, the Samui region, and other islands are very doubtful – because of their high density and/or tourism.

Much of Thailand's coast stretches along the far south region, yet that is also where there are festering problems with Muslim extremists. Rule that area out because of concerns for security. Extremists have been targeting anything and anyone who is even remotely connected with the Thai government. Teachers, street sweepers, coast guard piers, telephone booths – essentially anything that has the garuda state seal - is fair game. What juicier target than a nuclear power plant for those bent on causing trouble for government?

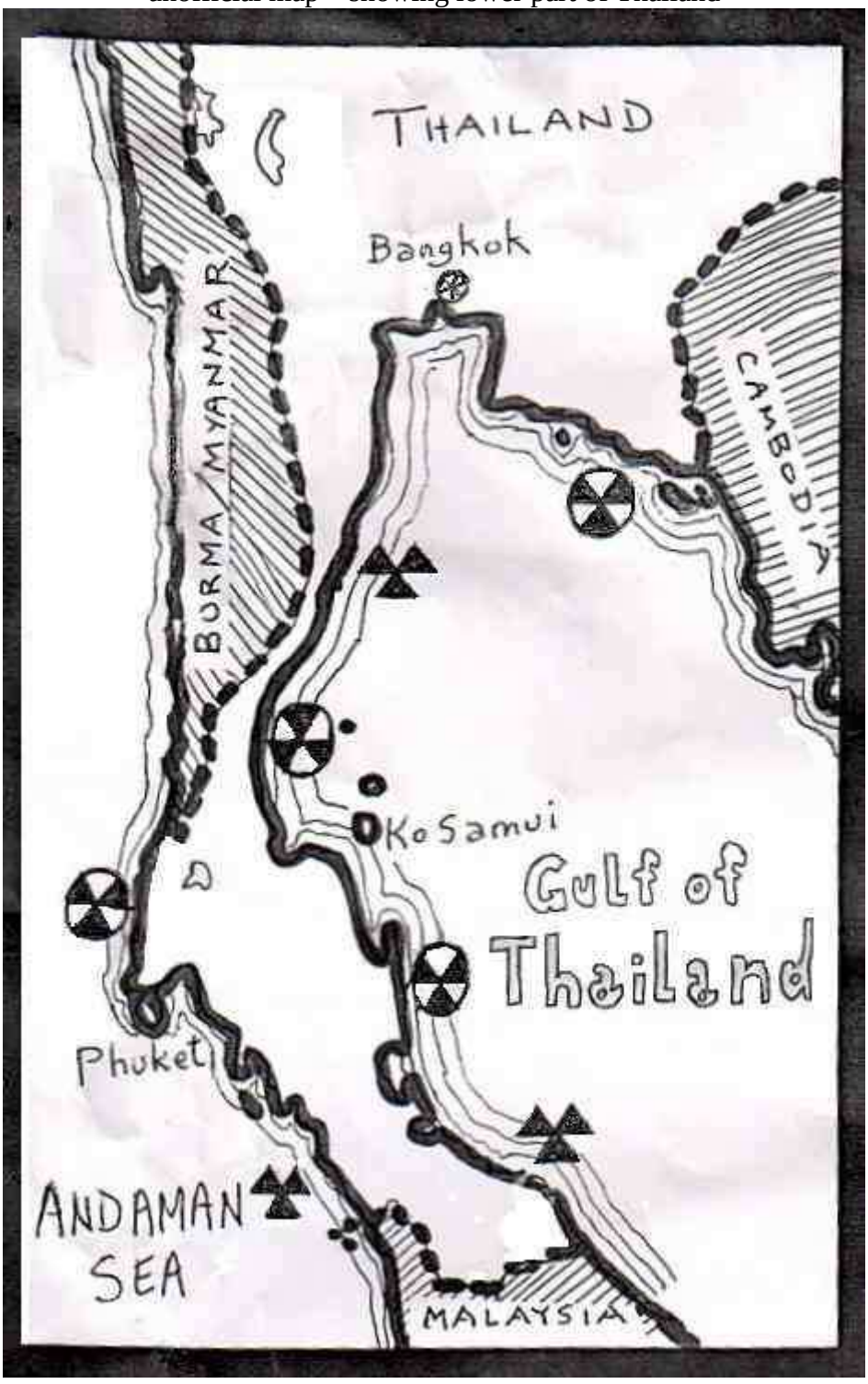
Much of Thailand's coast lies close to neighboring countries. It's doubtful that Cambodia, Malaysia or Burma would be warmed by the idea of having a Thai reactor planted near their fence line. Looking at Thailand's Andaman coast; its southern region meanders on down to Malaysia (and Islamist separatists) and the northern coast stretches near to Burma. The middle region is largely saturated with tourist destinations. Add to that, the new-found awareness of tsunamis and earthquakes, and that could preclude Thailand's entire Andaman coast from hosting any nuclear power plants.

Thailand's much longer coast around the Gulf of Thailand also has many similar impediments to building even one, let alone several nuclear power plants. Between its most southern region and the Samui area is the Buang Lagoon by the city of Songkla – which might be a proposed site – though it's still relatively close to areas of southern unrest.

The northernmost part of the Gulf of Thailand is called the Bight of Bangkok on some maps. It's bordered by land that includes Hua Hin, Pattaya, and of course; Bangkok itself. That whole region is out of the question as a site for a nuclear reactor

- not only because of high populations, but also because there are at least two royal residences in that area.

*** unofficial map – showing lower part of Thailand ***



☢	indicates a less likely site for a nuclear power plant
☢	indicates a more likely site

After eliminating the coastlines which have drawbacks for consideration, there is scant little coast left to plausibly site a nuclear plant. There is a 300 Km stretch going north/south between Hua Hin and Suratani/Samui – though much of that region hosts tourist towns – and none is more than 50 Km from Burma. Indeed, some middle parts of that beach line are only about 15 Km from the Burmese border – so it harkens back the issue of whether Burma will take kindly to a Thai nuclear reactor within shouting distance of their territory. Also, a major railroad line and highway go through that narrow corridor. A nuclear problem there would be akin to smashing the knee of a one legged man.

If the tables were turned, it's doubtful Thai authorities and their military masters would give a warm welcome to the idea of having Malaysia, Burma, Laos or Cambodia build nuclear power plants within 15 Km of their border.

The only other tenuous possibility is the 150 Km stretch of coast southeast of Bangkok between Sattahip and Trat. Much of the same concerns crop up, namely: resort towns (Ko Samet, Ko Chang, Chantaburi and Rayong, to name a few) and proximity to a foreign country (Cambodia). Residents of Rayong have been in the news recently as protesting polluting factories, so they've shown themselves to be environmentally aware and prepared to mobilize with protests – if need be.

If EGAT opts to site a nuclear plant alongside a lake, then surely protests will ensue – not least because water rights are a sensitive issue in Thailand. Along with annual flooding which affects many parts, there are also annual problems with droughts. Every year there are new and on-going protests that revolve around lack of water. Having power plants commandeering lakes or stretches of rivers is bound to elicit howls of protests from farmers and homeowners.

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4. Get Informed

As we all know, a few years ago, Thailand's Andaman coast was hit by an unexpected tsunami. The word 'unexpected' is used here, because if you had asked any Thai person, even their top scientists, what were the chances of a tsunami hitting the Andaman coast – before the big one hit - nearly every one would have said zero or close to zero. Those 'in the know' would have told you that tsunamis are very rare in the Indian Ocean – and in recorded history, no tsunamis have ever threatened Thailand's shores.

Indeed, before the recent big tsunami, all but a handful of Thai people didn't even know the word 'tsunami. When taking on such a serious technology as nuclear fission, awareness of potential threats should be a key component to planning process. Thais are certainly familiar with such things as flooding and drought, just as they know much about Bangkok and Thai history. But ask the average Thai to describe a

glacier or to name two cities in any one of their four bordering countries, and you're likely to draw a blank.

That's why a rounded education of what's involved with nuclear power plants is so important at this juncture in Thailand's history. It's not enough to get just the glossed-over campaign that EGAT with their hired celebrities will parade out. People need to see the whole picture – before they are able to make informed and wise decisions.

Even EGAT doesn't see the whole picture. Or, if some of their people see it, they surely don't want to share their ideas with others. If an EGAT employee knows that going nuclear is his employer's foregone conclusion, what good would it serve for that person to buck the trend and declare that something like 'concentrated solar' looks to be a much better power option? Such a person would be ridiculed at the least, probably ostracized and lose his job – and may even get knocked off – pow! Thai assassins have been hired to kill for less serious reasons than that.

A few years ago, an accountant from Australia was hired to come to Thailand to do an audit of a rice mill which appeared to be cooking the books. On his way to the mill, he got shot and killed. Recently, a Thai doctor and her friends were all gunned down while having a friendly little barbecue in the back of her house. The reason; some neighbors thought the music was too loud.

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5. Where There are Big Contracts, There are Big Pay-Offs

Consider this hypothetical situation: There are two types of electricity generating options under consideration by authorities: All the components of each are identical. However, one of the options entailed big lucrative contracts for the builders, whereas the other option was cheaper all-around. Guess which one would be picked? If it happened in Thailand, the option with the big contracts would be chosen. There are several reasons for this, but the biggest reason is money. That's the primary reason why the plans to build four nuclear power plants are being railroaded toward implementation with such vigor by the 'powers that be.'

Before, during, and after their expensive 'feasibility study,' EGAT (and everyone else who might a piece of the tens of billions of baht on offer) will be only singing praises for nuclear. They're not stupid, and they know there will be concerns by some for safety, security, environmental, and fiscal issues. So they're lining up their marketing campaign to address those issues in quite convincing ways.

They will start by emphasizing Thailand's future needs for electricity. That in itself is not a contentious issue – though EGAT and others are addressing it from just one angle. For starters, EGAT's projected numbers are not realistic.

Witoon Permpongsacharoen, who is secretary-general of the Foundation for

Ecological Recovery asserts the following; “Thailand does not need nuclear power. The purported "need" is based on an unrealistically high power demand projection and an unjustifiably small amount of real alternatives allowed in the PDP 2007 (the official 15-year power development plan). Last year, actual energy consumption grew 3.3% compared to the projection (by EGAT) of 6.14%. The government's forecast of future power demand is more than double the past 15-year average of only 914 megawatts per year.”

In contrast, Thailand’s nuclear proponents paint a picture of ever-increasing demand for electricity. Besides the fact that nobody knows for sure what the future will bring, there are some related issues that beg to be mentioned.

First off, there’s rarely a mention of conservation, except for the offhand mention of greenhouse emission related to global warming. That’s what’s called a ‘canard’ or a ‘red herring.’ Although nuclear plants don’t emit carbon when powered up, they do have a carbon footprint. Just one of many ways that nuclear plants contribute nightily to CO_2 emissions;

Mining requires very heavy machinery. Just one mine in Australia released the following numbers regarding the amount of diesel it will need to get through the top layer of rock – in order to access the ore it seeks: Roxby Downs estimates it will take one million liters of diesel per day for four years – that’s nearly 1.5 billion liters of fossil fuel just to get through the top layer of rubble. After that, they’ll need billions of additional liters of fuel to actually mine and process the ore they’re aiming for. So, next time of someone tells you that ‘nuclear emits no CO_2, or has ‘no carbon footprint,’ you can look them in the eye and tell them ‘that’s hogwash!’ ….and tell them why. [thanks to Roger Beaumont of the Nation Newspaper for passing that info along].

And to say nuclear doesn’t emit carbon, while obfuscating the more dire issue of radioactive waste, is like telling your child to not spill her soup on the floor, while you’re draining the used oil for your car on the same floor.

EGAT in particular, and nuclear boosters in general don’t seem to realize that the #1 best way to deal with energy shortages in the future, is to encourage Thais to conserve energy. Perhaps it’s understandable that EGAT skirts that issue, as it’s in the business of selling the stuff, so why should it encourage people to buy less of what it sells? A similar sort of outlook might explain why President Bush was never a keen enthusiast for alternative power options in America. After all, for generations, his family had become rich selling Texan oil.

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6. Some Nuke Related History

Does the name Hans Blix ring a bell? He was the Swede who was appointed by the UN to head a committee to look for 'weapons of mass destruction' in Iraq, prior to America's second Gulf War. Well, roughly ten years before, Mr. Blix, as director of the UN's International Atomic Energy Agency (IAEA), came to Thailand. His mission at that time was to convince the Thai government that nuclear energy was a good way to meet its future power needs. He told his eager listeners, "In the longer term it is inevitable and indispensable to use nuclear power and therefore any developing countries with fairly high levels of development, like Thailand, must begin to prepare for a nuclear period."

EGAT heads and the Thai generals in attendance appeared to agree heartily with his recommendation. Soon after, EGAT formed its first 'feasibility study' which lasted three years and came forth with a projected cost of $1,430 per kilowatt. [Note: current estimates for large-scale solar generated electricity are as low as 1 baht per Kw – but more details of that later].

The UN's IAEA's stated purpose is to ensure safe use of nuclear – especially as regards possible weapons off-shoots. The IAEA was not designed to act as a booster for nuclear – particularly in lieu of the fact that there is no UN agency that promotes alternative energy options.

Soon after Blix's promotion and EGAT's per/Kw numbers, (produced by a Japanese consulting firm with ties to nuclear contractors), the World Bank issued a paper which strongly advised Thailand against building any nuclear plants. The bank's report concluded that relying on natural gas, even if it had to be imported in liquefied form from Indonesia or the Persian Gulf, would be cheaper for Thailand than nuclear energy. It also estimates that nuclear power will cost Thailand $3,000 or more per kilowatt - 200 percent higher than the EGAT figure of a few months earlier – and many times higher than estimates for solar costs.

The following article is taken from a May 2008 syndicated newsletter written by Roy Wasson at **RenewableEnergyFund.net** based in Miami Florida, USA

Kevin Bullis in the MIT Technology Review predicts that the silicon shortage that has kept solar energy expensive is ending, paving the way to widespread expansion in PV system usage worldwide.

Mr. Bullis goes on to say; "Solar electricity is about to get much cheaper, industry analysts predict, because a shortage of the silicon used in solar panels is almost over. That could lead to a sharp drop in prices over the next decade, making solar electricity comparable in price to power from the grid."

Solarbuzz CEO Mike Bradford; says; "Crystalline silicon has long been the staple of the semiconductor industry - but it's also the active material in the most common types of solar panels. While only 15,000 tons of silicon were available for use in solar cells in 2005, by 2010, this number could grow to 123,000 tons, "What that means, practically, is that solar module prices are going to come down dramatically in the next three to five years,"

Bradford goes on to predict that over the next five years, production of solar panels will double each year. In a recent presentation, he said that prices for solar panels could drop by 50 percent or more – between 2007 to 2010.

In areas that get a lot of sun, that will translate to solar electricity costs of under 10 cents (3 baht) per kilowatt hour which will make large scale solar affordable." Bradford concludes by saying; "You can't even begin to imagine the transformation that that's going to create."

During the latter part of the 20th century, no new nuclear power plants were ordered in North America. Similarly, Canada's Ontario Hydro cancelled twenty planned nuclear plants. What did they know that Thailand didn't know? Perhaps their policies had something to do with North Americans have had decades more experience than Thailand – in the nuclear power plant arena.

It's no wonder that nuclear power plant manufacturers, like General Electric, became concerned. With the help of the IAEA and people like Blix, nuclear industry focused much of their marketing might on prestige-seeking Asia. Despite the marketing pressure from big players in the industry, there are currently less reactors in operation today than five years prior. There are also less plants under construction that ten years ago.

The U.S., which was the pioneer in nuclear power generation, has not had an order for a new nuclear plant in the past 20 years. Why is that so? It's not for lack of development funds. The reason is the American people, who have been directly acquainted with nuclear longer than the citizens of most other countries, have realized that the drawbacks of nuclear power outweigh its benefits. Indeed, the U.S. is one of the few places in the world where functioning nuclear plants have been decommissioned.

Bikini Atoll, a remote little island in the Pacific Ocean, was used by the U.S. military about 60 years ago, to test atomic weapons. The handful of residents were moved off the island beforehand. They have no possibility of returning to their home island any time soon, as the radioactivity remains too intense.

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7. Peaceful Ways to Assert The Will of the People

There are peaceful ways citizens of some countries can over-ride the wishes of their governments and large corporations. In other words, if a large and determined group of people decide to enact a policy shift, they can do it. They do it via a combination of free press, peaceful demonstrations, and the ballot box.

Such avenues that enable the will of the people to override government policy, or to challenge big business don't exist in most countries. For example, in China, it's currently near impossible for a popular peaceful movement to affect change. Same for Burma, North Korea, parts of the former Soviet Union, and most of Africa.

Thankfully, a country like Thailand does not have as much entrenched control apparatus as China, and the other countries mentioned in the prior sentence. Yet true democratic avenues to change still have a ways to go in Thailand, as it remains a stratified society.

However, Asia governments' attraction to nuclear has not abated. Below are listed several reasons why nuclear continues to appeal to Asian governments;

>>> Nuclear has a prestigious aura about it. It's not necessarily joining 'The Nuclear Club' in terms of the mightiest weapons, but it's a 'Nuclear Club' nevertheless – and gives the appearance of modernity and of being technically adept .

>>> With a few exceptions (Japan, Singapore come to mind), Asian safety standards are not as strict as Europe or the U.S – thereby making big construction jobs easier – by having comparatively lax standards.

>>> Organized protest movements are more difficult to get going – and are often brutally squashed at their inception. Besides some smaller countries, where protests are nearly impossible (Cambodia, Vietnam, Burma, Laos), even a large country like China suppresses protests with an iron fist. Partly for that reason, China has more nuclear plants on order than any other country – 30 at last count.

>>> Most Asians have grown up accustomed to having directives given from a patriarchal top echelon. Non-conformity is frowned-upon. In other words; the government decides the flavor of the month, and its citizens better accept it, or suffer consequences.

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8. Yellowcake is not a Kid's Treat

Yellowcake is refined uranium (U3O8) that is the fuel for a nuclear reactor. Most of the world's uranium is mined in one of five countries: Australia, Canada, Namibia, South Africa, and Kazakhstan. Which ones will Thailand purchase from?

Mined uranium comes in several forms, or isotopes. For starting a nuclear chain reaction in a reactor, the only useful isotope is uranium-235, which accounts for just 7 out of 1000 atoms in the mined product. The other isotopes are useless except to tip armor piercing bullets and missiles. In other words, once the uranium is freed from the sand and rock, it will initially need to be refined to get the 0.07% that's useful.

Several further steps of processing are still needed – to get the ratio up to 0.5%. This is done by separating isotopes in an enrichment process that achieves the higher concentration. That's when you get Yellowcake. If there's a glitch in any of the many steps of that process – no yellowcake comes out the other end of the conveyor belt. Compare that, to what's needed to process the fuel for solar generated power. No contest. Just low-cloud daytime skies, and you're generating power.

In early 2003, the commodity price for a pound of Yellowcake was $7. Four years later its price ballooned to $130 per pound without declining once. That's a 1,700% increase in a four-year span.

At the turn of this century, there was investment neither in new uranium mines nor in the facilities needed to process the raw material in to yellowcake. During that time, demand was partially met (in the U.S. and Russia) by breaking down nuclear weapons and draining inventories, which are now nearly gone. Worldwide, uranium production meets about 60 percent of current reactor requirements – and dozens of new reactors are planned – mostly in Asia.

According to Dr. Thomas Neff, a research affiliate at MIT's Center for International Studies, "The shortage of uranium and of processing facilities worldwide leaves a gap between the potential increase in demand for nuclear energy and the ability to supply fuel for it." ….and that gap will widen as more reactors get built.

When EGAT funded its initial study on nuclear power feasibility for Thailand, they were basing their findings on a very low price for fuel, and had no way of knowing that Yellowcake would skyrocket in value.

They also could not have foreseen that there would be less uranium mines in the near future – even though uranium is in ever-increasing demand. One of the most basic tenets of the 'Law of Supply and Demand' is if there's increased demand and less supply for a commodity, that commodity goes up in value accordingly.

There are no uranium mines in or near Thailand. The mining process is complex, many-tiered, and requires permits at every step – particularly as regards transporting across international boundaries.

Two of the very few Uranium mines worldwide are in Australia – namely; Energy Resources of Australia's Ranger mine, and Cameco's Cigar Lake operation, and both are having production problems. Each suffered serious flooding, though the causes were not the same. It underlines the fact that; a glitch in any step in the mining, processing or transport of Yellowcake can render a nuclear plant literally powerless without its fuel. Some of potential pitfalls of bringing uranium out of the ground and to the processors, and then transporting yellowcake to the end user:

1. Exploration. Are permits issued and valid? Will the survey yield a 'false positive' thereby stretching investment funds?

2. If ore is found, will permission and permits be forthcoming?

3. Property will have to be purchased or leased. In most countries, an Environmental Impact Report (EIR) will have to be developed, and in western countries that requires input from regional residents. [Note: some of these issues apply as well to establishing a site for a nuclear power plant. In Thailand, there supposedly are some laws that address 'EIP' issues, but they're easily circumvented by the powers that be – sometimes via devious means. Case in Point: Bangkok Post, April 6, 2008 edition, page 2, there was a half page report which mentions a large natural gas depot which sprang up

near a dense residential neighborhood. Only as the construction neared completion did some of the locals raise concerns. That's because the supposedly required EIR was skirted around via a devious series of shell games and ruses by the corporation which put in the depot.]

4. Equipment and facilities will need to be purchased or leased.

5. More investment. Maintenance will be needed on all equipment.

6. Will employees be unionized? That one issue alone can close a plant.

7. Processing: how efficient and safe will it be?

8. Natural 'acts of God' occurrences, such as the different types of flooding that closed down the two Australian mines mentioned above. There are a host of other potential natural phenomena which could cause glitches – or worse.

9. Sabotage: Wherever there's uranium-related activity, there will be people and/or organizations which may want to sabotage it, for one reason or another. This holds true not only for mining, but also for transport, and for the nuclear reactors themselves – and possibly also the controversial process of trying to deal with nuclear waste – a subject we'll discuss in detail, later in this text.

10. Protests and popular uprisings. Perhaps not as real a threat for mining and shipping as it is for the power plants, but a potential glitch factor nevertheless. Actually, protests along shipping routes are becoming popular and effective methods of getting strong messages across.

10. Lax Work Standards: - can happen in any industry. The operating nuclear power plant near Sacramento, called Rancho Seco ('Dry Ranch' in Spanish) wound up getting shut down. One of the initial complaints lodged by locals, in that case, was; security employees were shown to be using drugs while on duty. The idea of a team of people operating a nuclear power plant drunk or stoned was not very comforting to nearby residents. Thai authorities can brush all such concerns aside. They'll start by saying, 'it can't and it won't happen.' Then go on to give a plethora of reasons for its impossibility, and mentioning harsh penalties for anyone caught drunk or stoned on the job.

Fact is, Thais are forgiving of such improprieties. Example: if a government employee is found guilty of wrongdoing (in spite of initial denials from his superiors), the worst that can ever happen is a 'transferal to an inactive post.' In other words, there is no offense which can cause a Thai government official to get fired.

Another case in point: at Bangkok's new airport, there had been nagging complaints of luggage being broken in to and valuables being stolen. Apparently there were no security cameras in the cavernous baggage handling area, or the cameras didn't work, or no one was watching the displays, or higher ups knew the culprits, but didn't want to blow the whistle ….the list could go on and on as to why the pilfering continued. The sobering truth is; if the top echelon of security

took his job seriously and really wanted to bust the culprits, they could. Instead, a 'mai pen rai' attitude prevailed, along with denials, excuses, along with possible cover-ups and pay-offs.

11. Transport – is another area where glitches could logjam the supply of Yellowcake. Transport would be over land and sea. The sea lanes around Singapore (which is between Australia and Thailand) are notorious for pirate activity. A Yellowcake-laden ship would be a juicy prize.

Anything that can be shipped by sea is subject to permits and tariffs. Yellowcake especially so – because of its importance to national security. Permits and tariffs aren't static, and it shouldn't surprise anyone if such regulations get stiffened, and customs' duties increase over time. Political implications are never far from something like shipping important fuel. Look at all the controversy that has been stirred up over the years regarding the shipping of oil – and oil is not nearly as difficult to mine, nor as limited in its supply, nor as valuable on a per pound basis - as yellowcake.

Wars have been fought over the availability of oil and its shipping lanes. Why would we expect anything less in regard to Yellowcake? To take just one example: China will soon have dozens of nuclear power plants. All its fuel will have to imported, most likely from Russia and Australia. Electricity from nuclear will be an essential commodity, and any threat to its yellowcake fuel supply could possibly see China threaten to use its powerful military. During the 2008 Chinese New Year, millions of Chinese got stranded because of snow storms and lack of electricity. It was a national disaster. In that case, it was the blizzards that caused the blackouts. However, you can imagine; if the blackouts were man-made (piracy, terrorists, enemies, blockade, protests, etc) – Chinese top brass would stop at nothing to fix the problem.

With China, North America, Europe, Japan and others competing mightily for a finite amount of yellowcake, the price of the commodity will doubtless rise – probably astronomically. Has Thailand's EGAT taken that into account in its 'feasibility studies?' More important, how is little Thailand going to feasibly compete with the world's economic and military heavyweights for limited supplies of yellowcake?

It wasn't many years ago that Thailand's navy talked the government in to buying itself an aircraft carrier. Fighter planes were then needed. Then it was discovered that the planes had to be maintained, and there were copious amounts of fuel needed to get the big boat moving. Needless to say, the ship has been sitting in dock, and one of its three fighter aircraft may be operational. Overreaching and bad planning is no stranger to Thai top brass.

Another well-documented case in point: the new airport for Bangkok – with the long name whose transliteration doesn't fit with how the name is actually pronounced. We'll call it SUV. In planning stages for decades, there was never a real EIR filed, certainly never one that encouraged input from affected residents. Lo and behold, when the reality of jets flying in and out at low altitude dawned on the residents, it was too late to do much about it. Not surprisingly, the near-constant noise and

shaking is having an adverse affect on residents and their dwellings. Were they forewarned of drawbacks by authorities? Of course not. As for compensation for suffering and damage after the fact – that's being dealt with in typical Thai fashion: A few thousand baht dispensed here and there – just enough to try and keep the seething masses from protesting too much.

As for the site: Anyone who follows Thai news clippings will know that the airport was put in a swampy site. Drainage infrastructure was installed, but some cracking due to settling has plagued the airport since its opening weeks. If global warming has any credence, then the runways should be under a meter of water in thirty years or less. Leading up to that, will probably be plans to build a big levee around it – which is also what's been seriously suggested as a future mega project for Bangkok itself.

Any kid who has built a sandcastle knows that when you wall out water, you also wall it in. To be even remotely feasible, there would have to be gargantuan pumps going 24/7 - pumping water out of the airport (or city) up over the levee. Those pumps could soak up a significant portion of Thailand's electricity.

SUV airport and the aircraft carrier can serve as indicators for how things might develop if Thailand were to go ahead and build its planned nuclear power plants – because both SUV and the carrier are large scale recent projects taken on by the Thai government. Both were badly planned, badly executed, and continue to be problematic.
The worst that can happen with a carrier is it can sink or get sold – then sold for scrap. The worst that can happen with SUV airport is it becomes inoperable. However, a nuclear power plant has more dire worst case scenarios.

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9. Yet More Pitfalls

Besides the earlier mentions of the fuel (yellowcake) being hard to source and increasingly expensive, there are other potential pitfalls with Thailand going nuclear. Three Mile Island, in the eastern U.S., became world renown in the mid 1970's. That's when there was a mishap which resulted in a sustained release of radioactive steam. The reactor was rendered inoperable and has been shut down since that time.

The reactor meltdown at Chernobyl in the former USSR was more dire. Because it happened in state-controlled territory, emergency warnings to surrounding regions were not forthcoming for many hours after the disaster struck. China, with its high number of reactors, is also well known for being slow to admit to disasters. In Communist top-down systems like the former USSR and current China and North Korea, bad news gets published reluctantly, if at all. The main reason bad news gets published at all in such countries, is because of pressure from (and leaks to) outside countries – which in turn force disclosure. Thailand's ruling elite tend to be more open about releasing face-losing information, though reluctance is still evident in some scenarios. Example: bad news that adversely impacts on tourism revenue.

- For comments regarding Fukushima, Japan, please go to end of this text -

At both Three Mile Island and Chernobyl, mechanisms to remedy the situations were inadequate. It should be noted that both the U.S. and the USSR were at the vanguard of international technological prowess. If a reporter had gone to either one of those sites the day before their respective problems and voiced a hypothetical calamity, the technicians would have assured her that all was in good hands, and not to worry. Technical experts would likely have gone on to explain the many safeguards and back-up systems are extant in each plant.

That's the same sort of assurances a reporter would get – if she were to snoop around a contemporary nuclear plant. At any given time, it's natural for technicians to assert an air of confidence, essentially saying, "Yes, there may have been some drawbacks in earlier designs, but rest assured, we've worked out the bugs, and now we have reliable safeguards in place."

The fact is; no matter how advanced technology gets, there are always things that can go wrong. Take America's space shuttle programs, for example. The shuttles are the most sophisticated machines of recent times. Scientists initially predicted the odds at only one in one thousand that a shuttle mission would go fatally wrong. That's one flight out a thousand. The sobering truth is that, later in the program - within the span of several months, two shuttles crashed. The odds were quickly revised downward, and now the entire program is winding down – well before its designed obsolescence date.

The Chernobyl melt-down happened 22 years ago. The massive radioactive cloud which breached and blew out of the displaced protective concrete dome – was carried hundreds of kilometers west and northwest, Much of western Europe was affected, including homes and farms. Indeed, it was not until news of high Geiger counter readings from Sweden reached the world's media, that Russian bosses grudgingly admitted what the rest of the world was coming to realize.

Residents of Russian towns downwind of the breached reactor were not notified in a timely fashion, and 31 people died soon after the breach. A UN Health Agency memo estimates that nearly 10,000 people in the affected areas will die prematurely due to radioactivity. Greenpeace puts the estimate ten times higher, at close to 100,000. Either way, birth defects from radioactivity still affect many of those people and their offspring. Similarly, large tracts of farmland are still off-limits, and several ghost towns were created.

The U.S. and other countries have ponied-up to pay for a new sarcophagus for Chernobyl, because Russia can't afford to pay for it.

The first sarcophagus concrete cover, which had been in place for ten years, is leaking and crumbling (radiation is debilitating for organic and inorganic things). The new one will cost 1.4 billion dollars (50 billion baht) and is expected to last about ten additional years. That's 5 billion baht per year of outside money to try to contain a serious radiation leak. Think about it: Two sarcophagi, each lasting ten years - the second one costing ten times more than the first ….and the radiation will continue to

be extremely dangerous for tens, maybe hundreds of thousands of years. How many sarcophagi will be needed, and at what costs? The math is staggering.

Imagine if one of Thailand's four proposed reactors suffered serious problems. Would EGAT and Thai authorities be prepared to do the right thing? The required money could simply be too high, and Thai resolve to do fix such a problem responsibly might not be there.

When Thailand's economy tanked in 1997, large infusions of outside money were needed to get its economy back on the track to recovery. To its credit, the Thai government paid back the internationally sanctioned IMF loans. However, much of the effects of the economic disaster are sill unresolved (thousands of unfinished buildings, etc.), and scarcely any of the culprits or profiteers have been brought to book.

Current nuclear reactors operate at much higher temperatures than Chernobyl-type reactors. If a Thai reactor was breached, the radioactive fallout could travel hundreds of Km in whichever direction the wind happened to be blowing at that time. Unless the winds were blowing directly out to sea, it's possible that tens of thousands would be adversely affected. Because Thailand is not a big country (and winds don't give a hoot about national borders), it's conceivable that many of affected people and animals would be in one of more of Thailand's neighboring countries. Cities and farmland could be rendered unusable for decades

The Russian emergency crews which responded at Chernobyl were heroic to the extreme. They got helicoptered right to the edge of the most intense leakage point – knowing they were getting lethal doses of radiation. Any emergency responders who didn't die on the scene, became seriously ill with radiation sickness and died soon after.

Radioactivity affects every sort of thing it's near. It jangles the molecular structure within rocks, concrete, trees, living tissue, and people – causing all things in its range to become radioactive. It's a matter of dosage plus exposure time – which determine the extent of damage. When living cells become radioactive, they weaken and become susceptible to disease. In long-term high sustained doses, radioactivity turns living tissues to heated mass of mush – as if you got locked in a closet-sized microwave oven. Reproductive cells are also susceptible, which is why we hear of birth defects stemming from radioactivity, and is also why the residual effects of a radiation leak can last for decades.

Radioactivity has no dormancy period, and can penetrate nearly every sort of shield except lead, although even a lead shield will become radioactive if exposed to a strong sustained dose. One of the few foods that helps lessen the affects of radiation sickness is wheat grass juice. If Thai authorities had to provide wheat grass juice to treat radiation victims, how many liters could be made available within five days? Answer: zero. Nearly as good for allaying radiation sickness, are sprouts from buckwheat, rye, mung beans, or other select seeds. Except for mung bean sprouts, Thai authorities would have a tough time supplying such foods to radiation victims.

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10. Insurance

It would be interesting to see the wording for an insurance policy – for Thailand's proposed nuclear power plants. Would the policy propose to cover all damages to people, animals, towns and farms adversely affected by a serious radioactive release? Would the coverage extend to damage inflicted hundreds of Km from each site? Would it be a one-time pay-out, or would the policy have provisions for sustained pay-outs over the decades that injury persists? In other words, would the coverage cover loses from farmland and farm animals rendered non-productive for many years – as well as ill children whose parents were exposed to radiation? Would the policy only cover mishaps caused by mechanical failures, or would it also cover problems caused by the plants' employees? How about sabotage, or problems caused by faulty construction?

Without a doubt, as soon as any serious mishap occurs, top authorities will immediately blame mechanical or structural causes. It's the type of automatic response that airlines employ when one of their planes crash. Top management and government bosses know that finding a mechanical cause for a serious problem is advantageous. It forces the blame and, more importantly, the pay-out to come from the materials/parts manufacturer and/or the building contractor. Though lip service is paid to show compassion to victims, the most important two factors (from authorities' viewpoint) are about saving face and saving money.

When a Thai Airways plane crashed in Surat Thani, Thai authorities started the 'spin machine' even before the smoke had cleared. They were telling everyone who would listen, that it couldn't have been pilot error. Management knew that if it was shown to be 'pilot error' or 'control tower error,' then Thai Airways would be liable for big payouts to the victims. Incidentally, Thai Airways and EGAT are similar, in that neither is a private corporation, and both are controlled by the Thai government.

Objective evidence indicated strongly that the pilot was indeed in error. He was trying to land in a gale force rainstorm. He had aborted landing twice due to poor visibility. Pilot's handbook says that after two aborted attempts to land due to severe weather – the pilot should find a safer airport to land the craft. He didn't, and as a result, dozen of passengers died. Thai Airways and the Thai government used all its influence to try and prove the crash was due to mechanical failure. This is mentioned as a precaution to those who may, in the future, suffer damages from a problem stemming from a Thai nuclear power plant. Don't expect responsible responses from authorities. And then there's the quaint term that insurance policies use; 'Acts of God.' No matter that Thailand is mostly a Buddhist country and, as such, there is no need to worship or fear or believe in a God. For insurance jargon, 'Acts of God' phrase is still used, and means 'naturally occurring events and/or such phenomena that are not caused by man.' Lightning, floods, hurricanes/typhoons, earthquakes/tsunamis, extreme droughts, falling trees, are all considered acts of god. Of that list the most pertinent, in regards to impacting on nuclear plants in Thailand, are; floods, hurricanes/monsoons, earthquakes and tsunamis.

If you were to ask the experts at EGAT, they'd probably tell you that any power plants they build will have fail-safe provisions for all those threats. That's been a traditional attitude among planners. At any given time, they believe they've got the bases covered regarding safety measures and 'Acts of God.' The designers of the Titanic believed that also. That's why the coined word 'Thaitanic' is used in the title of this text. The space shuttle designers believed that. And so it goes.

Regardless of how confident EGAT and the other boosters of nuclear appear to be, deep down they must acknowledge that 'mother nature' always proves more powerful than all the most contemporary engineering muscle. Before Hurricane Katrina, New Orleans was considered safe by civil engineers.

There are four nuclear power plants planned for Thailand, each one of which will almost certainly be sited on or near a sea coast. We've all heard how global warming will cause water levels to rise in the near future. Thai engineers may have pat answers to that ("we'll build it above the highest water level" etc.) – however, such engineers just built an international airport in a swamp, and no one should be surprised if its runways are under water in the near future. Additionally, the new airport approached peak carrying capacity within weeks of opening.

Building above the high water mark is a no-brainer, but even a high water mark can rise alarmingly. There can be a time during highest tides, when a monsoon, earthquake or volcano erupts. Volcano danger may seem too remote to consider, but there have been times when one has erupted near a body or water, causing a massive landslide to dump in to the water – which can create a large tsunami. Earthquakes can do much the same. Such 'Acts of God' could bring mighty waves much higher than the accepted 'high water' mark.

Some geologists and climatologists might say, "Well, the Gulf of Thailand doesn't get typhoons, and it's not in an earthquake or volcano zone." Those are the same sort of experts who, before the Boxer Day earthquake/tsunami, would have said the Andaman coast has historically never had a serious threat from an earthquakes or a tsunami – so no need to worry.

If the power plants are insured, who pays for the policy? EGAT may say they'll foot the bill, but because EGAT is government owned and run, then it's essentially the Thai government which is paying for the policies. But wait a minute, The Thai government is funded largely by taxpayers, so it's likely that money from Thai citizens that will pay the lion's share of policy payments. EGAT rate payers and taxpayers (many citizens fall in to both categories) will wind up paying for insurance policies. However you slice it, there will be a commensurate increase in every rate-payer's electricity bill, and probably a tax increase as well.

If there are insurance policies for the proposed power plants, no one appears to know at this time what their monthly/annual costs will be. Often, it falls on Lloyds of London to insure mega projects that no one else is able to, or wants to cover. Whatever the bill, you can bet it won't be cheap – especially if the policy covers damages to a 200 Km radius – and if such payouts drag on for decades after a mishap.

With solar energy, insurance costs would be a tiny fraction of nuclear.

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No insurer, not even Lloyds of London nor AIS in New York could cover the damages from Japan's recent N disaster at Fukushima.

And the hundreds of farmers in that region of Japan.... now realizing nothing grown on their properties will have value for perhaps dozens of years. What a pity. Let's hope the Japanese government and/or insurers compensate them for their properties, and pay for relocation to greener pastures.

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11. Disposing of Nuclear Waste

Thailand does not have a stellar reputation for dealing with waste. Perhaps it's not fair to compare waste disposal habits of the general populace with projected policies for dealing with nuclear waste. However, analogies can be made between the habits of a certain culture and projections of how such people might deal with larger issues. For example: if a dog dies in Monaco and a dog dies in a village in North Korea – one can be expected to assume the locals in each locale would deal with disposing of the dead dogs differently.

In Thailand, you can go to a field the day after an outdoor festival – and the grounds will be strewn with trash. Plastic and paper trash will be everywhere, and if there's been any wind – the trash could settle hundreds of meters away. Similarly, Thai parks suffer a similar, albeit less dramatic fate. The closer the park is to a populated area, the more trash will be blowing around. Glass trash is rare, though not exempt, sometimes smashed for added effect.

If you've ever done physical work with Thais, such as construction or landscaping, you'll know that they're not inclined to take precautions. In other words, things like gloves, earplugs, dust masks, or safety glasses are rarely seen in situations where they're needed. As often as not, an offer to wear earplugs or gloves or a dust-mask, is met with a cheery, 'mai pen rai.' …same sort of response that 90% of Thai drivers will give, if you suggest they wear a seat-belt. Indeed, many a time, when I've been a passenger in a car, and I reach to fasten the seatbelt, the driver will good naturedly wave my efforts away, as if to say, 'Are you insinuating I'm an unsafe driver? Don't worry, we won't crash.' A caustic material such as PVC cement (a toxic glue) will be cavalierly applied with a naked finger. Perhaps it's just considered wimpy to use safety precautions.

Authorities, who should pose a good example, often don't. Every so often, newspaper readers will see a photo of a top politician riding without a seatbelt (in a car) or without a helmet while riding a motorcycle – or the helmet is on, but it's

unfastened, which renders it useless. These things are mentioned - not as put downs, but to give a sense of the 'devil-may-care' attitude that prevails in Thailand – as regards personal safety precautions, and responsibly dealing with garbage.

Employees working with nuclear power plants will likely comply with safety precautions most of the time – especially when inspectors are on the scene or it's a photo-op. However, knowing Thai habits, is to know how quickly things can get lax in that regard.

For example: In a Thai town, every motorbike rider knows that between 9 am and 5 pm on weekdays, within certain parts of town, there's a chance of getting pulled over and ticketed by a cop for not wearing a helmet. So naturally (for them) all other times, and at all other locales, few helmets are worn.
It's a simple drill: Wear a helmet when and where you might get pulled over, don't wear a helmet all other places and times.

Same can be said for putting helmets on children passengers on motorbikes (never happens), on pillion riders (rarely happens), slowing down for yellow lights (never happens), running red lights within the first two seconds (happens often), driving on the wrong side of the road (common), cutting blind corners too tightly (very often), ….the list goes on.

Nuclear waste falls in to two basic categories: Low-level and high-level. Low level is everything (uniforms, gloves, tools, etc) that has come in to contact with radioactive material. High level waste is the spent radioactive material itself – whether it be spent fuel rods, or any other items or construction materials which have high residual radiation.

Throughout the sixty odd years that high level nuclear waste has been generated, there's never been a satisfactory way to deal with it. Even today's best scientists and engineers haven't found a sure-fire way to put it safely away for the tens of thousands of years it will be significantly radioactive. It can't be shot to the sun - too expensive.

Currently, most highly radioactive waste is placed in containment packages (cement with copper and/or glass coating) with dubious effectiveness. No such containment is very reliable, and already there are reports of such packages leaking. In doing so, nearby flora and fauna is adversely affected. The extent of damage cannot be known, because such things are happening in all sorts of sea trenches worldwide. Anyone who is familiar with trash dumping at sea knows there are myriad ways to skirt the rules (if there are any rules to begin with):

>>>> Containment packages can easily be made skimpier than required
>>>> Radioactive trash can be over-packed within
>>>> Waste packages can be clandestinely dumped.

Who's going to know if the waste handling process is proceeding as regulated? Are Thai people going to be content to leave such procedures to officials who come from a culture where trash is routinely and consistently dealt with irresponsively?

Perhaps it's not fair to make the following comparison, but a person can stroll along any stretch of the hundreds of Km of Thai coastline – and every linear meter will contain trash. The exception might be rare small stretches where hotel staff clean the beach. That's offset by other places where thick trash covers wide areas. Most of those hundreds of tons of trash is plastic, but there are a variety of other items, such as large burned-out light bulbs (tossed by squid farmers), wire cables, discarded nets. Granted, nuclear waste will (hopefully) get dealt with more responsively than every-day garbage, but the point here is there's a deeply ingrained attitude that people have, that goes something like this; 'once something is dumped out of sight or in the sea, it magically becomes a non-issue' - a variation of the English saying; 'out of sight, out of mind.'

There have been plans in the US to bury it deep in supposedly 'stable' salt mountains somewhere near the California / Arizona border. Although that idea has some merit, it also has potential drawbacks – not least is what people will think about such waste – tens of thousands of years in the future – if there are people around then.

American Indians in that region are particularly offended. Their outlook goes something like this; "We revere the land of our ancestors and the spirits of all things that make up the world. We take personal offense that radioactive poison will get entombed deep in the land - a poison that will continue to emit lethal radiation non-stop for many lifetimes."

U.S. authorities say the mountain they've picked is safe and has little water seepage. However, these are the same types of authorities who convinced many intelligent people that Iraq had weapons of mass destruction (WMD). The best US military intelligence and CIA experts working together - were dead wrong about WMD in Iraq, and that was a contemporary scenario. As for plugging radioactivity in to a mountain; Americans are being asked to believe people who are talking authoritatively about projections for tens of thousands of years in the future.

What will the warning signs look like – will intelligent beings be expected to read the signs correctly in the far future? If the signs are carved in a rock (it's doubtful they'll use a sheet metal nailed to a wood pole), future beings might misinterpret it as an indicator of buried treasure – who knows?

Most contemporary people can not be expected to be as sensitive to the land as Native Americans or aboriginal people. Yet there can is still some resonant connection with the land with everyone - even people who worship Wall Street or sequined celebrities.

Thailand doesn't have any mountains for storing such things. They have some nice looking hills which they call 'mountains' but they're just bamboo covered bumps on the horizon. So how does EGAT plan to store the steady supply of radioactive waste? Will it seal the stuff in car-sized pellets of cement covered in glazing – and then dump it somewhere in the Andaman Sea ….or the Gulf of Thailand? What about sending the stuff back to Australia, where Thailand's yellowcake will likely come from. Aussies have vast tracts of sparsely inhabited land, but it's doubtful they'll want to store radioactive waste from Thailand - or any other country.

These are the types of things we can expect EGAT to gloss over on their 138 billion baht 'feasibility study.' If there are any public meetings, and some brave person has the audacity to ask the question, "How do you plan to dispose of the high level nuclear waste?" we can expect EGAT to say something similar to what their spokesmen said in a direct quote (below) a Bangkok Post interview from March 3rd, 2008; URL: http://bangkokpost.com/Business/03Mar2008_biz22.php
Note: the debate questions were written and the answers were submitted, so it was not a 'live' debate where speakers are required to 'think on their feet.'

Mr. Kopr Kritayakirana is described as "an expert adviser with the Nuclear Power Programme Development Office (NPPDO)." His prepared answer to the question of what is to be done with radioactive waste disposal is verbatim as follows;

"The easiest and most popular way is to use first "wet storage" and then "dry storage" at the reactor site itself. Of the 440 reactors running, more than half use this approach. Spent fuel rods are first kept in a water tank right next to the reactor core (wet storage) to cool down for three to five years. They are then taken out of water and put in steel caskets and stored in a simple concrete shack (dry storage) near the reactor building. They can stay there for 40 to 50 years."

"Long-term technological solutions to deal with spent fuel, such as "breeder reactor" or "transmutation burner" systems, have nearly been commercialised. A global nuclear fuel "leasing" scheme is being set up: the Global Nuclear Energy Partnership (GNEP). There is, therefore, no pressing concern to deal with spent nuclear fuel."

Comments from the peanut gallery: Highly radioactive material stored in a pool of water, and later in steel caskets in a concrete shed might be a moderately tenable short term solution – if all goes hummingly well as planned. However, even the best laid plans can go awry.

Radioactive material is a big lure for terrorist groups - it can be used to make weapons (dirty bombs) and is a lure for extortion. More than a few times, insurgents in Thailand have broken in to armories and stolen weapons. Other none-too-rare occurrences are armory explosions – which happen about once per year in Thailand.

Nuclear waste is not explosive, yet things can go wrong – even with plans to store the stuff in 'concrete sheds.' A gasoline tanker could be parked nearby, somebody flicks a cigarette butt – boom! Authorities will tell you that such a freak occurrence could never happen - but that's standard jargon – and it's always heard ***before*** a major calamity hits their post. Immediately afterwards, the blame machine gets cranked up, and it's always the guys at the bottom of the totem pole (if anyone) who get reprimanded.

Mr. Kritayakirana mentions possible ways to mitigate the issue of radioactive garbage, such as: "Long-term technological solutions to deal with spent fuel, such as "breeder reactor" or "transmutation burner" systems…." But that sounds a bit like tech-talk gobbly gook – intended to impress the eagerly impressionable among us. Indeed, 'breeder reactor' is where the waste came from, so how is the waste going to get rendered inert by going back through the radioactive furnace? He goes on to

mention, “A global nuclear fuel ‘leasing’ scheme is being set up: the Global Nuclear Energy Partnership (GNEP).”

Really? Will other entities want to lease spent fuel rods – for what? It sounds like either a plan for possibly reprocessing the rods (for weapons?). Reprocessing is a dubious-sounding and probably unworkable endeavor. Or perhaps GNEP is an incentive by rich countries to spread the use of nuclear for power generation. Maybe a ploy similarly to what the US did when it went to war #2 in Iraq – and it found few friends standing by its side. In order to recruit allies, Uncle Sam wound up paying all expenses for military contingents from smaller countries such as Thailand and Mongolia.

Since the US is home to at least two of the largest nuclear power plant contractors (General Electric and Westinghouse), then it might come as no surprise that the US government (or the corporations themselves) are subsidizing their commercial interests by setting up something with a nice sounding name like; ‘Global Nuclear Energy Partnership’ in order to try to defray a small customer country’s prickly issue of ‘what to do with radioactive garbage.’

Mr. Kritayakirana ends his comments by writing, “There is, therefore, no pressing concern to deal with spent nuclear fuel.” Those are comforting words, and as such may play well with some all-too-impressionable Thai people. However, those who care about environmental issues for future generations, won’t agree with Mr. Kritahakirana when he says, “there’s no pressing concerns.” The concerns are very pressing and will need to be addressed responsibly. Indeed, the serious issue of ‘what to do with radioactive waste’ is, on its own, a ‘make or break issue’ – regarding whether Thailand should go nuclear or not.

Just for fun, let’s compare the previous paragraphs, (where we’ve been grappling with how to deal responsibly with nuclear waste) – with how to deal with the waste from another fuel, namely; solar. “But wait,” you might say, “solar generates no waste!” Precisely the point. No mining and processing the fuel, virtually no safety issues, and no waste after using it – and those aren’t the only reasons why solar is a much better choice for Thailand’s future electricity generation needs.

* * * * * * *

12. Alternatives

When solar is mentioned in regards to generating electricity, there’s often the response; “Yes, solar panels are good, but they’re expensive and inappropriate for large scale power generation.” In other words, for well-off individuals, having a few solar panels on the roof - are cool way to power some of their lights and appliances.

Although that picture has some validity, it’s by no means the big picture of what’s currently happening with solar. It would be like, in 1903, if someone saw a few carriage-looking cars putt-putting along at 5 miles per hour, and said, “Yes, the

internal combustion engine is a fun little machine, but it could never really apply to future mass transportation needs. For that we'll need to stay with the steam engine."

Thai authorities have been shown to be 'behind the curve' at times. Less than ten years ago, top ministers in the Chuan government decided to opt out of joining up with other Southeast Asian countries on a plan to increase internet speed for Thailand. The proposal was to share payment for a series of conduits which would increase internet speeds significantly. Top Thai officials declined the offer, as they could not, at that time, see the significance of their citizens having fast internet service. More recently, the head of Communications in former PM Thaksin's government claimed he didn't know or care much about the world wide web. These are the types of leaders who get put in top leadership positions in 21st century Thailand.

To a great extent, such leaders are products of a Thai school system which rarely if ever fails a student, and is lax about cheating on exams. They're products of a school system which allows every student to pass on to the next grade, with little regard for test scores or attendance records. That same sort of lackadaisical attitude carries on to government - which will not allow a manager to get fired, regardless of the seriousness of an offense. The worst punishment for a government authority is; assignment, with full salary and benefits, to what they call 'an inactive post.' Also, entrance to prestigious universities, and promotions within government/military are often based on 'who you know' and 'who you're related to' rather than how bright or qualified a candidate is.

There are about a dozen recently formulated committees that have been charged with dealing with various facets of getting nuclear power plants built in Thailand. Each committee has a serious-sounding name, such as 'Office for the Peaceful Application of Atoms', and each is headed and staffed by people who have gone through the 'always-pass' school system. Their jobs have nothing to do with investigating alternatives to nuclear. Instead, all the committees and personal are assigned with establishing nuclear plants in Thailand. The game plan is simple: Don't question whether nuclear plants are a good idea for Thailand - that's already been established by your bosses. If you rock the boat, you could get posted to an inactive post at a moment's notice. Any questions?

Before giving details about the latest developments in solar, let's take a moment to mention some other interesting options.

Of the other top 'runner ups,' wind power shows some great potential. It is already proving to be a viable electricity producer off the coasts of Denmark, and in the pacific hills of California, among other places. Saudi Arabia, despite having large oil deposits, is paying the Germans and Danes to install wind generators in their deserts. For its part, Thailand doesn't appear to have consistently strong wind patterns to support wind power generation on a large scale.

Tidal power and wave power are other 'honorable mentions' with potential, and are worth serious study. Currently there are several interesting designs available. Tide and wave generators are worth considering for Thailand – and may inspire some Thai inventors to come up with new designs.

The following article is excerpted from a May 2008 syndicated newsletter written

by Roy Wasson at **RenewableEnergyFund.net** based in Miami Florida, USA

D. Tapping Tidal Currents for Electric Power:

Solar power works best when the sun is shining, but with the current breaksthroughs in effectiveness and efficiency, solar can also generate power during hazy or partially overcast skies. When combined with storage technology, solar can deliver power 24 hours a day, and can prove functional even during several-day stretches of no sun.

Even so, ocean waves keep breaking on beaches and tides and currents keep ebbing and flowing 24/7 - providing promise of being a steady energy provider.

The following is a quote from Brian Wagner for the **Voice of America** published on the **RenewableEnergyWorld.com** Online website:

"The same energy that drives ocean waves and currents may be a rich source of electrical power. Researchers in Florida say even gentle flows of two or three knots are enough to drive a propeller attached to an underwater turbine. Advocates say ocean power could be cheap and help and replace oil or coal-based systems."

Douglas Bedgood, president of **Keys Hydro Power** is planning to build a turbine farm in the Florida Keys, 'We could upscale this to 10 feet across and it would be perfect [for 24 hour power generation].' Units could be added as needed.

The goal is to harness the energy produced by the rise and fall of waters during the tidal cycle. His group is working on a test turbine that it plans to submerge in a site about [thirty feet] under water between two islands. By the end of 2008 or early 2009, Doug and his team plan to have several turbines functioning. The following year, the plan is to have several hundred in series." Bedgood said.

The first step, however, is to show authorities that the groundbreaking project will not damage wildlife or coastal resources in the popular tourist area. Bedgood says marine life should be unharmed. "For manatees and turtles, our turbines will be mounted up off the [ocean] floor, so they can maneuver through them. And the leading edges of any moving part will have foam rubber cushions on them," he explains.

Similar projects are planned in Europe and in other U.S. cities. Just 300 kilometers from Key West, researchers at **Florida Atlantic University** want to tap the powerful Gulf Stream current that brings warm water north into the Atlantic Ocean.

'Just a portion of the Gulf Stream contains a significant velocity with the equivalent energy of some of the world's richest energy sites,' says Rick Driscoll, head of the University's Science Center

He goes on to say; "It is a lot more challenging to put something in the ocean than in a tidal pool or along a sea shore. There is a lot of significant potential, and perfecting such new and existing technologies could bring real benefits to other countries around the world."

What sorts of alternative energy research are Thai scientists involved with? With hundreds of Km of coast, Thailand is in a prime position for tapping in to the vast

potential of tidal energy. Even if Thai-based research doesn't come up with any practical new technology, at least the effort's been made. Some would say spending a portion of EGAT's 1.38 billion baht on research toward renewable energy technology - would be lot smarter than spending that gargantuan sum of money on a report with a foregone conclusion.

If Thai researchers are not inspired or innovative enough to do their own experimentation – then there are existing blueprints for functional power generators which harness the unceasing power of coastal waves and tides. As far back as the mid-1960's there was a front cover article in Scientific American magazine – which featured a tidal powered electric generator, complete with description and drawings. I recall the contraption looked like two barge-sized flat floats tethered in place perpendicular to the shore. The connecting apparatus was like a giant hinge which powered a generator. Power transmission lines ran to the shore. The non-stop action of the waves caused the two large floats to crank the power generating hinge back and forth over and over – as long as the waves rolled toward the shore.

There is also a new technological process that can turn garbage in to its basic components – all of which are useful. It's like an assembly line, and nearly any type of garbage which goes in one side, can come out the other side divvied up as various proportions of water, dry fertilizer, and a few types of oil – all of which are clean and utilitarian. Some of the resulting oil can be used to power the process.

It uses the principle of first turning garbage in to a hot pressurized slush. The next major step quickly decompresses the slush - like stuff coming out of a spray can. In so doing, water is released and recovered – so it's major dehydration. The ending steps coax out the basic components mentioned above; mostly fertilizers and oils.

Amazing as it sounds, nearly any type of garbage can be run through the system: Everything from slaughterhouse offal, to steel-belted tires, to dirty plastic trash. Granted, an assembly to handle the garbage from a large city would not be cheap, but would still be a small fraction of the cost of a nuclear power plant. And the end products between the two are as different as night and day. One produces radioactive garbage, the other produces 100% utilitarian products. ….And no, the *'garbage in – useful products out'* machinery would not work to process spent nuclear fuel rods.

Ethanol is interesting, in that it makes a type of useful alcohol from plants. The more sugar in the plant, the more ethanol can be produced per weight. That's a big reason why ethanol production is somewhat successful in Brazil – because Brazil is a big country, and they're willing to devote millions of acres to growing sugar cane to convert to ethanol. The vegetation of choice in the U.S. is corn – although corn produces less ethanol per hectare than sugar cane.

However, wherever growing plants for ethanol production has caught on, there is also controversy. There appear to be two main reasons; #1. Farmland that could be used to grow food or fodder, is being devoted to growing plants for fuel. The #2 reason ethanol is not as popular as some had hoped, is because it's not cost-effective. In Brazil, it yields a bit higher value than the cost of production. In the U.S., ethanol from corn actually costs about the same or less than the process to make it. Much of

the corn is grown in Mexico – as a result, the cost of that essential food staple for ordinary Mexicans has quadrupled in the past year.

The cost to produce ethanol is often more than the value of the fuel itself. In other words, $100 worth of ethanol might cost over $100 to produce. Another way to look at its inefficiency; some studies have found that it takes 1,000 liters of water, and over a liter of fossil fuel to produce 1 liter of ethanol. Why so much water? The reason is; water is needed to farm the plants. The one liter of fossil fuel is used in the farm machinery, transport, processing, and yet more transport (to outlets) and pumping. Unless efficiency is improved, ethanol is not a smart 'wave of the future.'

However, not all is gloomy in the ethanol department. In Florida, the citrus industry produces 3.5 to 5 million tons of citrus waste every year. Two US scientists have developed a method to not only convert that waste to ethanol, but to get useful by-products as part of the process. One of the by-products is a useful oil (used in cleaning solutions) called d-limonene. Another by-product is pelletized animal feed. Altogether, the ethanol and the two by-products combine to make their waste-to-ethanol process cost-effective.

Thailand also has industries which involve citrus and other fruits such as lamyai, coconut, rambutan, oil palm, pomelo, and others. With some 'thinking outside the box,' Thai innovators could develop ways to turn fruit wastes into useful and profit-generating products. Besides possibilities with ethanol and its by-products, there are potential fertilizer and/or soil enhancing items.

Another type of bio-fuel is diesel made from used cooking oil. Though interesting for some individuals who don't mind the extra effort to find the oil and process it – it's not cost effective on any large scale.

A few select countries like Iceland, are blessed with naturally heated underground water – which they're able to tap for good use. Geothermal potential worldwide is phenomenal – in the sense of the availability of hot steam and water. Most, electricity is produced by heated water which turns turbines. Except in rare cases, geothermal temperatures are not hot enough as they come out of the ground. However, they can be further heated by concentrated solar or whatever.

Set-up costs are often high for geothermal, because of the need to drill deep wells. New technology is bringing efficiencies of up to 15% - though still less than coal fired plants. Thailand has hot spots of moderate temperatures, though it's doubtful it has easily accessible sources above 100 ºC – as do places like Iceland, and "The Geysers' in northern California. Iceland is taking advantage of its geothermal to the extent where most of its houses are heated and a quarter of its electricity is generated by it.

Thailand probably has several dozen geothermal sites. The natural heat could be channeled to pre-heat water in a heat-exchange closed system, and that hot water could then be heated by concentrated solar to temperatures hot enough to generate electricity. Such plants would not be cheap to set up, and would not likely be large scale, but any such power generation would have zero fuel costs and would likely pay for themselves in a few years.

One of Thailand's main political parties (not TRT or PPP) came up with an idea in 2007 for small-scale alternative power generation for Thailand. The idea was to utilize farm wastes to generate methane – which in turn could be burned to generate heat and/or power. The idea sounds as though it has merit and should be pursued – especially because it's small scale and low tech and it deals sensibly with natural by-products that would ordinarily be unused - all the sorts of things that make it uninteresting for the people currently running the country (the PPP).

There are several reasons why methane is not even on the back burner (pun intended) for the current set of power brokers in Bangkok; It's not glamorous-sounding, like nuclear. It's not high tech like nuclear. It's village oriented, so is harder to control by Bangkok. Its fuel is farm by-products, so there's little involvement with big business. Probably the #1 reason such small-scale low-tech technology will not be pursued by the heavies in Bangkok is there's little or no provision for under-the-table pay-offs. An additional reason why the current government won't pursue such peasant technology, is they're simply too busy playing political games. In other words, most of the time they're not in restaurants, or playing golf, or tending to mistresses, the top government people are desperately maneuvering to bolster their job security. It's similar to the time, in American during the early 1970's when then-president Nixon spent all his waking hours seized upon political maneuvering to save his skin. The fact that he was being paid a salary by the taxpayers to govern - was irrelevant to him and his cronies.

Village-level methane production and other low-tech, low-cost technologies, along with all-around conservation of electricity could lessen dependency on the main power grid.

Speaking of power grid (the infrastructure used to generate and deliver electricity), there are scenarios in North America and Europe where ordinary people sell electricity to power utilities. One common scenario is a home owner who sets up his own solar PV panels for his house. On days when excess power is generated, the excess goes automatically through the municipal power lines – to add to the grid. In other words, the little wheel on his electric meter might actually turn clockwise rather than counter-clockwise – which is the opposite direction from normal. In effect, the power company is paying that person for the electricity he's providing. Another way to view it is: that person' regular electric bill is being lowered.

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13. Standard Solar

Note: in a later chapter we discuss 'Concentrated Solar' which is the most feasible solution for Thailand's power needs of the 21st century. This chapter deals with more conventional solar applications.

Anyone familiar with solar, knows the term 'passive solar' – which basically describes using the sun's rays without much, if any, machinery. An example is a hot water heater that's simply a stainless steel tank painted black, and hooked up to the existing water system. Although there may be a pump attached somewhere (as with nearly all water systems), it would still be a 'passive system' – as compared to a solar

heater with more 'whistles and bells' such as added pumps and thermostats, and/or heat exchange systems.

For example, in a cold climate, some solar hot water systems have a heat exchange provision. The solar panels outside (not PV panels) are filled with antifreeze liquid (propylene glycol) which gets hot and flows with the aid of a small pump within a closed system – to heat the water in a tank. That's an example of an 'active solar HW system'.

You may wonder why these seemingly remote topics are mentioned in a text subtitled; 'Why Nuclear Power Plants Are Not Good for Thailand.' The main reason is this: Thailand's leaders are looking for solutions to meet increased electricity demands of the future. Any sorts of conservation and/or viable alternative ways to do things that would ordinarily need electricity – are ways to lessen future electricity needs. Sadly, conservation is rarely mentioned by 'higher ups' in the debate about Thailand's future power needs. Like a household which is trying to make ends meet within the context of rising costs; 'every baht saved is like a baht earned.'

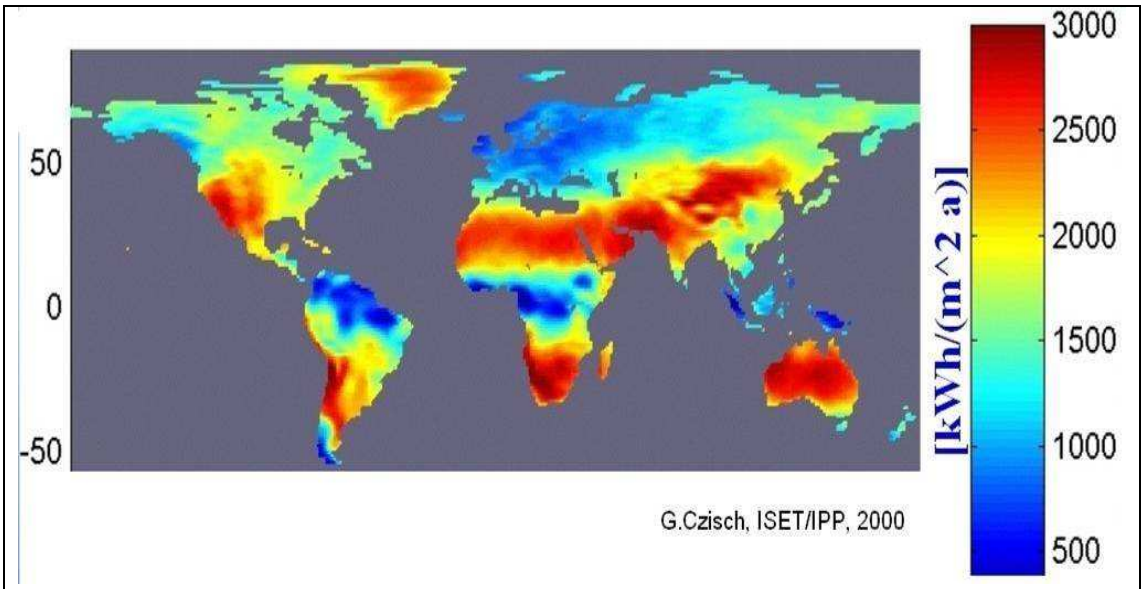
Thailand is well suited for both types of pre-heat HW systems.– though passive systems are particularly smart, because they're cheaper and easier to set up. If a forward-thinking politician were heading the appropriate department – she would be doing a lot of good for a lot of people if she were to develop a program to get passive solar HW systems installed throughout Thailand. Alas, Thai politicians are too busy with the day to day business of protecting their jobs and playing golf, than to seriously tend to such odd matters as popularizing passive solar heating. After all, where's the glamour and where are the pay-offs? There's much more pay-back potential with being involved with mega projects like nuclear power plants.

Passive solar cook stoves can also be useful. Though not quite as versatile as propane (can't use solar at night, or early morning, or on cloudy days), you can't beat the fuel cost advantage of solar. Some designs look like oversized aluminum flowers, with metal 'petals' opening up to focus the suns rays. Not a 'cure all' solution by any means, but could be useful for some applications – such as heating things up. Any passive solar designs get increased 'bang for the ray' (become additionally effective) with well placed applications of insulation and glass panes – particularly double-paned insulating glass (currently not available in Thailand).

Passive solar has obvious useful advantages for building design. Though it never freezes hard, much of northern Thailand gets cold in the winter months. A bit of advance planning on house design would go a long way to warming a house in cold months, and cooling a house at other times. There are ways to design, which would put the sun to work in the winter months, while shading it for the rest of the year. Example: tall trees with exposed trunks near the south side of a house would shade in the summer (when the sun is high), and allow sunshine to strike the house in the colder months. Building construction in Thailand rarely uses added insulation materials. Indeed, all but a few hardware stores don't even sell insulation. Well placed insulation in well-designed buildings can also lower AC costs.

A well-crafted building built in to hillside can retain coolness of the earth on hot days. England's royal family had stainless steel pipes sunk deep in the earth, with

solar-powered blower fans blowing the resultant cool air in to their Windsor Castle. Even some very rich people, who could easily afford giant AC units going 24/7 at full blast, are not too proud to use simpler methods. Perhaps stainless steel piping is a bit extravagant for ordinary folks, yet there are cheaper methods that give similar results. Example: burying a hundred meters of 3" diameter galvanized steel drainpipe material two feet deep around one's home or office, would give a steady stream of cool air to an interior space. Only a small fan would be needed to force the air through the pipe.
Strange as it sounds, passive solar can also be used to cool things. On a small level, there are specially designed clay jars used in parts of Africa which, when misted with water, effect a coolness to things inside – thereby saving on low-level refrigeration. After AC use, refrigeration is probably the next biggest user of electric in Thai homes. Though not cold enough to make ice, the clay pot idea is cool enough to keep vegetables and such from spoiling too soon.



This map shows which regions of the world get the most solar energy each year. The map was found after writing this text, so I was a bit taken aback to see that Thailand is not in a red zone. However, to look at the sunny side (pun intended), with solar technology developing so quickly, and with costs going down while efficiencies go up, there's still an immense amount of potential for Thailand to go solar.

On a larger scale, there are ways to build a special masonry 'cooling tower' that will have a cooling effect on a building. Instead of being a chimney in the traditional sense (which vents smoke out of a house) it's like a chimney with openings in its lower end – the end which is inside the building. The top is a dark color, and rises above the roof. The sun heats the above-roof section and causes the heated air to rise out vigorously, thereby drawing warm air out of the house. That interior air will have to get replaced, and this design works particularly well with the aforementioned vents bringing earth-cooled air in to the house. Alternately, it works if there are screened vents allowing air to flow in from under a house – where it's always cool. This design is not compatible with air conditioning, but instead can preclude AC if designed smartly. It may seem obvious, but it's worth mentioning; the larger the roof area and the more masonry in a house's construction, the cooler it will be in warm weather – thereby lessening the need for AC.

People tend to opine that solar power is not practical because of the need to store energy when the sun doesn't shine.

Two scientists who work at MIT, who have devised a cheaper way than batteries - to store excess energy. Inspired by photosynthesis performed by plants, they have developed a newfangled process that uses the sun's energy to split water into hydrogen and oxygen gases. Later those gases can be recombined to power a fuel cell, creating carbon-free electricity.

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14. Concentrated Solar

If all the uranium in the earth's crust were mined and processed, it would yield about 1.5 million terawatt hours. A terawatt hour = 1 billion kilowatt hours. That yield is about the same as all the world's recoverable natural gas, and about 50% more than the world's finite supply of oil. Uranium, natural gas, oil, and even coal are all non-renewables. In other words, they ain't makin' any more of the stuff. Oil reserves are expected to be nearly dried up in thirty years. By that time, the little bit of oil that's available on the market will be as expensive as genuine perfume.

Now let's compare those fuels to the all time #1 renewable energy source; the sun's rays. Each year, 350 million terawatts of solar energy fall on this little planet. As a comparison, the world's entire supply of fissionable uranium would equal one and a half days worth of solar energy. Not only that, as mentioned earlier in this text, the uranium that's useful for power generation would have to go through a complicated series of processing and shipping steps, thereby using a considerable amount of fossil fuel to get from the earth to the power plant. And that doesn't include the additional steps of dealing responsibly with its waste.

Solar doesn't need to be processed or shipped. It doesn't have waste issues. It's not any more dangerous than a cookstove. Compared to nuclear, here are additional attributes for solar energy;

>>>> Nearly no security threats. What's a terrorist going to do, take a solar worker hostage – or steal some solar panels to extort a ransom?

>>>> Low insurance costs

>>>> Neighbors won't have to live in fear of a serious mishap.

>>>> a decommissioned solar power plant won't leave a nuclear plant's radioactive 'dead zone' – essentially a sarcophagus with skull & crossbone warning signs all around – lasting tens of thousands of years. Wild birds and animals don't heed warning signs – so what's to stop them from visiting a radioactive site – and spreading the rems around?

If solar is such a better option than nuclear, then why are so many big shots in Thailand pushing nuclear? Here's a partial list:

>>>> They see nuclear as having technological dazzle and is impressive in the eyes of the world.

>>>> Thailand's neighboring countries have it or are planning to get it. Neighbors further away, such as China and Japan are fully committed to nuclear. No matter that Japan has had some safety breaches – one as recently as July 2007 (note: this booklet was written before the Fukushima nuclear disaster in Japan), where a very large reactor suffered leaks caused by an earthquake. The leaks weren't so dangerous, but Japanese authorities waited many hours before informing the public. China may have had its share of mishaps, but we may never know, as it's a closed society. Chinese authorities would not disclose bad news unless it was forced to, or had no alternative. In other words, if authorities can away with hushing up radiation leaks, they'll surely do so.

Indonesia and Vietnam want to go nuclear. Even cash-strapped Burma announced, in the summer of 2007, its plans for building a nuclear plant with Russian assistance. A big reason why Thailand's officials are so determined to go nuclear is the fact that many other Asian countries are going that route, and Thailand is worried it will lose prestige by not joining the crowd.

more reasons why Thai authorities are so determined to go nuclear……

>>>> Nuclear promises very large contracts. Where there are large contracts, there are large pay-offs. In Thailand, one goes hand in hand with the other. No exceptions.

>>>> Lucrative contracts extend beyond the plant construction – …on to fuel supply, maintenance, security, to disposal of waste, to eventual decommissioning of the plant.

The following info mentions some of the cutting edge technologies and companies dealing with 'concentrated solar'

If this entire text mentioned nothing else, it would be useful to just have this list.
It was culled from the URL
http://peswiki.com/index.php/Directory:Concentrated_Solar_Power
which is an offshoot of Wikipedia.net.

Solar Concentrators can be divided into several categories, among them; photovoltaic systems and thermal systems. Photovoltaic systems (a.k.a. 'solar panels or PV panels) turn light directly into electricity. The pretty blue panels you see in some shops (though rarely seen in Thailand) are great. But advances in PV panels are happening at a phenomenal clip. Vast 'solar parks' with thousands of large PV panels

are being developed in SW America, Western Europe, Australia and other locales. Will Thailand get on board? Let's hope so.

Thermal systems use the concentrated sunlight to create heat which typically turns a turbine. One popular design uses salt which quickly gets molten by the intense focused heat of a field of mirrors. Which would you rather have powering turbines in your town, water heated by molten salt, or water heated by radioactive yellowcake?

Forget Lightning. How Do We Catch Sunshine in a Bottle?

Renewable power is inspiring clever new ways to store electricity—and to uncork it exactly when and where it is needed.

by Maggie Koerth-Baker

From Discover Magazine, June 2009 issue
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Renewable energy has a critical role to play in reducing greenhouse gases and leading the United States toward energy independence. That role should soon be getting bigger: The U.S. government is pushing for a 100 percent increase in renewable energy by 2012. The two biggest sources are the wind and the sun. But the variable nature of wind and solar energy can cause problems with matching supply to demand—problems that would be greatly eased if only we had a really good way of storing electricity on an industrial scale. Currently there are several storage systems vying for dominance.

Compressed-Air Energy Storage
At night, when the strongest winds blow and customers are sleeping, unused wind-generated electricity can run giant compressors, forcing large amounts of air into sealed underground spaces. When demand rises during the day, the compressed air can be used to spin turbines, turning the energy back into electricity. Georgianne Peek, a mechanical engineer at Sandia National Laboratories in New Mexico, says this technology can provide a lot of power over long periods of time at a relatively low cost. The technology is also well established: Two compressed-air storage plants have been in operation for decades. The McIntosh Unit 1 plant in McIntosh, Alabama, went online in 1991; a similar plant in Germany has been running since the 1970s. McIntosh 1 can reliably put out 110 megawatts for 26 hours. (One megawatt is enough power to supply roughly 600 to 1,000 typical American homes.)

The compressed-air system does have its drawbacks. For one, it does not completely eliminate the need for fossil fuels, because the associated electric generators use natural gas to supplement the energy from the stored compressed air. Compressed-air storage systems also require an airtight underground space, limiting the locations where they can be installed. The two existing compressed-air plants use natural salt domes. Engineers flushed the domes with water to dissolve the salt, then pumped out the brine to create a nicely sealed cavern. But salt dome formations are not plentiful, so researchers are investigating other inexpensive ways to create storage chambers. A facility proposed for Norton, Ohio, would use an abandoned limestone mine. Another, in Iowa, would pump air into drained natural aquifers. Abandoned oil wells and depleted natural gas reservoirs might also work,

Peek says, as long as they are not too remote to be hooked into the electrical grid.

Molten Salt Heat Exchanger

The sun, like the wind, is a variable source of energy, disappearing at night and ducking behind clouds at inconvenient moments. Thermal storage systems, such as molten salt heat exchangers, mitigate those problems by making solar power available anytime.

Right now only one example exists: Spain's Andasol Power Station, which began operating last fall. Andasol has about 126 acres' worth of trough-shaped solar collectors that focus the sun's heat onto pipes full of synthetic oil. The hot oil is piped to a nearby power plant, where it is used to generate steam. During the day, some of the oil is used to heat a mixture of liquid nitrate salts (made by combining elements like sodium and potassium with nitric acid) to temperatures above 700 degrees Fahrenheit. These liquid salts can retain their heat for weeks in insulated tanks. When the collectors cannot generate enough power to meet demand, the salts are drawn out from the tanks and their heat is tapped to run the power plant. A full stockpile of molten salts can keep the Andasol plant running at top capacity—50 megawatts of electricity—for up to seven and a half hours.

Molten salt backup systems make solar power more flexible and reliable, says Frank Wilkins of the U.S. Department of Energy's Solar Energy Technologies Program. Wilkins says that thermal storage systems can increase a solar plant's annual capacity factor (the percentage of time, on average, that the plant is operational) from 25 percent to up to 70 percent. Expense is the biggest drawback. The Andasol Power Station cost about $400 million, and that was just for phase one of a planned three-phase project. But costs may come down as more plants are built. This past February, the Arizona Public Service power utility announced plans to construct a power station similar to Andasol. It is expected to go online in 2012.

Sodium-Sulfur Batteries

Sodium-sulfur batteries work much the same way as the lead-acid battery that starts your car; both use chemical reactions to store and produce electricity. The difference lies in the materials used. Lead-acid batteries contain a lead plate and a lead dioxide plate (the electrodes) in a bath of sulfuric acid (the electrolyte). A reaction between the lead and the acid creates the electric current. Lead-acid batteries are simple and reliable, but they are impractical to use on wind farms because of the amount of space and power electronics they would require.

The sun is a variable source of energy, disappearing at night. Thermal storage systems make solar power available at any time.

Sodium-sulfur batteries, which use molten sodium and sulfur as electrodes and a solid ceramic electrolyte, have a higher energy density. "Lead-acid batteries are cheaper," Peek says. "But you can get the same amount of energy in a smaller amount of space with sodium-sulfur—and that's important, because real estate costs money too." Sodium-sulfur batteries can also be charged up to the maximum and discharged completely, which makes them more efficient. And they last about 20 years, versus three to five years for lead-acid.

Some U.S. utility companies, including Xcel Energy, have installed small-scale combinations of wind farms and sodium-sulfur batteries. (American Electric Power's is not yet operational.) Excess electricity from the wind farms can be stored in the batteries and fed into the system later, when wind is low and demand is high. Each battery system, which is roughly the size of a semitrailer, can store about one

megawatt and discharge it over six to eight hours. The downside, again, is cost, which is high in part because there are no American companies making sodium-sulfur batteries; the only manufacturers are in Japan.

Zinc bromide and vanadium redox flow batteries are other promising technologies. Although not as far along in development as sodium-sulfur, they may be easier to scale up. Vanadium batteries may also charge and discharge more quickly than sodium-sulfur, so they might be better suited to smoothing out power fluctuations caused by rapidly changing weather.

Hydrogen
Hydrogen-based energy storage looks great on paper: Use electricity to split hydrogen out of water, then convert the hydrogen back into electricity in a fuel cell when needed. Alas, the underlying technology is expensive and complicated, but MIT chemist Daniel Nocera may have found a better way. His hydrogen-ion-creating system uses an indium tin oxide electrode and a container of water with cobalt and potassium phosphate mixed in. Put the electrode in the water and add voltage. Cobalt, potassium, and phosphate migrate to the electrode, forming a catalyst that begins splitting water molecules into oxygen gas and hydrogen ions. Unlike most existing systems, the materials are fairly inexpensive, and the catalyst renews itself so it lasts a long time.

Nocera is still seeking a cheap way to convert hydrogen ions into hydrogen gas and an efficient way to get electricity from photovoltaic panels to the catalyst. But he thinks his approach will help other pieces of the hydrogen infrastructure fall into place. “The discovery opens doors we haven’t been able to walk through before,” Nocera says. “I don’t think this will be as hard.”

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15. Solar for Power Generating Plants

Ausra is at the vanguard of large scale power generation. Its solar storage system generates power at centralized stations using concentrating solar power to create steam that turns a turbine to make electricity. It also stores hot water that a power plant can draw on during times when the sun is not shining, reducing the cost to 8 cents per kilowatt hour, compared to 12 cents for natural gas. **http://www.ausra.com/**

Solar Two has built a 10-megawatt Solar Two power tower pilot plant near Barstow, California. It collects and stores concentrated solar energy in molten salt and generates electricity when needed by the utility and its customers. The unique storage capability allowed solar energy to be collected when the sun is shining and electric power to be generated even when the sun is not shining.
Details: **http://www.energylan.sandia.gov/sunlab/Snapshot/STFUTURE.HTM**

SkyFuel was awarded a grant by the U.S. Department of Energy (DOE) to develop its advanced Concentrating Solar Power system known as the **Linear Power Tower** for utility-scale solar thermal power plants. LPT is a high-temperature linear Fresnel system with molten salt storage. The diagram at left looks like a grill for an air conditioner, but it actually shows a football pitch-sized array of solar mirrors.

HelioDynamics uses solar concentrators use mirror banks which concentrate solar radiation onto a receiver unit to produce heat or a combination of heat-and-power. They are designed to be mounted on roofs, on parking lots and in open-field sites. Units can be added to produce MW capacities of power. **http://www.hdsolar.com/** -

Nevada Solar One is a 64-megawatt power plant outside of Las Vegas, Nevada which supplies electric power to the municipal grid. **Acciona Solar Power** built the plant. Press Release: http://news.com.com/Solar+thermal+energy+making +a+comeback/2100-11392_3-6189468.html?tag=cd.lede -

EMCORE Received a $24 Million Purchase Order for Concentrator Solar Cells from **Green and Gold Energy** EMCORE Corporation has been awarded an order for 3 million solar cells for use in GGE's SunCube(TM) terrestrial concentrator system. ***This 105 MW purchase order represents the largest procurement of concentrator solar cells in the industry to date.*** http://biz.yahoo.com/prnews/070806/nym035a.html?.v=3
EMCORE attained a record 39% conversion efficiency under 1000x concentrated illumination on its multi-cell products currently in high volume production.
http://www.emcore.com/

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16. Concentrated Solar

November 2010 – The Concentrated Solar Power plant of Ain Beni Mathar is now supplying electricity to the Moroccan grid. Located in the East of Morocco near the Algerian border, it will provide numerous lessons for further diffusion of concentrated solar power technology. This plant uses a cutting edge design, combining a large array of 224 parabolic mirror collectors concentrating sun energy and boosting the

steam output needed to produce electricity in this 470MW facility. Two other plants with similar design will soon be commissioned in Egypt and Algeria. Source: http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT/MOROCCOEXTN/0,,print:Y~isCURL:Y~contentMDK:22750446~menuPK:294545~pagePK:2865066~piPK:2865079~theSitePK:294540,00.html

Los Alamos Renewable Energy - Solar Reduction of Carbon Dioxide (SOLAREC™) produces fuel while simultaneously producing electricity from solar energy, at a cost competitive with fossil fuel generated power. The fuel can be burned at night to produce power 24/7 with no environmentally harmful by-products. The process has an over-all efficiency of nearly 48%. **http://www.lare.us/**

Compare the aforementioned 48% efficiency with the efficiency of nuclear. If all the factors for nuclear are factored in (mining, processing, shipping, security, plant maintenance, insurance, dealing with radioactive waste, eventual decommissioning of nuclear, etc.) …..the resultant efficiency of nuclear would probably under 6%.

Menova Energy developer of the **Power-Spar® solar concentrator** can be configured for electricity, heat, cooling and/or lighting solutions. It consists of a parabolic trough reflector which concentrates the sun's energy onto a modular absorber. Capable of capturing up to 80% of the sun's energy, Power-Spar systems can reduce energy bills by as much as 70%. **http://www.power-spar.com**

SpectroLab has continued to produce world-record (terrestrial) concentrator cells, the latest of which is the 40.7% efficient **http://www.spectrolab.com/**

PhotoVolt – features Vertical Multi-Junction (VMJ™) solar cells for photovoltaic power systems that are cost-competitive with traditional fossil-fuel sources of electricity. A postage stamp size VMJ cell delivers 100 watts at 1000 suns. Press Release: http://users.adelphia.net/~esch/index.html

AzurSpace has developed Triple Junction Cells on Ge Substrate for Concentrations up to 1000x. Supplier for commercial and large scale systems via **SOL3G http://www.sol3g.com/ http://www.azurspace.com/**

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17. Solar Thermal Systems

Schott is a pioneer in developing receivers for Solar Thermal Power Plants – the heart of solar power systems. Schott built the first Solar Thermal Parabolic Trough Power Plant in The U.S.

The photo shows a large acreage tract of mirrors, all directing the sun's rays on one spot – which in turn gets very hot. That's basically what electricity generation is about; generate high heat to power generators. **http://schott.com**

Solargenix Nevada Solar One has built a 64-megawatt Solar Thermal Electric Generating Plant located in Boulder City, Nevada. Also by Solargenix: **The Winston Series Compound Parabolic Collector (CPC)** using non-imaging optics to focus sunlight onto a high efficiency absorber tube. Can be used for solar water heating, space heating and solar cooling applications. **http://www.solargenix.com/**

The Saguaro Solar Generating Station uses rows of parabolic mirrors to focus the sun's rays onto SCHOTT PTR 70® receivers, enabling the generation of clean electricity.

Solel's Mojave Solar Park is a 553 megawatt solar thermal plant on 6,000 acres (15,000 rai) of the Mojave Desert, Arizona. The plant will use Solel's solar thermal parabolic trough technology which has powered nine operating solar power plants in the Mojave Desert and is currently generating 354 MW of annual electricity. **http://www.solel.com/**

Note: Thailand's EGAT, and their friends have often said that one of the main reasons solar isn't practical for Thailand is that it's not suited for large scale. Proof of the ridiculousness of that myth is Solel (just one company), which has built solar plants generating over 900 MW of electricity. That's enough juice for millions of Thai homes, and the resultant price per Kw/Hr is considerably lower than nuclear. Not only that, the generating capacity can be ramped up simply by adding more trough mirrors. Does Thailand have space to set up mirrors? A solar site doesn't even have to be flat ground. There are even solar designs which float above the ground, thereby allowing crops and/or grazing animals beneath – but let's not get too far ahead of ourselves now.

Solucar **600-mirror Solar Tower in Seville Spain** is the first commercial concentrator station in Europe. It focuses Sunlight onto water pipes at the top of a 40-storey concrete tower, which drives a turbine to generate 11 megawatts of electricity. Thousands more mirrors will be added to further boost the output. Added details: **http://www.solucar.es/**

Shuff Steel from Phoenix Arizona, is in partnership with **Stirling Corporation** building a solar farm located north of Los Angeles. It is to produce 500 megawatts of power from 20,000 25-kilowatt Stirling solar dishes that are 38 feet tall. The project includes an option where the farm could be expanded to 850 megawatts and 34,000 dishes. Rather than PV panels, the solar farm's panels harnesses heat from the sun with 82 mirrors and reflect it toward a series of hydrogen-filled tubes that expand when heated. The expanding gas cycles back and forth from cold to hot, and its movement powers a piston that creates up to 25 kilowatts of power.

The deal mentioned above is in close coordination with Southern California Electric (SCE) which is a municipal power company, serving a similar function for California, as EGAT does for Thailand. SCE has a voter-imposed mandate that 20% of its electric power must be from alternative sources by the year 2017.
Even before this new solar farm (mentioned earlier), Southern California will be at 18%. So they'll we well over their goal - nine years before the deadline. California also has monetary incentives for citizens purchasing solar for their homes and businesses. These incentives are tax breaks and/or rebates (refunded money) from a prior purchase of designated items.

In contrast, Thailand has no government incentives for its citizens which encourage purchasing solar. It's also doubtful that Thailand's EGAT has any provision for purchasing power from citizens who happen to generate surplus electricity with their own devices. That too happens in the U.S., where citizens with alternative power generators, can sell their excess to their local utility company. There are stories, where enterprising people actually see the little wheels on their electric meters turning backwards!

As for government level goals for alternative power generation, Thai authorities have mentioned a vague goal of one to three percent. That's a paltry amount. With the amount of sunshine that falls on Thailand, the goal could be 50% or more.

Luz **400 MW Solar Thermal Plant**
The photo at left shows a very tall tower – the top of which becomes the focus of all the mirrors on ground level below.
Press release:
http://www.renewableenergyaccess.com/rea/news/story;jsessionid=8510AAA5F374B296CD44C510C2E54C79?id=49887

Can this sort of solar power plant (shown above) get constructed in Thailand? Not if the Thai people rely on the chauffeured power brokers in Bangkok. However, such clean & safe thermal plants can get built if regular people really want them. In order for the common folk to get smart things done, they have to, #1.get informed & educated #2.Network among each other and organize. #3.Let the fat cats in Bangkok know, in no uncertain terms, that ignorance and corruption (i.e. business as usual) won't be tolerated.

Solar Thermal technology is relatively simple, but the materials and technicians will have to be imported from other countries, because Thailand does not currently have avenues which inventors and innovations. With their myopic seizure on the allure of on nuclear power plants, Thai leaders are determined to stay fixated on dusty out-moded plans that offer juicy under-the-table kickbacks.

BrightSource Energy plans to develop a solar thermal power complex in California, utilizing Distributed Power Tower (DPT) technology developed by Luz II (http://www.luz2.com/). It consists of mirrors called heliostats, which reflect the sun's light to a central tower to heat water and run a steam turbine to create electricity. **http://www.brightsourceenergy.com/**

Sopogy solar thermal power units which can fit on a building's roof, to generate electricity on-site rather than in giant power plants. Each MicroCSP collector produces 500 watts, roughly what a house (or three Thai houses) consume. **http://www.sopogy.com/**

Solar Trust of America, along with its sister company, Flagsol GmbH, has receive the Concentrated Solar Power (CSP) Innovation Award for its HelioTrough parabolic trough collector. The award was recently given to the Company at the 4th Annual Concentrated Solar Power Summit in San Francisco, California. The cutting-edge collector was voted for the award by conference attendees for its highly-innovative design. Additionally the collector demonstrated increased thermal output efficiency and reduced component costs. “HelioTrough represents the future for parabolic trough technology and we expect it to be the cornerstone of our proposed solar thermal power plants in the southwestern United States,” said Uwe T. Schmidt, Chairman and Chief Executive Officer of Solar Trust of America. “Thanks to the exceptional development and testing work by our colleagues at Flagsol, we are one step closer to providing performance and cost efficiencies not seen on the commercial market today.” Source: http://www.energydigital.com/sectors/renewables/solar-trust-america-receives-csp-innovation-award

eSolar Utility-Scale Solar Power eSolar heliostats were designed to minimize cost, realizing economy-of-scale benefits at much smaller power plant sizes than traditional solar thermalplants. Mass manufacturing means eSolar power plants will be cost competitive with coal and fossil fuels. **http://www.esolar.com/**

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18. Photovoltaic Systems / PV Panels

Amonix – has developed **High Concentration Photovoltaic (HCPV)** power generation systems for large commercial and utility scale applications offer significant cost savings by using inexpensive flat, plastic Fresnel lenses to concentrate sunlight approximately 500 times. The Amonix high-concentration silicon solar cell holds the world record for the performance of a cell manufactured in a commercial environment. (26.5% efficiency). **http://www.amonix.com/**

Concentrix Solar GmbH based in Germany, features FLATCON® concentrator PV modules to focus sunlight on high-performance solar cells, which then directly convert solar energy into electricity. Fresnel lenses focus direct sunlight through a 2mm-diameter focal x`point, concentrating the sunlight by a factor of 500. **http://www.concentrixsolar.de/**

Green and Gold Energy based in Australia, uses SunCube / SolarCube™ which in turn use Fresnel lenses to focus sun's energy onto photovoltaic cells. 5.8 cents per kWh. **http://www.greenandgoldenergy.com.au**

SOL3G is a Spanish company manufacturing solar photovoltaic concentrators using 32% efficient triple junction cells. Alos commerically available in MW quantities. **http://www.sol3g.com/**

SolFocus combines the record-setting efficiency of triple-junction solar cells with the magnifying power of tailored imaging optics. The current designs of SolFocus promise to deliver the lowest cost-per-watt of installed energy as well as the lowest cost per kW/h of any solar PV design for the foreseeable future. **http://www.solfocus.com/**

Practical Instruments **Heliotube** brings together the efficiency of concentrator technology with the convenience of a traditional flat panel. Heliotube's concentrators have integrated tracking built into the panel, enabling roof mounting and uniform power throughout the day. The company's product uses 88% less photovoltaic material than traditional panels. **http://www.practical-instruments.com/index.php**

Pacific SolarTech produces concentrator photovoltaic modules for utility-scale, remote and grid-connected systems using dome-shaped lenses to concentrate sunlight 10x onto small solar cells. This reduces the requisite amount of silicone, making solar power affordable. Dome-shaped lenses can diffuse light and redirect it to the solar cells with a fixed, non-tracking mount for rooftop applications. **http://www.pacificsolartech.com/**

Whitfield Solar is a British company developing a solar concentrated PV system

using fresnel lenses and triple junction cells. Pilot systems were installed in Spain in 2006. **http://www.whitfieldsolar.com/**

Prism Solar Technologies manufactures a new type of photovoltaic module that uses transparent holographic optical elements to reduce the amount of silicon required. Spectral selection keeps it cool. Passive tracking reduces the cost. **http://www.prismsolar.com/**

Definition of a couple of terms:

Active tracking = special sensors connected with motors that adapt the orientation of solar devices – to gain maximum exposure to the sun's rays. There are various methods, but all involve some sort of power unit to power it, however slight.

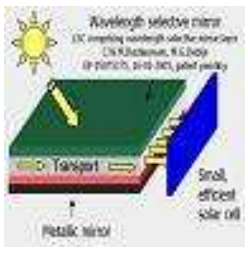
In slight contrast, ***'passive tracking'*** implies tracking the sun's rays without the use of sensors, motors or other tracking devices. There are developments in some current solar devices that employ special lenses, or Fresnel lenses, and/or spectral lenses on a stationary solar device - which give the nearly the same results as active tracking. Passive tracking, if it works well enough, has the advantage of having less components, therefore less things that go wrong.

New Kind of Solar Plant (http://www.ecogeek.org/content/view/768/) -

GreenVolts concentrated solar PV plants are being installed in California by PG&E (municipal power company) as solar plants designed to produce up to five megawatts during the peak demand at the hottest part of the day. They're composed of small mirrors that concentrate the sun's light on a small, ultra-efficient photovoltaic cell. **http://www.greenvolts.com/**

Solaria is developing a "new form of low-concentration solar PV multiplying technology that produces two to three times the number of PV cells from the same amount of silicon material." **http://www.Solaria.com/**

Entech uses inexpensive Fresnel lenses capture the sunlight, and focus it onto small solar cells, thereby reducing electricity costs compared to conventional flat-plate (planar) solar energy approaches. This method concentrates the sunlight 20 times, while also reducing the use of silicon cell material by 95%. **http://www.entechsolar.com/**



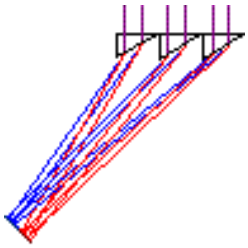
Maxxun is developing luminescent solar energy concentrators with special coatings to enhance the light output of these

concentrators by 2-3 times. The concentrators are combined with highly efficient photovoltaic cells and it is anticipated that these systems will provide solar energy at a cost which is competitive with the standard electric grid. **http://www.maxxun.com/**

Solenergy is an Australian company which has developed **Sunflower SRC Solar Ridge Concentrators** which are a simple, reliable and low cost way to generate twice as much energy as fixed modules. They have achieved a recordable ***12 cents per kW-hour*** energy cost. **Ridge concentrators** do not require precise tracking, which makes them very simple in installation and reliable in operation. **http://www.solenergy.com.au/**

Stellaris has demonstrated Concentrating Photovoltaic Glazing (CPG) can lower manufacturing costs of solar modules by more than 40% versus those of leading competitors in the solar industry. Superior encapsulation technique also increases efficiency by over 20% and provides greater protection of the photovoltaic (PV) material. Final module cost approaches $1/watt. http://www.stellaris-corp.com/

Sliver Solar Cells - New manufacturing process developed at the **Australian National University** uses as little as 1/30th the amount of hyper-pure silicon as in square solar PV technology. Manufacturing plant is complete, and process testing is underway. The thinness of the wafers makes them flexible and both top and bottom surfaces are active. Can be used for curved surfaced such as car/truck roofs.



PARC concentrator PV (CPV) module reduces the size of the CPV design into a smaller, thin, flat, molded glass tile and yields an even more high-performance, cost-effective product. An offshoot, **Sol Solution** is developing a photovoltaic system that takes advantage of chromatic aberration called a 'Rainbow Concentrator' to separate and concentrate the solar spectrum. This will allow higher efficiencies for solar cells that are optimized for a specific range of wavelengths
parc.com/research/projects/cleantech/cpv.html

H2Go has committed to first generation design incorporating non-imaging compound concentrating optics employing the Spectrolab triple junction cells. The concentration ratio is 500 suns, allowing for passive cooling. **http://www.h2go.org/**

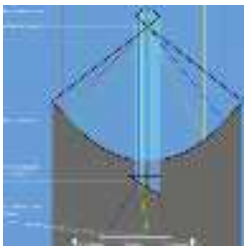
Infinia produces a 3 Kw Solar Stirling product for commercial and residential users which will generate electricity more efficiently and economically than Photovoltaic (PV) systems. It concentrates sunlight on a free-piston Stirling engine made from common materials using low-cost manufacturing techniques, delivering a net system efficiency of over 24%. Note to Thai entrepreneurs: Stirling engines could be manufactured under license **http://www.infiniacorp.com/**

Sunengy Liquid Solar Array - The LSA system is based on floating solar collectors made mostly of plastic. Each has a very small area of silicon photovoltaic cells at the water surface with a 1 meter square, 2 mm thick plastic focusing lens rotating slowly above to track the sun. The collectors can be arrayed on a raft on a lake. If the a strong wind whips up, sensors cause the collectors to automatically submerge until the threat is passed. Has the potential to produce electricity for 3 US cents (one baht) per Kw hour and has a 20% efficiency rating – which is high. **http://www.sunengy.com/**

Pyron Solar - Developed in cooperation with Boeing-Spectrolab a low-profile floating system with short-focal-length lenses concentrating direct sunlight by 400X onto photovoltaic cells. These advanced multi-junction cells produce 800 times more electricity than conventional non-concentrating cells the same size. High efficiency and low material requirements make the new system competitive with conventional power plants. http://www.pyronsolar.com/US/

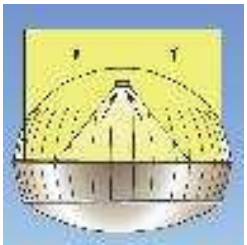
SV Solar or **Silicon Valley Solar** manufactures flat plate, internal concentrator solar modules, that produce 16% more power with half the solar cells. **Sol-X modules** do not require tracking and uses no moving parts. Additionally, it is efficient, reliable, cost effective and easy to install. **http://www.sv-solar.com/**

Energy Innovations - Standing over five feet square and five feet high, **the Sunflower™** has 25 mirrors that track the sun, reflecting light onto the receiver. The solar cell array turns concentrated light into electricity while fans keep operating temperatures low. Cost is about two-thirds that of comparably rated PV-based systems. **http://www.energyinnovations.com/**



Total Spectrum Solar Concentrator - **United Innovations** first concentrates the solar energy via parabolic reflectors, then splits the light through a prism to focus the wavelengths onto solar collectors optimized for a given spectrum.

Solarsphere Technology combines elements of both direct intercept dishes and Solar Towers. The design focuses on spheres and lightweight, thin film materials. Concentrators can be ramped up to larger scale which are low-cost and can be mass produced. **http://www.seao2.com/solarsphere/csp.htm**



Cool Earth Solar is a company which has developed an inflatable solar concentrator technology that slashes materials costs, making solar farms competitive with commercial electricity generation systems.

NuEdison - has created a low concentration photovoltaic module that gets up to twice the power out of any other solar cell, requires no tracking, is simple to manufacture. Can be installed on a roof. **http://www.nuedison.com**

Solaria - applies existing technologies from the semi-conductor and optics industries to established form factors and testing methodologies of current PV production. The result is a new form of low-concentration solar PV technology that produces two to three times the number of PV modules from the same amount of silicon material. **http://www.solaria.com/**

Israeli Solar - **DiSP**'s unique concept in solar energy is a miniature concentrating photovoltaic (MCPV) unit that increases efficiency to 79% by capturing and transforming the sun's heat as well. In areas of sustained sun, the cost could be lower than utility prices, about 15x better than flat panel PV systems. **http://www.disp.co.il/**

Flagsol has their New Solar Collector which are a new line of parabolic trough collectors that will reduce costs by 15%-20%. Flagsol is showing that solar thermal energy costs-per-Kw can match or beat cost-per-Kw for coal or fossil fuels. **http://www.flagsol.com**

For added info on Parabolic Trough Technology:
http://thefraserdomain.typepad.com/energy/2007/04/parabolic_trough.html

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19. Organizations Which Promote Alternative Energy

Palang Thai is a Thailand-based non-profit organization that works to ensure that the transformations that occur in the region's energy sector are economically rational, and that they augment, rather than undermine, social and environmental justice and sustainability. **http://www.palangthai.org/**

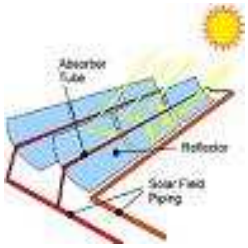
Algarve Energy Park is an innovative concept at national and European level, focused on developing specialized renewable energy solutions by creating a nucleus

platform for the advanced training, research and development of energy technologies. The Algarve Energy Park in Portugal aims to complete the solutions circuit by integrally launching product demonstration, communication and commercialization from this platform. contact@algarveenergypark.com

Renewable Energy Fund is for investors who choose to invest in companies which are directly involved with alternative energy products and projects. Tel# in Miami, Florida: (305) 666 5053

The Trans-Mediterranean Renewable Energy Cooperation (TREC) an initiative of the Club of Rome. TREC is a group of scientists, engineers and politicians developing a collaboration amongst countries in Europe, the Middle East and North Africa (EUMENA) to take advantage of the truly enormous quantities of solar energy falling as sunlight on the world's hot deserts. **http://www.trecers.net/index.html**

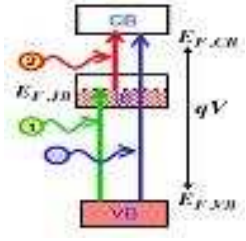
North Africa and solar could be like a marriage made in heaven. The Sahara desert and its southern perimeter, the Sahel are ideal locations for solar. There's no limit its power-generating potential – if there was willingness and investment funds. North Africa could be a solar harvester – shipping valuable power to Europe, the Middle East, and other parts of Africa.



The National Renewable Energy Laboratory (NREL) coined the name **'TroughNet'** to describe trough solar technology, which offers the lowest cost solar electric option for large power plant applications. TroughNet is a technical resource that offers information about the various components of a solar trough. **http://www.nrel.gov/csp/troughnet/**

TREC-UK is a group of volunteers, mainly in the UK, who are developing concepts developed by TREC and aim to raise awareness of those concepts in the UK and beyond. TREC-Australia **http://www.trec.net.au/**
The UK branch is; **http://www.trec-uk.org.uk/index.htm**

42.8% Solar Cell Efficiency
Using a novel technology that adds multiple innovations to a very high-performance crystalline silicon solar cell platform, a consortium led by the **University of Delaware** (UD) has achieved a record-breaking combined solar cell efficiency of 42.8 percent. Details: **http://www.cis.udel.edu/~honsberg/Refs/50percent-hawaii.pdf**



While still in development, **intermediate band solar cells** could promise efficiencies up to 63.2%! To be cost effective, the design will only be applicable in highly concentrated sunlight

applications suited to utility-grade solar power.
Details: **http://www.insidegreentech.com/node/1365**

Soliant Energy has designed a solar concentrator that combines both lenses and mirrors in a compact roof-mounted system that tracks the sun, focusing light on small areas of photovoltaic material. They are manufactured at half the cost of conventional solar panels. **http://www.soliant-energy.com/**

Nevada Solar One is one of the world's largest solar installations, **and generates 64 megawatts** from Boulder City, Nevada. It covers 300 acres (750 rai) and contains 760 mirror arrays, each measuring about 100 meters. The mirrors direct sunlight onto an oil-filled tube which creates steam to turn a turbine, which in turn generates cheap electricity. Press release: **http://www.technologyreview.com/Energy/18718/**
Nevada Solar One has also built a new large solar thermal power plant, has begun supplying electricity to the Nevada state grid. Similar and larger plants are being constructed in California's Mojave Desert, where an existing solar thermal plant has been supplying commercial loads of electricity for over 20 years.
http://news.com.com/Solar+thermal+energy+making+a+comeback/2100-11392_3-6189468.html?tag=cd.lede

Delta Electronics has developed a manufacturing process for modules using the high efficiency solar cells recently developed by Spectrolab The new concentrating photovoltaic (CPV) modules will get greater than 35% efficiency
http://www.delta.com.tw/

Balloon technology cuts solar cost 90% **Cool Earth Solar** could make solar energy cheaper than coal within a year, using inflatable solar PV concentrators suspended above farmland. The company hopes to cut the cost of electricity to **29 cents per watt by 2010** http://news.mongabay.com/2007/0221-coolearth.html

Practical Instruments is in partnership with installers for the **Heliotube**. It reduces solar electric costs using 10 small reflective solar troughs that rotate to catch the sun for longer periods, and requires less silicon in construction.
http://www.practical-instruments.com/

A California startup company, **SolFocus** says it can slash the cost of solar power with its concentrator technology. At the heart of their system are thousands of small diameter (10 baht-sized) mirrors that focus sunlight on photovoltaic "dots" just one millimeter in size **http://www.solfocus.com/**

Prism Solar Technologies of NY has developed a proof-of-concept solar module that uses holograms to concentrate light, possibly cutting the cost of solar modules by as much as 75 %, making them competitive with electricity generated from fossil fuels. **http://www.prismsolar.com/**

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20. Using Solar to Produce Hydrogen

Isracast claims zinc powder will drive your hydrogen car
By concentrating solar energy to produce zinc, which can be stored and shipped, and then deployed for hydrogen release on demand. Said to be clean, safe and inexpensive; it's been developed by a cooperation of scientists from Israel, Sweden, Switzerland and France. **http://www.isracast.com/**

Sunlight Used to Produce Hydrogen From Water. Solar Hydrogen Energy Corporation has demonstrated that solar energy can be concentrated to over 1500°F and used to produce Hydrogen. Press release: http://www.pureenergysystems.com/news/2004/07/09/6900033_Solar_Hydrogen/index.html

N E W S I T E M F R O M B A N G K O K P O S T

An article in the Bangkok Post titled "Thailand: Four Global Giants Vie to Supply Nuclear Plants" written by Nareerat Wiriyapong on Jan. 11, 2008, as follows: [author's comments appear in brackets]

The world's four largest nuclear technology manufacturers have expressed interest in bidding for Thailand's proposed nuclear power project.

Toshiba and Mitsubishi from Japan, Areva from France and General Electric from the US have each contacted the Electricity Generating Authority of Thailand (Egat) about submitting proposals to build a new nuclear plant.

Thailand hopes to have four nuclear plants, each costing at least $1 billion, in operation by 2020-21. Vietnam and Indonesia are expected to have nuclear plants operational by the same time.

[comment: Agence France Presse recently announced that Thailand's first nuclear power plant is estimated (by Egat's own experts) to cost 6 million dollars. Which is it – the $1 billion each in this article, or the $6 billion each reported within the same week by one of Europe's most respected wire services? It's a moot point, really. Regardless of whether the proposed cost is 1 or 6 or 12 billion bucks each, you can

bet the actual cost will be much higher than the estimate. It's doubtful whether a mega project has ever stayed on budget since Siam changed to Thailand.]

Kamol Takabut, Egat's assistant governor for power plant engineering, said Candu from Canada was also keen but that its technology may cost more. GE and Toshiba, which earlier acquired 100% of Westinghouse, have offered boiling water reactor (BWR) technology that is used by 21% of the world's 442 nuclear power plants.

Mitsubishi and Areva propose the more popular pressurized water reactor (PWR) used by 60% the world's utilities.

"Both BWR and PWR require pretty much the same in terms of cost, but PWR is slightly better in terms of safety for personnel that operate the plant, so it is more popular," Mr Kamol said.

However, he insisted that all types of nuclear power plants are safe and are fitted with automatic shutdown features. They generate no greenhouse gases.

[comment: Mr. Kamol conveniently skirts the fact that considerable amounts of greenhouse gases are released in relation to nuclear energy. There are fossils fuels (FF) burned to mine and process the fuel, FF burned to transport it, FF burned to build and maintain the plants, and FF burned to deal with the radioactive waste, and ultimately to decommission the plant.]

Egat expects to complete a nuclear proposal within three years. If the government decides to begin the project, construction could start in 2015, he said. Mr Kamol said that without nuclear power, Thailand was going to lose competitiveness to regional rivals.

[comment. Egat, in its own preliminary studies, has indicated it will survey sites before deciding which sites to pick. Yes, you read that right. According to Egat, the surveying takes place ***before*** the picking process. That's like saying you're going to lay a foundation for a house before you've found a house site. As for Thailand 'losing competitiveness' if no nuclear plants were built, the opposite is more likely true. If Vietnam and Indonesia build nuclear power plants, they may wind up facing many of the problems outlined in this text. Similarly, if Thailand's leaders see clearly and develop concentrated solar, it will be a lot smarter investment for Thailand's future, and the competitive edge will favor Thailand.]

Nuclear technology, despite higher investment costs, is competitive with other fuel sources in terms of cost per megawatt of electricity. "Once Vietnam has nuclear power, it can produce goods that are cheaper than Thailand's, so we will lose in competition to our arch rival," Mr Kamol said.

[comment: Mr. Kamol is wrong. Nuclear power generation, especially with all its peripheral costs, will wind up being considerably more expensive that any current projections indicate. The higher costs won't just be monetary, but will also tax the Thai peoples' patience and good will - and will set up flash points for violent protests. Even if nuclear power plants improved Thailand competitive standing (which it won't) the dire drawbacks to nuclear far outweigh any assumed advantage in the marketplace. Planning for Thailand's future entails a lot more than getting a lower electric bill for manufacturing goods.]

”In the planning stage, Vietnam is already two to three years ahead of us as the government has already approved the project. It has already sent thousands of personnel to train with nuclear technology in France and Japan.” If Thailand’s first nuclear plant is operational in 2020, nuclear energy would generate 5% of the country’s power, rising to 9% a year after, Mr Kamol said. ”Now, as much as 70% of power generation in Thailand is dominated by natural gas and existing world reserves would last only 40 years,” he said. ”So we need both coal-fired and nuclear power plants to support rising power demand and make the whole power generation system more secure by having a balanced mixture of fuel types.”

[comment: Mr. Kamol and his like-minded friends would do well to become apprised of what’s happening at the vanguard of solar energy technology. Hopefully it’s not too late for them to view it objectively and with open minds. The worry is that they’re so seized on the idea that Thailand must go nuclear, that they’re determined that nothing will stand in their way.]

Nuclear power accounts for 16% of the 17,450 terawatts of capacity worldwide. Apart from 442 plants now operating, 29 more are under construction.

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Full Bangkok Post article can be found online at the URL:
johnibii.wordpress.com/2008/01/11/
thailand-four-global-giants-vie-to-supply-nuclear-plants/

For the sake of fairness and showing some of the other side of this debate, the following article is included herein, which paints a somewhat favorable picture for nuclear. Note, near the end part of the article, it claims that the best of the experimental new technology probably won’t get instated before the second half of this century, and its costs could be prohibitive.

Two new designs aim to make nuclear reactors safer and vastly more efficient. by Elizabeth Svoboda

From the June 2009 issue, published online at
http://discovermagazine.com/2009/jun/08-new-tech-could-make-nuclear-best-weapon-against-climate-change/article_view?b_start:int=0&-C=

In December 20, 1951, just outside the tiny town of Arco, Idaho, four 100-watt light bulbs strung on a single cord flickered to life and then glowed brightly, becoming the first appliances ever powered by nuclear energy. The small group of scientists watching, employees of the Idaho National Laboratory (INL), toasted to a future powered by the splitting of atoms.

It would be a dream deferred. Nuclear power stalled in America amid highly publicized accidents and concerns about radioactive waste. But scientists at the INL quietly soldiered on, and now the tide may be turning: The imperative to limit greenhouse-gas emissions is sparking an atomic renaissance on the very site of

nuclear energy's birth.

Buoyed by an allocation of $1.25 billion in funding for reactor research from the 2005 Energy Policy Act, INL scientists are working to improve safety, boost efficiency, minimize waste, and decrease cost in a new generation of nuclear reactors. Even if renewable energy goes mainstream, INL researchers still believe nuclear will be essential for supporting the electrical grid's base load—that portion of the nation's electricity that must be supplied at a constant rate, in contrast to the variable supplies from the sun and wind. "Nuclear is the major base load–producing energy source that could reduce greenhouse-gas emissions," says Kathryn McCarthy, INL's deputy director for nuclear science and technology.

Unlike burning coal or other fossil fuels, fission—the breaking apart of atomic nuclei, the process underlying nuclear energy—emits no carbon dioxide. A nuclear reactor generates power from a cluster of fuel rods inside its core, each filled with uranium oxide. Every time an incoming neutron bombards one of the uranium atoms, the atom splits in two, expelling energy and releasing more neutrons, which in turn collide with other atoms and establish a chain reaction. The cumulative heat from this process boils water into steam, which spins a turbine to create electricity.

The fission of an atom of uranium is 10 million times as potent as burning an atom of carbon from coal, making nuclear power efficient and inexpensive—in principle, at least. The average cost of generating nuclear energy in the United States was less than two cents per kilowatt-hour in 2006, according to the Atlanta-based utility data provider Ventyx, which puts it on par with coal. Critics like Rocky Mountain Institute cofounder and chief scientist Amory Lovins dispute this apparent parity, arguing that the price of nuclear energy would increase if more plants were built. The current cost of delivering nuclear-generated electricity is low in part because many plants were paid for long ago, Lovins notes. Nuclear's day-in, day-out reliability makes it an essential companion to renewable energy, argues Burton Richter, winner of the 1976 Nobel Prize in Physics. "The sun doesn't shine at night, and wind power is highly variable," he says. "To meet our emissions goals, we're going to have to grasp every arrow in the quiver, and nuclear is one of those arrows."

Before that can happen, though, nuclear power will have to overcome the unresolved issue of how to dispose of radioactive fuel waste. In February President Obama deep-sixed the government's long-standing plan to bury waste at Nevada's Yucca Mountain after opponents argued that the strategy was too risky. "Now it's time to start over and find a viable way to deal with used nuclear fuel," says Patrick Moore, chief scientist at the sustainability consulting firm Greenspirit Strategies and a cofounder of Greenpeace. But finding an alternate solution could take years, and some observers concerned about nuclear waste's effects on human health do not want to plunge ahead in the meantime. "I think there's a solution out there; I just don't think we've landed on it yet," says Mary Woollen, executive director of the nonprofit group Keep Yellowstone Nuclear Free. "It's foolhardy to ramp up the scale of nuclear power before the waste issue is resolved."

That is exactly what the INL scientists are aiming to do, however, confident that their work is essential to the planet's well-being. Their efforts focus on two new designs:

the very-high-temperature reactor (VHTR) and the sodium-cooled fast reactor (SFR). Both incorporate inherent safety features to prevent core overheating and the release of radioactive material. The hope is that these new approaches will finally erase the memory of Three Mile Island and Chernobyl and eliminate some of the political opposition that has stymied the American nuclear power industry for three decades.

The VHTR, which is still in the planning stage, has a reactor core made of graphite, a substance that remains strong and stable even at high temperatures. Helium gas cools the reactor and transports heat to outside the core. The reactor uses uranium dioxide fuel particles that are also coated with graphite so they will not crack and release fission products even in extreme heat. As a result, VHTR plants will be able to heat helium to a temperature of up to 1000 degrees Celsius (1800°F)—nearly three times as high as existing reactors can go. The heat from the helium can then be used to create steam to drive a turbine. Unlike reactors of the Chernobyl type, the VHTR has a negative temperature coefficient, meaning that as the core temperature rises, nuclear reactions inside naturally begin to slow down. This feature ensures that the reactor never approaches a temperature that would trigger a meltdown. “No matter what humans do wrong,” McCarthy says, “if anything abnormal happens, the plant will shut itself down.”

The VHTR should produce electricity about 40 percent more efficiently than do most reactors in the United States. The heat it generates would also be useful for nearby industrial plants. VHTR plants could even produce hydrogen for fuel using high-temperature steam electrolysis, which breaks apart the bonds of water molecules; this process is 50 percent more energy-efficient than existing hydrogen production methods. In 2005 the Department of Energy authorized INL to build a VHTR plant. The prototype should be completed sometime between 2018 and 2021.

But first the INL team must surmount a slew of technical obstacles. For instance, hardy new alloys may be necessary to protect some surfaces inside the reactor. “Right now, materials don’t always exist to go with the kinds of temperatures and pressures they are talking about,” Richter says. Even if such materials are found, he adds, they might add millions of dollars to the still-unknown cost of constructing a VHTR power plant.

The competing SFR design banks on a novel fission concept: bombarding uranium atoms with neutrons of much higher energy than those used in a tradi-tional nuclear plant. This concentrated atomic assault allows the reactor to extract 100 times as much energy from uranium fuel as do current thermal reactors, which use less than 1 percent of the fuel’s potential energy. The SFR can also burn spent nuclear rods from other reactors and depleted uranium left over from the uranium-enrichment process, putting a serious dent in the nuclear waste problem.

Scientists from the industry’s professional group, the American Nuclear Society, estimate the energy an SFR plant could coax from these by-products would be enough to supply all of America’s needs for more than 100 years. Reburning spent rods in an SFR also reduces their radioactive decay time; the resulting waste would have to be sequestered for only a few hundred years instead of several thousand.

Unfortunately, the sodium used to transfer heat out of the core in an SFR plant is a mixed blessing. Liquid sodium is an ideal coolant in that, unlike water, it does not impede the movement of fast neutrons. It also improves safety because it works under normal atmospheric pressure. But liquid sodium is opaque, making it hard for reactor operators to monitor heat transfer. To compensate for this difficulty, INL researchers are developing computer simulations that model the way liquid sodium acts inside a fast reactor.

A few early-model SFRs have been around for a while: Idaho's low-power, experimental EBR-II operated for 30 years, and Russia's 29-year-old BN-600 is still running. However, INL does not want to roll out a new prototype until researchers have finished refining the computer models. This may mean that an improved SFR plant will not appear for another 10 or 20 years.

Such a lengthy timeline, combined with hefty up-front costs and lingering public skittishness, suggests that next-generation nuclear faces an uphill battle. Current designs could cost up to $10 billion to build; new ones are likely to be even more expensive. Energy companies are reluctant to commit such sums until they are sure that the upgraded designs deliver on their promise. "We need a demo plant—that's really what's holding the industry back," says David Petti, an INL technical director. "The end users have basically told us, 'We'll be first in line for the second plant.'"

Even if INL can persuade energy companies to sign on, long construction times guarantee that the nuclear renaissance will be gradual. "These new reactors won't come into broad use until the second half of the century. So for the next 50 years, we are going to be relying on the current generation," Richter says.

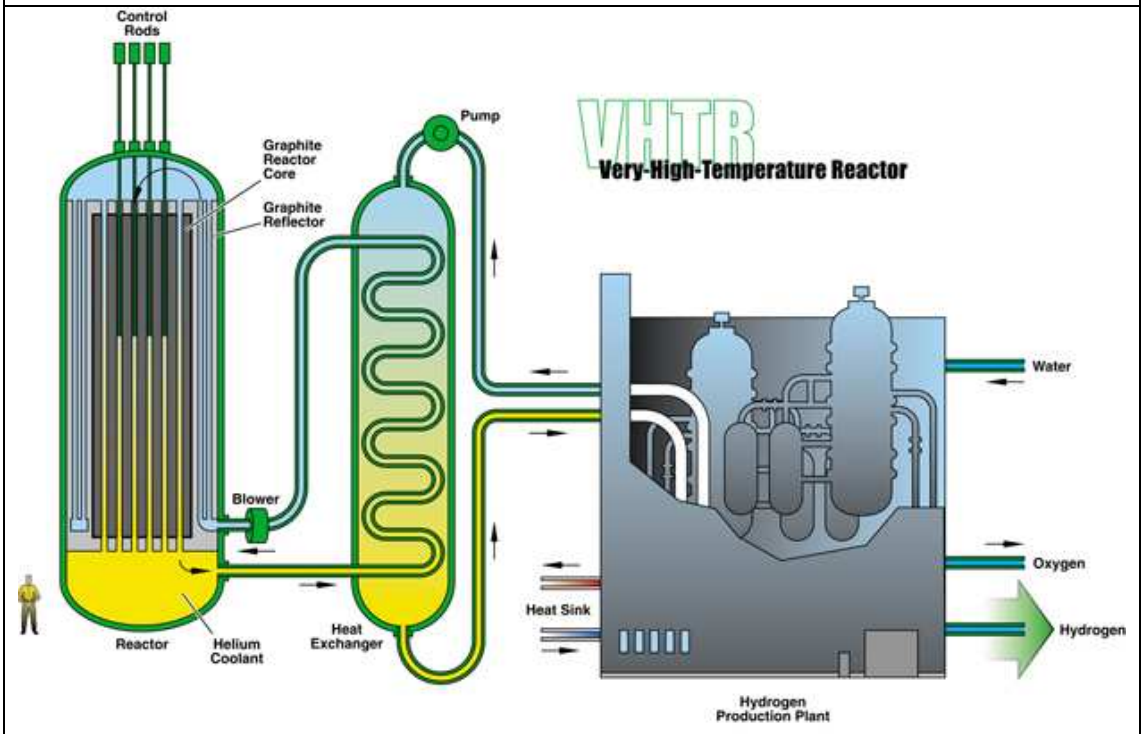
Maintaining today's nuclear plants will require finding a practical, safe, and politically palatable way to dispose of waste. "As to spent fuel, love it or hate it, we have it," Richter says. **"We have 60,000 tons of spent fuel from reactors that are now running."** A refined SFR design could eventually mitigate the waste issue because of the reactor's ability to burn spent fuel, but even in a best-case scenario, the reused fuel would retain unsafe levels of radioactivity for several centuries. The nuclear industry will also have to address widespread fears about the reactors themselves. Insiders claim that today's nuclear plants are far safer than many people realize.

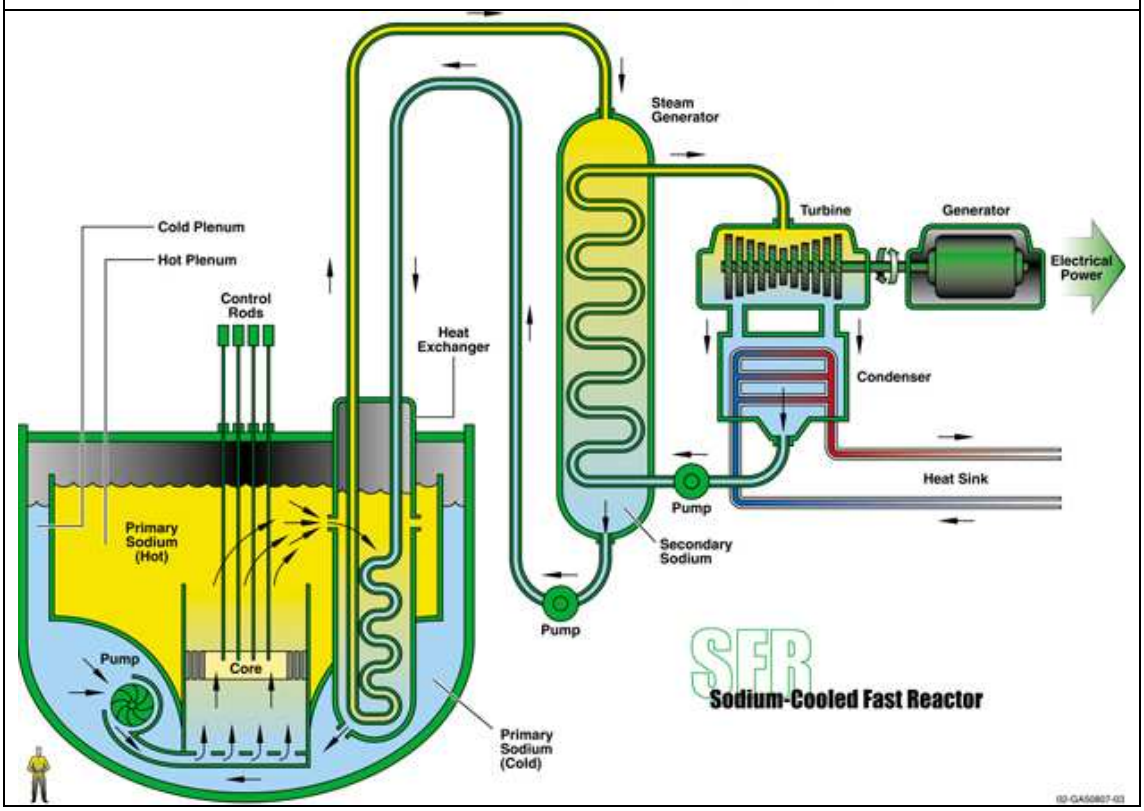
George W. Bush was supportive of INL's nuclear research, but so far it is not clear if the Obama administration shares that enthusiasm, McCarthy says. Still, the threat of climate change has once-skeptical environmentalists like Greenspirit's Patrick Moore—along with environmental icons like Stewart Brand and James Lovelock—throwing their support behind nuclear energy. "I think the environmental movement made the mistake of lumping nuclear energy in with nuclear weapons," Moore says. "It's clear to me that no technology will do more than nuclear to reduce our use of fossil fuels."

Going Nuclear

In its efforts to develop safer, cheaper, and more efficient nuclear reactors, the Idaho National Laboratory has researched half a dozen next-generation reactor designs;

these two (the sodium-cooled fast reactor and the very-high-temperature reactor) are the most promising. Both are configured to exploit the laws of nuclear physics to make a meltdown impossible, even in the face of an engineering failure or operator error. **Whether or not either design is practical is still unknown.**





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21. Mechanics of Nuclear

Nuclear proponents in Thailand acknowledge there have been problems with a few of the other countries nuclear power plants in the past. However, if mentioned at all, it is a brief reference – then on to cheerier news.

Here's a quote from Mr. Kopr Kritayakirana, who is described as "an expert adviser with the Nuclear Power Programme Development Office (NPPDO)." The following paragraph was gleaned from a written debate the front Business page of the Bangkok Post newspaper on March 3rd, 2008. bangkokpost.com/Business/03Mar2008_biz22.php
"Of the 440 reactors operating worldwide, there has been one significant accident at the Three Mile Island plant in the US. Nobody died. There has also been one catastrophe at Chernobyl in what was then known as the USSR. The Chernobyl reactor was not running in the regulated commercial mode."

[comment] The radioactive cloud emitted by Chernobyl meltdown effected territory as distant as 1400 Km away. From the destroyed power plant in what is now Ukraine, a NNW wind blew the cloud of radioactivity across hundreds of square Kms of cities and farmland, and contaminated bovine milk production in far away Sweden. If a Thai reactor suffered a similar fate, winds could take the radioactivity to any part of Thailand. Just as sobering, airborne radioactivity could blow in to parts of Laos, Vietnam, Cambodia, Malaysia, Burma, and Southern China. Even some border areas of India, Bangladesh, Singapore, and the Indonesian Island of Sumatra are within reach of a Chernobyl-type contamination - depending on which way and how hard the wind was blowing during a worst-case-scenario.

Of course, authorities tell us that a meltdown is all but impossible with today's safeguards Yet those are the same words that officials were using pre-Chernobyl and Three Mile Island. Technology may improve over time, but it will never be infallible.

Similarly, we're told computer operating systems are always improving, yet we know that glitches happen with even the most modern software. Indeed, much of what keeps a nuclear reactor safe is its software. All of Thailand's nuclear plant software will be imported and, after the foreign trainers leave, it will be in the hands of Thai technicians. Indeed, if a serious glitch is discovered (hopefully not too late), it's likely that foreign experts will be called upon to come and straighten things out. Case in point; in late 2007, nearly-new security software for the SUV airport broke down. Passengers were backed up badly, and nothing was diagnosed or fixed until outside experts were able to jet over to Thailand to fix the problems.

Similar scenarios can be expected for the precision hardware needed to safely run a power plant. As with any machinery that is expected to run around the clock, nuclear plant machinery will need to be serviced and parts replaced from time to time.

Thailand's engineers do not have a sterling reputation for maintenance. One example: a popular water amusement park for children had some old rusting components fall apart during a particularly busy day in 2007. A structural piece of a water slide broke, and several children tumbled down two meters and were severely injured.

The water slide was low-tech and all the joining parts were readily visible to an inspector at any time prior to that major mishap. In contrast, nuclear power plants are high tech and consist of many parts, such as pumps, fitted pipes, check valves, pressure relief valves (PRV's), on-off cocks, heat sensors, and Geiger counters. Their workings are often not visible. People living near nuclear power plants will have to put their trust in inspectors and technicians doing their jobs professionally – and that parts are maintained and replaced according to schedules.

The hourglass shape that most people associate with nuclear plants doesn't pose a danger. That large structure merely serves as a giant heat exchange. Even if it were bombed by terrorists, it would not cause radiation leaks. The meat of the matter is the smaller containment building. Actually it's about the size of a twelve unit apartment complex, so using the word 'smaller' is misleading.

The containment structure is made from reinforced concrete. One hopes that Thai sub-contractors will not try to save money by using less than top-quality building materials. The legacy of the new airport's concrete runways and turn-around pads does not bode well for confidence - but we can always hope for the best. The concrete for a reactor should also be stressed while curing (drying) in order to add strength. The stressing process might involve long bolts that are tightened with nuts while the concrete is curing. That's one type of 'hardening' method that is used for 'Minutemen' nuclear missile silos and for bomb shelters.

The concrete used for Kuala Lumpur's twin towers had special ingredients (including ground-up electronic chips) added to the mix in order to make it especially strong. Tests were conducted during the construction. One time, about half way up one of the towers, the concrete was found to be 99% of the required strength. The floor had already been poured and had started to harden, yet the inspector required that the entire floor be removed and rebuilt with the mandated 100% strength concrete mix. Could something like that happen in Thailand construction? It's doubtful that if a lone inspector finding something that was 99% in compliance - would require that an already-poured and dried segment be torn up and done again. Anyone familiar with Thai construction would be aghast to see that happen.

USSR's Chernobyl and the USA's Three Mile Island power plants were run and maintained by two countries which were at the vanguard of technology at the time. Yet even those power plants suffered problems. How much safer will Thai reactors be? Thailand is not near the top of the list of technologically adept countries. Even tech-savvy Japan had radiation leaks at nuclear facilities - which is to say; glitches can happen in any country. No matter how advanced the safety precautions are said to be, things can go wrong.

April 19, 2008 article in Nation Newspaper / Bangkok

The following article was written by Nophakhun Limsamarnphun for 'WATCHDOG' opinion section of the Nation newspaper.

http://nationmultimedia.com/2008/04/19/opinion/opinion_30071051.php

[comment] the text looks like it was taken directly from an EGAT press release.

Title: **Nuclear plan looks sound; political will must follow**
Subtitle: A government blueprint for Thailand's proposed nuclear power plant (NPP) project shows that it will take 13-14 years from now to actually commission a 4,000-megawatt plant.

Starting last year, the government set a period of three years for pre-project activities, namely: power system planning, a feasibility study and a site survey. By the end of the third year (2010), the government will have to make its final decision on whether to embark on this long-term and capital-intensive scheme.

If it is given the go-ahead by then, there will be no turning back, because project implementation needs a very long lead time of up to a decade before commissioning. For instance, site selection and qualification alone will take about two years, since it is a technically complicated and politically sensitive process.

About four decades ago, Ao Pai, off the eastern province of Chon Buri, was picked as a potential site, but the project was later suspended.

The new NPP blueprint shows that the preparation of project specifications, as well as bidding, will also be completed during the first two years. It will then take one year to evaluate all bids and another year to negotiate the contract, estimated to be worth a combined Bt300 billion.

Other key elements of the project-implementation phase are completing project engineering, applying for local and international licenses and procuring equipment and materials.

Plant construction will take six years to complete, starting in the seventh or eighth year of the project.

Site preparation and excavation will take about six months, while construction of the reactor building and containment facilities will take about four years.

Construction of auxiliary buildings will follow, while installation of primary systems will be done during the 10th and 13th years of the project. During this period, there will also be construction of turbine and generator buildings.

In terms of manpower, the blueprint shows that 800-1,000 qualified personnel will be needed to complete the 4,000-megawatt plant.

Dr Somporn Chongkum, executive director of the Thailand Institute of Nuclear Technology, said about 200 physicists and 500 engineers would be needed. A significant number of these personnel should have advanced degrees (masters and

PhDs) in their respective fields.

Somporn said an open invitation is expected to attract a large pool of qualified personnel if the salaries are competitive.

At present, a bachelor's-degree holder will get around Bt15,000-Bt30,000 a month while a master's degree holder will receive Bt20,000-Bt50,000 depending on experience.

As for PhD holders, the salary range is Bt40,000-Bt100,000 per month, depending on experience.

According to the blueprint, the project will need power-plant, electrical and other engineers with 10-15 years of experience, with special training in nuclear physics and power-plant operation. In addition, personnel with advanced degrees in economics and law, with similar special training, will be in demand.

In general, manpower will be sought from the power and industrial sectors, for special technical training, as well as from educational institutes where personnel are already trained in these areas. [italics added]

All in all, the blueprint appears sound. But the big question is whether the government will have the political will to get the project off the ground come 2010.

- - - - - end of article - - - - -

[comments regarding the Nation's 'opinion' article above]: That last sentence; "All in all, the blueprint appears sound. But the big question is whether the government will have the political will to get the project off the ground come 2010" is suspect. It could be better phrased by turning it around to read; "All in all, the blueprint appears unsound. But there's no question the government has the political will to get the project off the ground come 2010."

The Nation article lacks any mention of EGAT or of alternatives, (or insurance, or dealing with waste, or exorbitant price of uranium fuel), though perhaps it's not fair to fault an article for what it omits to mention.

However, seven of the final eight paragraphs talk about the many high paying jobs that will be created. Talking about creating hundreds of jobs is one of the biggest lures that Thai government agencies will use – to try to sway support for their nuclear plans.

A solar power plant will also create jobs, though not nearly as many engineers (or security personnel) will be needed for solar - as will be needed for nuclear. The reason is simple: Solar plants are simpler technology and, with less hired personnel (professional and others) the overall costs for solar are lower. Additionally, costs for planning and constructing a solar facility are considerably less than nuclear costs, but you already knew that.

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American futurist Ray Kurzweil accurately predicted that a computer would beat a man at chess, and that a worldwide communications network (the internet) would emerge by the 1990s. He made those predictions years before they came to pass - and years before others perceived of those possibilities.

Kurzweil was recently part of a panel convened by the National Association of Engineers and, together with Google co-founder Larry Page and billionaire investor T. Boone Pickens, concluded that solar energy technology is improving at such a rate that it will soon be cheaper than fossil fuels or nuclear. Here is what Kurzweil said about solar's future:

"One of my primary theses is that information technologies grow exponentially in capability and power and bandwidth. If you buy an iPhone today, it's twice as good as two years ago for half that cost. That is happening with solar energy — it is doubling every two years. Every two years we have twice as much solar energy in the world.

Solar costs are coming down rapidly — we are only a few years away from parity. And then it's going to keep coming down, and more people will be gravitating towards solar. Even those who don't care about environmental issues will go with solar, just because it makes economic sense.

Right now, solar is at half a percent of the world's energy. People tend to dismiss technologies when they are half a percent of the solution. But doubling every two years means it's only eight more doublings before it meets a hundred percent of the world's energy needs. So that's 16 years. People say we're running out of energy. That's only true if we stick with archaic thinking. We are awash in energy from the sun."

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22. Conservation and Breathable Air

Conservation of energy and resources should be the first goal of Thailand electricity policy. Every baht not spent on an electric bill, is a baht that can be put in the bank, or spent on other things. Every watt not used through conservation, lessens the burden of building ever-bigger power stations.

For farang visiting Thailand for the first time, one of their most noticeable observations is how many spaces are so cold. Most farang who come to visit, do so to get away from their frigid home countries in North America and Europe. That's why it's a warped joke to finally get to a tropical country and be subject to chilly temperatures when entering buildings or AC buses. It would be just a quirky observation were it not for the knowledge that it's sucking much electricity unnecessarily. Some of the coldest places are movie theaters. To go to a Thai movie without added clothing is to risk being uncomfortably chilled. Never mind that the theater is as big as a basketball stadium and there may only be three or four viewers, the place must be refrigerator cold.

Ubiquitous Seven Eleven stores also rate high in over-loading on AC, as do banks, government buildings, and VIP buses. Whether or not outdoor temperatures are pleasantly cool and/or it's raining, managers of such places deem that air conditioners must be on full bore. The manager of one small Seven Eleven said her electric bill was 12,000 baht per month. Besides full-blast AC units, there were refrigeration units and 54 one-meter long fluorescent lamps on all the time. That's just one small shop

in a small town. Imagine the amounts of kilowatts unnecessarily used in shops and homes throughout Thailand – it's staggering! There are also low-tech ways to bring in natural light (hint; windows and mirrors), but then we'll go charging off on yet another tangent.

Ironically, there are clinics in Japanese cities that charge high rates for sunshine. As with any big city, Tokyo's tall buildings block out much of the sun. However, entrepreneurs have designed a way to use fiber optics to channel the sun's rays down from a rooftop – on in to their 'clinic.' The rays are not magnified. In the clinic, well-heeled customers lay back in cushioned reclining chairs – while 'technicians' use a 2 centimeter diameter flexible optic tube to apply the sun to their clients' skin.

People can buy bottled water, and on some NYC sidewalks there are dispensers selling oxygen for relief from smog. Now, Tokyo is at the vanguard of selling sunshine in clinics. Water, air, sunshine; that's some pretty basic stuff. What's next, gravity for sale? – for people who are too spaced out to keep their feet on the ground?

The number one way to lessen electricity usage in Thailand is to try to impress upon people that a cool ambient temperature is ok, and that cold is unnecessary. There are several low-tech ways to posit a modicum of sanity to the situation. Tinted and shaded windows can help, as well as shading from trees. Strategic placement of small fans near ceilings would help considerably. Solar powered DC fans would be preferable to electrically driven fans. When outdoor temperatures are reasonably cool, such fans could be used to blow air in (with paper or cloth filters if need be). Conversely, the same fans (or others) could be used to blow warm air out when need be.

One of the main reasons Thailand needs nuclear reactors – is to keep millions of cubic meters of Bangkok building interiors unnecessarily cold.

Some people have a 'perfect' temperature in mind. Two degrees below is 'too cold' and two degrees above that ideal temperature is deemed 'hot.' It might seem cute to complain about such barely perceptible changes in temperature, but it has consequences. For example, if a person thinks the temperature is too hot (when it's not), that person may nonchalantly flick on an air-conditioning unit which may churn away for hours trying to keep a large space cold. The AC'd person might wear added long-sleeved shirts or even a jacket, and may leave doors and windows open – thereby negating the power usage, and cooling the great outdoors.

The folks at EGAT might not mind, because they're in the business of selling electricity, but whomever is paying the high electric bills should think about the ramifications of such actions. On a deeper level, every bit of electricity we use, has to get generated – usually at some harm to environment. That's not to say we should all become hermit tree-huggers and quit using electricity – but rather it's good to gain an awareness of the consequences of our actions – big and small.

If, for example, the million or so office workers in Bangkok decided to turn their air-conditioners on when it's only a tiny bit warmer than their ideal temperature – then that's one heck of a large electricity load on the grid. That's millions of cubic meters being cooled – where a few well placed fans and a few less over-shirts would

preclude those AC units having to chug away. AC units also release warm air outside, so alley ways in particular get heated. Along with smog coming out of internal combustion engines, the waste heat from a million AC units may add one or two degrees to Bangkok's year 'round warm temperature. And add to that the heat sink affect of millions of square meters of dark asphalt roads, and that's a lot of residual heat for Bangkokians.

Another justification for air conditioning is the idea that it cleans the air. Some models do have little filters in them, but filters clog, and how often are they changed? In all but a few units, the answer is; never. Even if AC units cleaned air, they don't oxygenate it. It's ironic that the fanciest, most expensive hotels don't have as much oxygen in their rooms as the cheapest little bungalows with dirt floors. Fancy pants hotel suites don't often allow for fresh air for three reasons: #1 they're usually in cities, and city air is not clean, #2. People think AC's cold air has plenty of oxygen (it doesn't) #3. Many of the most deluxe hotel rooms don't have screens on their windows and exterior doors.

Perhaps they think it's low class to 'open a window,' who knows? So, unless you like to spend large amounts of money on deluxe accommodations, or if you're getting acclimatized to climb a tall mountain in Nepal, you'd do better to find a hotel room with a screened window. Another option is an AC unit that pulls in air from outside, but those are rare.

As if low oxygen air weren't bad enough, high priced hotels are good at serving up formaldehyde. There are other unpleasant chemicals in the mix, but formaldehyde is probably the most prevalent. About twenty years ago, the terms 'sick building syndrome' and 'new building syndrome' were coined. For some people, the effects of the chemicals in a building would bring more than just headaches and drowsiness. Some might even have allergic reactions. Nearly all new furniture, carpets, drapes, and bedding emit formaldehyde fumes. Mastic for installing carpets and tile also emit the stuff – sometimes for many months.

Formaldehyde is an odorless gas that's used to preserve things. All things made with foam, including mattresses and stuffed furniture emit it.

Warped Scenario #673: Bangkok is hosting a world class football match. The opponents' team members arrive and are treated to all-expenses-paid accommodations at the most deluxe hotel in town. To further pamper their visitors, all their rooms are fitted with brand new mattresses and pillows. The next day, the visiting team is trounced by the Thai team. They leave bewildered, wondering why they all feel so dough-headed.

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23. Lessening Traffic Gridlock

Since the topic of Bangkok's smog belching autos was touched upon a few paragraphs earlier, here are some unsolicited suggestions to help ease gridlock in Thai cities:

>>>> Encourage drivers to turn off their motors while waiting for a light to change. Traffic lights are timed for long intervals in Thailand. Most drivers are familiar enough with their particular route to know if they catch the start of red light, they may wind up sitting there for two minutes or more. If just $1/10^{th}$ of Bangkok drivers turned off their idling motors – while they're waiting for light to turn green, that would add up to lot less unnecessary smog.

>>>> Regarding timed intervals for traffic lights: A major improvement in traffic flow would be to allow right turning traffic, coming from opposite directions, to turn at the same time. All over Thailand, the standard intersection allows only one lane to turn right at any one time. If north facing highway is turning right, then why not allow its south facing traffic to turn right concurrently? They're not going to crash unless they intend to do so. For sure, it would help to have designated turn lanes, and designated green arrow lights - as most highways already do. Allowing opposing traffic to turn concurrently, would lessen waiting and idling time by about 20 minutes per hour – per each major intersection. Let's say Bangkok has 500 major intersections. That would be 166 hours of non-waiting/non-idling time per hour. Most traffic is between the hours of 7 am and 6 pm, or eleven hours per day. In a given month, the added time that vehicles could be moving, rather than sitting with their motors idling, is well over 50,000 hours.

>>>> Thai drivers never slow down for yellow lights, and many run red lights routinely. In my town of Chiang Rai, it's been estimated that there are 10,000 red light jumpers per hour. You might say, 'there aren't a whole lot more than 10,000 drivers on the streets at any one time.' In response; the figure is 'per hour,' so a single driver could hypothetically run several red lights in one hour of driving. Since Bangkok is many times larger than Chiang Rai, the numbers are commensurately higher also. In Chiang Rai, it's doubtful that anyone has ever been pulled over and ticketed for going through a red light - ….same for driving too fast. Going through red lights is not only dangerous, but it's also rude – because it forces other traffic to wait until the intersection is clear – in effect slowing the flow of traffic.

>>>> Chiang Rai again; the busiest intersection is called Hi Ek, which also boasts a handsome life-sized statue of Chiang Rai's founder; King Mengrei. During daylight hours, that intersection is always gridlocked, sometimes for a Km north and south along the four lane highway. Two things would lessen the gridlock dramatically. One is a two lane ramp stretching overhead, about 600 meters. Such a ramp would channel traffic, going north/south on the highway, up and over the intersection. The other addition, which wouldn't entail much construction at all, is a nice wide traffic circle under the ramp. With those two additions, traffic would rarely back up, because it would be moving at all but the most congested times. The whole thing could be done without one traffic light – though that would be contingent on Thai drivers being polite when negotiating the traffic circle.

>>>> Four way stops are virtually never seen in Thailand – except late night flashing lights. The advantage of four-way stops is the intersection is only empty

when there are no vehicles. The current situation in Thailand has unneeded stop lights situated at thousands of intersections. At any given light, there may be dozens of vehicles stopped and idling, while the intersection is empty

> > > > Because Thais drive on the left side of the road (most of the time), right hand turns are tougher to negotiate, and take longer, than left hand turns. If drivers planned their routes to lessen right hand turns, they would save time and they'd burn less fuel. USP delivery service in NYC, planned delivery routes to have as few of such cross-traffic turns as possible, and wound up saving tens of thousands of dollars per year on fuel costs.

Ok, sorry for the diversion. Now, we'll try getting back on the main topic;
'Why Thailand Doesn't Need Nuclear Power Plants.'

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24. More Sobering News

The following article was taken from the Economic Times website URL: EconomicTimes.indiatimes.com/News/International__Business/Soaring_energy_needs_oil_prices_push_SE_Asia_to_nuclear_power/articleshow/2625567.cms

Soaring energy needs, oil prices push SE Asia to nuclear power

16 Dec, 2007, AGENCIES

INDONESIA: As oil prices and energy demand soar in tandem in Southeast Asia, many nations are turning to nuclear power -- to the horror of environmentalists who say it is not a safe option.

Thirsting for energy to fuel their growing economies, Thailand, Indonesia and Vietnam have all put in place nuclear power strategies, aiming to build the first plants by 2015 at the earliest.

Thailand's energy minister, Piyasvasti Amranand, said energy demand per capita in his country was rocketing, and with the kingdom currently importing 60 percent of its energy, new sources were needed to maintain growth.

"We have to look at nuclear, which is proven technology," he said in an interview with AFP in the run-up to key climate change talks in Indonesia.

Governments are also citing climate change as a reason for their switch to nuclear power.

Some hail it as a clean energy that will help lessen the world's dependence on the polluting fossil fuels, gas, oil and coal, which spew damaging greenhouse gasses into the air and drive global warming.

In September, US President George W. Bush said rich countries should help developing nations obtain "secure, cost-effective and proliferation-resistant nuclear power."

"Nuclear power is the one existing source of energy that can generate massive amounts of electricity without causing any air pollution or greenhouse-gas emissions," Bush said.

But green groups dismiss that argument, and the row spilled over at Bali, where environment ministers from nearly 190 nations last week grappled over a plan to tackle climate change.

"Nuclear power is neither a clean nor viable option for any of these countries," said Shailendra Yashwant, climate change head with Greenpeace Southeast Asia.

"The hazard of radioactive leaks, Chernobyl-like accidents, lack of safe waste disposal mechanisms or facility and finally the humongous costs of building a nuclear power plant make it the least attractive or viable option."

Activists from around the world staged a protest outside the Bali conference centre, urging the ministers to shun nuclear power.

"Promoting nuclear energy to countries which are exposed to extreme weather events, seismic activity and other natural catastrophes is irresponsible," said Sabine Bock, of green group Women in Europe for a Common Future.

But boundaries have recently blurred between nuclear friends and foes. A number of gurus of the environmental movement, including Greenpeace co-founder Patrick Moore and scientist James Lovelock, have come out in favor of nuclear power.

The potential of nuclear energy to help reduce carbon dioxide emissions was mentioned in a May report by the Nobel-winning Intergovernmental Panel on Climate Change (IPCC), the UN's top scientific authority on the issue.

But the report also mentioned safety concerns, the threat of weapons proliferation and waste disposal as problems.

Energy security and oil prices are also key concerns for governments. Crude prices have more than tripled in three years, while countries across Southeast Asia are seeing breakneck economic growth.

Greenpeace's Shailendra said energy efficiency and renewable energy such as solar and wind can meet half of the world's energy needs by 2050 while cutting global carbon dioxide emissions by almost 50 percent.

Piyasvasti said that for Thailand, renewables were part of the plan but would not meet their requirement of 1,400 more megawatts of energy per year.

"I think that new projects in renewable energy (will produce) 1,400 megawatts over the next five years," he said, adding that Thailand aims to have their first nuclear plant up and running by about 2020.

Indonesia, meanwhile, said it plans to reduce its dependency on oil from 24 percent of total energy supply now to 3 percent in 2025, when it aims to generate 4 percent of energy from nuclear power.

So far, the only country in Southeast Asia that has built a nuclear power plant is the Philippines -- with chaotic results. Its 2.3 billion dollar Bataan nuclear plant was closed in 1987 without generating one watt of electricity after it was declared unsafe

and inoperable.

Shifting skeptical public opinion in favor of nuclear energy also remains a mammoth task, experts say.

"Public awareness of the nuclear risks seems to outweigh its awareness of the benefits," said Hans-Holger Rogner, of the International Atomic Energy Agency (IAEA).

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25. Sunshine is a Great Disinfectant

Besides being true in a literal sense, that chapter title can also apply to the spoken word. When a debate is open, with no holds barred (i.e. out in the sunshine), then the truth is a lot more likely to shine forth.

In the mid-1960's, San Francisco was the epicenter of the 'Flower Power' movement. A lot can be said 'pro and con' about those times, but most people will agree it was a time and place which enabled young people to open up to one another, and to new ideas, more readily than they normally would. There was more going on than pot parties, acid-rock, bell-bottoms, and Hare Krishna - though some people say, 'if you can remember the sixties, you weren't there.'

Stewart Brand was a young man in the San Francisco bay area who decided to put together a unique magazine. He called it 'The Whole Earth Catalogue' (WEC) The idea was basically for it to serve as a networking tool among people interested in alternative building, tools, design and power.

At that time, there was no such thing as a personal computer, and the internet was 30 years in the future. A mouse was a little rodent which scurried under kitchen cabinets, multi-tasking was something a mother of twins did, and a browser was a cow in the field. Those were ancient times when the only search engine in your life was your mother or your wife (where did I put my gloves?).

The Whole Earth Catalog's back cover was all black with a small photo of the Earth in the middle. Never before had anyone seen a photo of the Earth, and its smallness in the big black page gave a sense of the uniqueness and vulnerability of the only planet we've got. It also showed wispy banks of clouds over brown and green continents, and over blue pools of water – indicating life. Earth is the only planet we have, and its living part is very thin – thinner than the skin of a grape compared to its fruit.

Nearly every concept inside the Whole Earth Catalogue was unique at the time – and none was fictional. For many, it was their first exposure to practical applications of solar energy, to domes, to zomes, to wind energy and other innovations. Granted, it's not as though many of those concepts were brand new (we use solar energy every

time we hang clothes out to dry), but rather the presenting of the info in a casual manner – often with hand lettered scripts and hand-drawn diagrams on grainy paper.

It was all black and white, and many of the photos were non-slick, non-commercial. Altogether, it was fun and informative reading, and if you were between the ages of 15 and 35, you felt you were getting abreast of what your creative peers were developing.

The Whole Earth Catalog spawned a periodical magazine and web site, but it also inspired an annual fair in nearby Davis California, called (not surprisingly) The Whole Earth Fair (WEF). The venue was a large outdoor space at the University of California, Davis. The same spirit of innovativeness and experimentation imbued the Whole Earth Fair – and each year hundreds of vendors and thousands of people would come to play and eat and dance, and learn about innovative new things.

If you've read this far and wonder where this is going, here it is: Let's have a Whole Earth Fair for Thailand. Even if it's a one time event, there's never been a better time. The focus could be alternative energy. Oh ok, in the name of fairness, we'd allow nuclear proponents (and boosters of coal, and LPG, etc) to strut their stuff. But the main idea would be to get as many proponents of alternative energy to display their wares and share ideas.

It would be a totally win/win situation. The organizers would not have to pay any of the vendors to come to display – as the vendors would jump at the opportunity to showcase their innovations. Fairgoers would get a golden opportunity to see new things up-close – and to ask questions. Just as good as any other attributes, would be the effect on aspiring Thai inventors.

Quick, name one innovation or invention by a Thai person in the energy field. Sad to say, there are none. The reasons are many, but it's not because Thais are not as bright as others. Case in point: One of the world's top Scrabble experts is a young Thai man. Scrabble uses the English language, and English isn't even that guy's first language - he studied a dictionary to memorize the spellings of words! So don't let anyone tell you Thais are not potentially as bright as anyone else. One big reason something like a Whole Earth Fair in Thailand would be great for Thais, especially innovative thinking young people, is the inspiration factor. There's no better way to learn than hands-on exposure – especially shoulder to shoulder with dem dats doin – where questions and suggestions can be bandied back and forth. Oh, and it will need to have a large outdoor venue – in order to display solar designs that will be there.

Thailand has big annual fairs for cars, for gifts, for manufacturing machinery, for books, for printing, ….but nothing for alternative energy. Suggested name: **Jing Jing Fair**. "Jing jing' is the Thai phrase for 'really!' or 'for sure' – it's spelt with the Thai 'r' like 'jring,' but the 'r' is silent. The fair doesn't need the word Thailand or Asia in the name, because that would limit its scope – and frankly, Asia is behind the leaders, as regards alternative energy innovations. And that's another reason for the fair:

Currently, Asian countries (India, China, Indonesia, Japan, Korea, Vietnam, Thailand and others) are looking longingly at nuclear power generators. They need to see the out-dated folly of their ways. Let's hope they get smart before they get

burned – and I mean that literally as well as figuratively. Radiation sickness is physiologically burning – just ask the survivors of Hiroshima or Nagasaki.

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26. Dost Thou Protesteth Too Much?

I witnessed my first successful protest when I was eight years old – at a military base in Virginia. There was a grammar school there. One Sunday, the principal of the school invited all the children to bring their parents to an open-air hall for a fund raising auction. The last item to be auctioned was the principal's own caged bird.

He introduced the item; "I caught this raptor on my farm in Tennessee four years ago. He's a great pet. Starting bid, $5."

I was sitting next to Suki, a school mate, who was one year older. Suki immediately shouted, "Let it go!"

My strict 'obey you elders' upbringing coupled with extreme shyness, caused me to blush and feel embarrassed at my friend's brashness.

The school principal, a respectable elder man, kindly gave several reasons why the bird should not be let out of the cage.

"Let it go free!" Suki called out, louder than before. Right away, voices called out to support her plea. There was no doubt about the sentiments of the community crowd in that room.

Without another word, the schoolmaster slowly held the cage aloft and opened the little wire door. The bird hesitated a moment, then hopped to the opening, sprung up and flew off – but not without first doing a swift circuit within the room. A roar went up from the crowd. Even the principal looked pleased.

That was an inspiration for kid to witness. It had a young person, who would ordinarily be disenfranchised from decision making, openly challenging an elder person of authority. That same authority could conceivably discipline her later, for insubordination. The initial voice of protest had conviction – and Suki wasn't afraid to speak up a second time, and hold her ground, even when the authority figure publicly dismissed her concern.

The scene had the added dynamic of common citizens getting their concerns sparked. They wound up raising their voices in support. Some of the others at the auction may have had thoughts of freeing the bird, but none were initially willing to express those sentiments out loud. The adamant stand of one kid inspired most of the attendees to stand as one, and demand the bird be let free.

Even then, the principal could have withdrawn the item and kept his caged bird, or he could have been adamant, and gone ahead to auction it off.

The other protest took place many years later in Thailand. As happens with towns and cities in Thailand, places to dump garbage are getting scarce. My adopted town of Chiang Rai was having that that issue. Garbage trucks would sometimes be seen cruising back roads, their drivers trying to find a place dump their loads clandestinely. Other times, the driver's boss would find a landowner to accept a few hundred baht to allow garbage to get dumped on his property.

I had secured some property just NW of Chiang Rai - which was located a Km down a dirt road. An absentee neighbor opposite my property had taken the garbage money. Of course, no one else on the road had an inkling of the deal until long lines of garbage trucks suddenly showed up. To exacerbate the situation, it was the beginning of rainy season, so at any given time, several trucks were stuck in the mud, and blocking the narrow road.

Right away, many of the residents formed a protest. The parcels along that road were large, so there weren't many residents - perhaps 30 in all. One guy took his medium sized truck and positioned it sideways at the point where our road tee'd off from the highway - thereby blocking entry to the garbage trucks, which were then arriving every half minute or so.

I went to get my seven workers who were helping build a house - in order to add to the number of protesters. When I returned to the corner, ten minutes later, the blocking truck had been moved, and the protesters were off to the side speaking with the boss of the garbage trucks. The trucks had resumed running down the dirt road unhindered. I was annoyed that the protest had petered out so quickly.

I didn't speak Thai at the time (am still elementary level) but someone explained to me that the negotiations were aiming toward an agreement where the garbage trucks could continue for another two weeks. After that, the boss would see to it that gravel was applied to the worst affected parts of the road.

Needless to say, the garbage trucks continued running the road for nearly a month, and just a small bit of gravel was applied.

The lesson here is; "negotiate from strength." When the protesting residents saw the big boss man arriving in his expensive vehicle, it was evident he was a power broker. When the boss saw his trucks backed up, he immediately demanded the protestors withdraw - which they did. The protestors weakened their position by removing the blocking truck and support people.

If the protestors had more of the steadfast spirit of little Suki, the garbage boss would have had to do one of two things: Either consider strong-arming the protestors out of the way (perhaps with his hired thugs or with police), or the boss would have had to negotiate with an empowered group. As it was, the boss diluted the protestors' strength right away, and therefore strengthened his own position. In that situation, the boss wanted, above else, to keep the trucks moving, so his operation would not lose any money.

Not surprisingly, the above little stories apply to the current crossroads that Thailand is facing. Will Thailand take the fork in the road that leads to nuclear power plants, or will it take the cleaner, safer, cheaper route toward reasonable power generation facilities. If Thailand takes the reasonable route, it won't happen without protests. The 'powers-that-be' have shown themselves to be deeply entrenched in favor of nuclear.

For Thai people who love their country and have high hopes for their offspring – this is an important juncture. The first thing Thais need to do is garner information. The info is available, even for those without an internet connection. They can get informed, not only on sensible alternatives to nuclear, but also to what nuclear power generation is about. They can also hear what EGAT and its supporters have to say.

The next thing needed, which is just as important, is to develop the conviction to do what's right. Much as the little girl, Suki, mentioned in the earlier paragraphs of this chapter, that conviction has to be strong enough for the individual to stand up to authority – and to maintain that stance for as long as it takes. It won't be easy, but significant achievements are rarely easy. Let's hope the path to getting reasonable power generation for Thailand won't be blood-stained. In other words, even with contentiousness - people with opposing views can discuss the issues in a civil manner in an open forum.

Probably the best scenario would be a popular vote on the topic – similar to the vote in 2007 on a new constitution for Thailand. If the nuclear issue were up for a nationwide vote, it is hoped the opposing sides won't resort to dirty tactics. That's a big 'hope' as anyone familiar with Thai politics knows how endemic vote-buying has become.

When I look at little children, I am reminded of the adage, "hope springs eternal." Regardless of how cynical older people become as the years roll by, their kids and grandkids pop out with a 'clean slate,' and it's heartening to see. It's a bit like springbok (small African deer) in a field. While the adults graze and peer warily to the bushes for danger – the juvenile springbok prance around with springs on their legs – as if bouncing on air.

As adults, it's our responsibility to use our acquired education, wisdom and wariness – to set the stage for a reasonably safe and content life for our offspring. In effect, we're looking to the bushes for dangers, while our kids are frolicking around. Later, when we're old or out of the way, it will be our grown up kids who take the responsible roles, and so on. Let's nip the menace of nuclear in the bud while we still can. If we hesitate, it will be too late. It's the least we can do for our kids and their kids.

Does the name Jim Whittaker ring a bell? He gained notoriety in the early 1950's for being the first American to summit Mount Everest. Years later, as head of a sports outfitting business called R.E.I. (Recreational Equipment Incorporated), he spearheaded an small environmental campaign. At the time, his home and business were in Seattle, Washington state. There was a nearby lake which, because of its nearness to the city, and its intrinsic beauty, had become popular with revelers. Over

the years, beer cans had been thrown in the lake and trash was strewn about (yes, it's not only Thais who litter).

Mr. Whittaker organized a volunteer force of mostly young people – to go out to the site and devote a full day to cleaning up. Most of the volunteers were combing the surrounding hills, picking up trash and setting up trash bins. Jim donned scuba gear, grabbed a net, and went down repeatedly in to the lake to gather all sorts of garbage that had been thrown there over the years. He was a middle aged man at the time, and could have easily found an excuse for opting out of such a yucky detail. He didn't gain anything monetarily from organizing the clean-up. It wasn't a personal or business promotion. The main things he gained from that operation were possibly;

>>>> the satisfaction of cleaning up a natural spot – and making it more pleasant for the next people.

>>>> setting an example for future visitors to the lake - to be more responsible with their trash.

>>>> inspiring some of the young people on the crew to do selfless acts of kindness in their daily lives – and perhaps instill a greater sense of appreciation for the great outdoors.

For the average person, the easiest thing to do, if they see or hear about something like a trashed park, is to wave it away, and say something like, "Yes, some places are trashy, but that's not my problem. The people who throw trash should be taught a lesson, blah blah blah."

Avoiding things which are ugly, smelly or uncomfortable is what people do – along with explaining such things away, or figuring; 'that's someone else's problem' or 'let the proper authorities deal with it.' Rare people like Jim Whittaker are the exception, in that, when they see a problem, they're not afraid to 'think outside the box' to come up with a solution. Even better than conjuring a solution, is taking dynamic, non-confrontational action to effect positive change.

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27. Corruption Hurts Ordinary Citizens

Large scale solar is a competitive market. That allows for open competition among many players and prices per Kw are falling month by month. That's a different picture than the nuclear power business, where just a few players are vying for multi-billion dollar contracts. It's easy to see how rife the nuclear scenario is for price-fixing and collusion between a very few companies. Plus it's an ideal scenario for back-alley pay-offs for officials involved with the bidding process – things that Thailand is world renown for. It's doubtful that a large contract has ever been transacted in Thailand's recent history - without pay-off allegations. That would apply both to 'in-house' contracts (with Thai companies) and those with international involvement.

EGAT wants to build four nuclear plants – which will entail the largest bunch of contracts ever awarded in Thailand. No one familiar with business practices in Thailand can seriously perceive of such contracts being corruption-free. Some people may wonder, "so what's the big deal if there are some under-the-table pay-offs?" That question goes hand-in-hand with many peoples' laissez-faire attitude that goes something like this; "There are billions of baht earmarked for these projects, so what's the big deal if some government heavies, middle men, and some corporation bosses get pay-offs."

Here are some reasons why under-the-table pay-offs hurt ordinary citizens:

>>>>> Every baht that slips in to a VIP's pocket, is a baht added to the cost of the project. Thai municipal projects are ultimately paid for by Thai taxpayers. Taxpayers pay even if there are outside loans (World Bank, etc) - though doesn't apply if the funds come from grants or donations.

>>>>> Pay-offs don't increase the quality of the project – neither the construction, nor the expertise, nor whether the project will meet its deadlines.

>>>>> Inspectors are and permit handlers are often easy to influence with sufficient pay-offs. If inspection is lax, then the end-product suffer. Example: After an earthquake in Taiwan, it was found that a large recently-built shopping mall had an inferior concrete foundation. The building toppled – causing deaths and injuries. Upon close inspection, it was plain that water-filled 5 gallon tins were placed within the foundation when the footings were poured – in order to save on concrete. A few inspectors would have to be mighty brave to stand up to combined pressure from government and mega corporations – if there were a difference of opinion. A few greased palms makes things go a lot smoother.

>>>>> As for bidding on contracts: The best way is to have no collusion between bidding entities, no inside 'secret' information, and no spying. Additionally, there should be no favoritism on the part of the powers awarding the contracts, no switching conditions in mid-stream, and no pay-offs. To believe none of those things can happen in a big money bidding process in Thailand is to believe the moon is made of dehydrated yogurt. To phrase it in a positive way: Bidding should be fair, and untainted by inside information or pay-offs.

>>>>> All too often, the winning bidder will submit a cost figure or time schedule that they know is too low – in order to win the contract. Then inevitable negotiations are added later on – to substantially increase payments and time frame. Granted,
Big projects are tough to bid, but if a company submits a bid that they know is lower than their projected costs for labor and materials, then that gives that company an unfair advantage over other bidders. By doing so, they can score the winning bid, yet they inevitably go to the bargaining table later on to increase the bid, sometimes by 200% or more. The entity awarding the contract has little choice but to approve the large increase, because the work is partially finished and can't be left undone. This is yet another of the many opportunities that are rife for under-the-table pay-offs.

>>>>> If the person or panel of people awarding the contract has any connection with any of the bidders, they should recuse (fancy word for excuse) themselves from

making such decisions. In reality, there are often connections between bidders and those awarding the contract. If such connections (via friendships, business investments, extended family members, etc.) are not forthrightly mentioned, then they can be found with a bit of sleuthing. Indeed, such investigating should be a basic component of the bidding process. So too, there should be investigations and/or surveillance which might uncover pay-offs – but that sort of thing is rare in Thailand, because pay-offs and connections are essentially accepted components of any bidding process.

Two examples: In 2007, a Thai government manager was implicated for receiving a big pay-off from an American couple – having to do with the Americans getting the rights to sponsor a film festival in Bangkok. Ordinarily, such a thing is a yawning 'mai pen rai' for Thais. However, the illicit pay-off was discovered by American authorities, and the info was publicized - so Thai authorities had to sit up and take notice. Were it not for the public mention by U.S. authorities, this would have been just another little blip to be swept under the carpet by Thai authorities.

Similarly, the 2006 story of corruption regarding baggage scanning equipment for the new SUV airport was first publicized by U.S. authorities. The alleged pay-off/bribe (to a Thai middle man) would not likely have been discovered by Thai authorities. Even if it had been found, it would have been either ignored or, in a worst case scenario; the agent would get a slight reprimand.

American Utilities Making Major Shift To Solar:

by Roy D. Wasson, February 2009

While the pace of installations of distributed solar systems for homes and businesses has steadily risen over the past few years, utilities have mostly stayed out of the picture. However, that appears to be changing now as more and more utilities are looking at solar energy as major contributor to their current and future renewable energy portfolios.

The shift has occurred for a number of reasons, including rising fossil fuel prices, renewable portfolio standards (RPSs) coming into effect in many states and an American public that is becoming increasingly interested in renewable energy sources. There remains, however, some concern over whether this interest will translate into putting megawatts (MW) of solar energy generating capacity on the ground and the roof.

"2008 was a foundational step for utility-scale project announcements," said Julia Hamm, executive director of the Solar Electric Power Association (SEPA), whose aim is to help the solar industry work with the utility sector.

"SEPA is aware of contracts totaling over 1,500 MW of PV [photovoltaic] and 4,000 MW of concentrating solar thermal. However, very few are digging dirt or hoisting onto roofs yet and there is a high level of uncertainty for some projects," said Hamm.

Hamm pointed to a number of key utility-scale solar projects that SEPA is watching.

In 2008, PG&E entered into an agreement with Topaz Solar Farms LLC, a subsidiary of OptiSolar Inc., to install 550 MW of thin-film PV solar power. The utility also signed a contract with High Plains Ranch II LLC, a subsidiary of SunPower Corporation, for 250 MW of solar PV. Thin-film panels for the Topaz Solar Farm will be designed and manufactured by OptiSolar.

In total, the projects are expected to deliver approximately 1.1 million megawatt-hours annually and could begin power delivery as early as 2011. PG&E expects it to be fully operational by 2013.

The utility has also signed a long-term agreement with El Dorado Energy LLC, a wholly-owned subsidiary of Sempra Generation, to purchase 10 megawatts of PV-produced energy from Sempra's El Dorado Energy Solar facility in Nevada (RenewableEnergyWorld.com will be touring this facility in March and we'll have an in depth look at the project). The El Dorado facility is located on 80 acres adjacent to Sempra Generation's existing gas-fired power plant in Boulder City, Nevada. Power deliveries to PG&E have already begun. The project will generate up to 23.2 gigawatt-hours of renewable energy annually.

Cleantech America LLC and GreenVolts Inc. also signed deals with PG&E to develop utility-scale PV projects that could deliver up to 7 MW of utility-scale solar energy for PG&E's customers throughout northern and central California, with project completion dates of this year.

In addition to solar PV, PG&E has been active in pursuing solar thermal power, and has signed a deal with Solel to purchase renewable energy from the Mojave Solar Park, to be constructed in California's Mojave Desert. The project will deliver 553 MW of solar power. The utility is also involved in a 177-MW solar thermal project with Ausra Inc. The plant, to be located in San Luis Obispo County, California, is expected to begin generating power in 2011.

Finally, PG&E entered into two contracts with San Joaquin Solar LLC, a subsidiary of Martifer Renewables Electricity LLC, for a combined 106.8 MW of solar thermal-biofuel hybrid power. Located near Coalinga, CA, the solar-biofuel projects will deliver a total of 700 gigawatt-hours (GWh) annually.

Another project that is being closely watched by the industry is Duke Energy's distributed PV project. It was originally announced in June 2008 as a $100 million, 16-MW project. Then in late 2008, Duke scaled back the project to $50 million and 8 MW.

Duke spokesman Dave Scanzoni said, "We certainly see solar as a growing component of our portfolio. We see more solar initiatives going forward as well. Solar is going to be a major part of our future."

SEPA and the rest of the industry are following the progress on a number of other projects that run the gamut of solar technology.

Arizona Public Service (APS) is working on a 280-MW solar thermal project with a storage component that industry insiders are closely watching. Abengoa Solar has signed a contract with APS, to build, own and operate the Solana plant, scheduled to go into operation by 2011. It will sell the electricity produced to APS over the next 30 years for a total revenue of around $4 billion, bringing over $1 billion in economic benefits to the state of Arizona.

NextEra Energy Resources, formerly FPL Energy, is planning a 75-MW hybrid solar plant, which broke ground in December. The Martin Next Generation Solar Energy Center will consist of approximately 180,000 mirrors over roughly 500 acres of land. The facility combines a solar-thermal field with a combined-cycle natural gas power plant. NexEra and SunPower are also set to install a 25-megawatt (MW) power plant in DeSoto County, Florida and a 10-MW project at the Kennedy Space Center. The DeSoto plant is expected to be completed in 2009.

This week, Southern California Edison (SCE) and BrightSource Energy reached agreement on a series of contracts for 1,300 megawatts (MW) of solar thermal power. The agreement, which now requires approval from the California Public Utilities Commission (CPUC), calls for a series of seven projects to make up the total capacity. The first of these solar power plants, sized at 100 MW and located in Ivanpah, California., could be operating in early 2013 and is expected to produce 286,000 megawatt-hours (MWh) of renewable electricity per year.

Last year, the CPUC approved the FSE Blythe project that First Solar Inc. is developing for Southern California Edison. Initially a 7.5-MW solar photovoltaic (PV) facility, the project has the potential to expand to 21 MW.

Public Service Electric and Gas Company (PSE&G) this month asked New Jersey regulators to approve a US $773-million proposal to bring 120 megawatts of solar power directly to communities and customers throughout its service territory. PSE&G will invest in, own and operate the grid-connected solar energy systems and will collaborate with experienced solar developers, installers and manufacturers to develop projects. (Original reporting by Graham Jesmer and Renewable Energy World).

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28. Summary Execution

If you were to ask members of EGAT or any one of the hastily assigned acronymic oversight committees dealing with nuclear in Thailand - about solar, the most common response you'd get would be something like, "Solar is fine for houses and such, but it's not commercially feasible for large scale power generation."

They might go on to mention some cost per KW figures that make nuclear appear cheaper than solar. The truth is; nuclear, besides its other comparative drawbacks, winds up being costlier than solar. This is particularly true when one factors in the skyrocketing costs of yellowcake, and all the peripheral expenses involved with

nuclear, including insurance, waste, and eventual decommissioning of the plants. The nuclear boosters either don't know this, or they steadfastly want to move their nuclear agenda ahead regardless of truth or reason.

There are cutting edge solar technologies that can generate electricity for low cost. There are some solar energy systems that give an efficiency rate of 48%, and solar efficiency ratios are increasing month by month. What is the efficiency of nuclear? - ….probably in the low single digits.

California's governor Brown signed in to law, in Spring 2011, a law which mandates that the amount of electricity generated by renewable sources, must increase from its current 20% to 33% of total amount by 2020. California also offers a 30% tax credit for solar installations. In other words, 30% of the cost of a solar power system can be deducted from that person's or his/her business' subsequent tax obligations. Could these sorts of incentives be implemented in Thailand? Perhaps, if politicians could break out of their internecine bickering over silly things. Such forward-thinking energy policies will benefit all Thais. A refreshing alternative to spending hundreds of millions of baht on publicity tours to try and convince Thais that nuclear is safe, clean and cheap - which is what EGAT and its friends (in high places) are doing.

One popular myth that nuclear proponents like to parley is that solar is ok for small scale, but it's not geared for large-scale power production. If anyone tries to pass that silly notion over on you, you can look them in the eye and say 'poppycock!' (or the Thai equivalent, which might be 'kee wua' meaning; 'cow poop').

There are at least a dozen large scale solar power plants operational today, and many more are in the planning stages. Tell the nuclear boosters about the 600-mirror 'Solar Tower' in Seville Spain that focuses sunlight - which drives a turbine to generate 11 megawatts of electricity. Thousands more mirrors can be added to further boost the output. It's producing Kw cheaper that nuclear, it's up and functioning, its fuel is free. Furthermore, it produces no waste, and creates no danger for neighbors. If Thailand has sunshine, and can either make or purchase mirrors, and has some land set-aside to set up the mirrors, then most of their solar equation can be solved.

Additionally, Thailand could position itself at the vanguard of solar technology. If it's not ready for the innovations and inventions part of the equation, at least Thai businesses could gear up for manufacturing essential components.

Regions with 50 years experience with nuclear are phasing it out. North Americans have had decades to come to the realization that nuclear is not the smart way to move toward the future. Asian regions are forty years behind the curve – essentially at the stage of being dazzled by its purported 'low cost' and 'zero carbon emissions.' ….both of which are hype. On the other hand, North American corporations with nuclear expertise are glad to sell the machinery to Asians.

It would be as though Asian corporations had developed a particular technology fifty years ago, but the Asian people had come to realize it was too hazardous and expensive. Yet, in order to make money, Asian corporations vigorously marketed the technology to far away regions.

If Thailand's nuclear power boosters really believe the myths they're perpetuating about solar ('it's inefficient,' 'it's costly,' 'it's only suited for small scale'), then they're either uninformed, or they're not telling the truth – in order to further an agenda. Come to think of it, that's what politicians do for a living, so what's so odd about that?

If you only do one thing after reading this text, try looking up some of the URL's mentioned in the 'Concentrated Solar' chapter. Those web sites are chock full of cutting-edge insight – showing facets of the exciting directions solar is heading. A few of the listings have products in the conception phase, but most are up and running – available for anyone to scrutinize.

If Thailand goes nuclear, then problems will ensue. Some of those potential problems have been mentioned in this text, yet other problems are unforeseeable at this time – just like the aircraft carrier's and SUV airport's problems were unforeseen in their early stages.

To avoid future problems with nuclear, it would be easier to 'nip it in the bud' at this early pre-construction phase, than it will be to decommission plants later on. At least now, only a few tens of billions of baht have been spent. Later, the powers-that-be will be much heavier invested, and they'll be more entrenched in keeping the plants at any price – even the bloody price of busting protestors' heads.

If the Thai people realize too late that nuclear is rife with problems, then the transition to closing the plants won't be anywhere near as smooth as the closing of the Rancho Seco nuclear plant in Sacramento, California. A peaceful process leading to a closing down one or more Thai nuclear power plants is all but inconceivable.

Allowing nuclear to come to Thailand is like letting a charming rich stranger come and stay in your house. If, after awhile, you find that person is bad news, it becomes a whole lot more difficult to expel him after he's moved in, than if you had barred his entry at the beginning.

If you've read through this text, you'll know it was not designed to mince words and be polite. This text is subjective and is passionately aimed at conveying the message:

Enabling nuclear power plants to get entrenched in Thailand is like allowing that rich stranger to charm his way in to staying at your house. Don't be surprised if he later turns in to a tyrant - when your family asks him to leave.

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29. Fukushima and its Dire Legacy

NOTE: The above text was published several months before the Japanese tsunami of March 2011 which damaged the Fukushima Nuclear Plant, NW of Tokyo. In this 2nd Edition of Thailand's EGAT, there follows some updates to the nuclear debate, based on nuclear-related events in Japan.

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The following is excerpts from a paper written by Ken Silverstein about Japan's impending problems with its nuclear plants. Titled, "Japan's Nuclear Blunder" it was ***published over four years BEFORE*** the crippling tsunami of 2011.

The Japanese nuclear industry is under fire. The sector there has been attacked for years for documented lax safety procedures. But it was a 6.8 magnitude earthquake that set off radiation leaks and flames that is prompting the latest surge of scrutiny.

A central question is whether the recent malfunctions and cover-ups in Japan will have an affect on the nuclear renaissance that is underway in the United States. It's unlikely. Certainly, the accident gives opponents the ammunition they need to continue to wage battle against the industry.

Tokyo Electric Power Co. can be faulted for taking too long to report broken pipes, radioactive water leaks and a small release of radioactive material into the air. It was not until hours later when smoke and fire were seen at a transformer site near the plant that the utility made a public statement, noting that 315 gallons of radioactive water had made its way into the Sea of Japan, although it said such amounts were negligible. The company also said that small quantities of cobalt-60 and chromium-51 were released via smokestacks but that the level of toxins would not cause any harm.

The nation is also one of the most susceptible places to earthquakes with experts giving it a 90 percent chance of getting hit with a major trembler in the next 50 years. That potential, along with the fact that accidents have plagued the industry, reinforces to opponents that nuclear power is unsafe. In fact, two nuclear workers in 1999 died in a fuel processing plant accident while another four died in 2004 from a similar misfortune. Meantime, Tokyo Electric admitted in 2002 to falsifying records and covering up problems since the 1980s. That caused it to temporarily shut down its 17 nuclear plants.

"This fire and radioactive leakage reminds us yet again of the serious threats posed by nuclear power," says Jan Beranek, Greenpeace International Nuclear Campaigner. "There is a real risk in Japan, and globally, of larger earthquakes and other natural disasters, as well as of terrorist attacks that could lead to far more serious nuclear accidents." Nuclear power undermines the real solutions to environmental challenges, he adds, by eroding the resources necessary to build out the renewable energy sector.

"Personally I think a nuclear power plant is the safest place you could go in an earthquake," Hisashi Ninokata, a nuclear engineering professor at Tokyo Institute of Technology, told Reuters News Service.

by Ken Silverstein
From 'Energy Biz Insider', Jul 23, 2007

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Just a month prior to the 2011 earthquake/tsunami which crippled Fukushima, nuclear experts would have told you that Japanese N plants were among the safest in the world - virtually fail-safe. If in doubt, please read the last paragraph/quote of the letter above, written 4 years prior to the Fukushima plant failure. Now, turning to Thailand's predicament: Would anyone familiar with Thai safety & security standards expect Thai N plants to be near as safe as Japanese plants? About once a month, an armory blows up, or a bunch of weapons & ammo gets stolen from a Thai military facility. The same military that would be charged with providing security for a Thai N plant.

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Science Question: Take a beer bottle of special die. Pour it in the ocean. After it gets fully diluted, take a beer bottle's amount of water from any part of any ocean. What are the chances one or more molecules from that original bottle's die will be in the new sample? Answer: 100%. Reason; there are more molecules in that beer bottle than there are beer bottle sized increments in the world's oceans.

We're hearing reports that large amounts of water is spilling daily in to the ocean north of Tokyo - between 5 and 7 million times the 'radioactive limit' declared safe for life.

Radiation ingested by a tiny diatom, algae or photo-plankton — can work it's way up the food chain - where it gets concentrated up to 3 to 4 times each time it's eaten. Many fish, birds, turtles, eels are migratory, and naturally spread far and wide. Larger animals tend to be more sensitive to radiation than smaller ones. In humans, top of the food chain, concentrated radiation can make its way into the bloodstream, lungs, and bones, potentially causing genetic damage, reproductive problems, cancer or death.

Does Thailand's EGAT still want to build several nuclear power plants along Thailand's coasts?

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Fish in waters near Fukushima are being measured at 4,000% above the Codex Alimentarius limits for Iodine-131 and 447% of Caesium-137. Radioactive caesium has a half-life of 30 years. Radiation levels for the isotope are not considered "safe" for 10 to 20 times longer. The caesium released today will remain dangerous six centuries from now.

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If you think the crippled Fukushima N plant is problematic, wait until another of Japan's plants get crippled. It's called Monju, and it's actually already crippled, but just waiting for an earthquake to make things worse. It's packed with hyper radioactive plutonium, and had some heavy machinery accidentally dropped near its core. It can't be fixed, is not generating electricity, but costs 18.4 billion baht/year (or 70 million baht/day or nearly $2.5 million per day!) to maintain the crippled plant.

Much of that maintenance cost is to pay for electricity brought in from elsewhere, even though Monju is, itself, supposed to be generating electricity.

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There are some 'silver linings' to Japan's nuclear problem.

>>>> Since Asians in general, and Chinese in particular are so dazzled by sharks fin soup, perhaps their awareness of the inevitable radiation stored in shark fins will dampen the trade, and give sharks a break.

>>>> Similarly, radiation will get concentrated in other marine species which are high up the food chain: porpoises, whales, tuna - and lessening their harvest will give then some chance to replenish their numbers. Same for species which are low on the food chain, like albacore and small fish.

Will the Chinese and Japanese give credence to the likelihood that seafood will now become irradiated? And if so, will that slow their habits of ingesting such things en masse? Time will tell.

For the past decade, tuna populations have gone dangerously low in the Mediterranean (and elsewhere) because of the insatiable demand and highest prices paid by the Japanese. Shark fins, served in upscale Chinese and Bangkok restaurants, are scalped off all sorts of sharks, even docile whale sharks, with the scalped fish left to slowly die in the sea. The Japanese also play a game about pretending to do scientific research on minke whales, in order to harvest hundreds of whales each year, thereby skirting international bans on killing whales.

The biggest 'silver lining' to the Japan's nuclear disaster is it will dampen their, and other countries enthusiasm for building nuke plants.

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As if we needed an added reminder of why Thailand should not go nuclear, there was a photo journal recently (April 2011) BBC which showed recent shots of some of the survivors of Chernobyl. Some photos showed children born from irradiated parents. The dozens of kids were disfigured and mentally out to lunch - being kept alive in sanitoriums.

Man made radioactivity is like mega poison put in large bottles. Thailand will be playing Russian roulette with its planned nuclear power plants. There's a possibility at least one of those plants will leak radiation. When that happens, how will Thai authorities put the poison back in the broken bottle?

The ensuing radiation might affect more than just Thai citizens downwind - as plumes don't respect national borders. Plus, it adversely affects all plants and animals in its path. Wars have been started on less provocation than that.

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Those Japanese reactors which were affected by the earthquake/tsunami were relatively new. We're always told, every time a newer generation reactor gets built or planned, that it will be far safer than previous designs. Then something like this happens. Now there will be newer designs, and we'll be told again by politicians and nuclear boosters, "Don't worry, this newest design is extremely safe. It's essentially fail-safe - so nothing can go wrong, no matter what." Then it too will fail, people will get endangered, and then there will be yet a newer design, with the same accompanying assurances, and so on, ad infinitum.

Let's face it. Nuclear reactions are fine for the sun, but they're just not good for this planet.

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People talk a lot about radiation leaks and such, but almost never talk about how radiation actually affects things.

Radiation affects atoms on atomic levels. It sort of jimmies or zaps them. Since all is made from atoms, it affects everything: not just humans, but all living things .....and all things, period. Even a reinforced cement wall will weaken if zapped with enough radiation. Of course, living cells are much more sensitive to radiation than cement walls. And reproductive cells (sperm and eggs) even more so - that's why even small doses of radiation can screw up reproduction processes. Similarly, cancer is caused (at least partly) by normally functioning cells going awry. Radiation zaps cells in strange ways, which can lead to cancer. That's why we so often hear of various types of cancer showing up after people have been zapped by radiation. We never hear about plants or animals affected that way, because people are primarily focused on the plight of people.

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The chairman of Exelon Corp., which is America's largest operator of nuclear power plants, said his company would not be building any more nuclear plants because they cannot compete with natural gas plants - at current and projected prices. He made that statement three days before the devastating 2011 quake struck Japan.

The recent releases of radiation in Japan are akin to the crash of the last Concorde in Paris five years ago - which grounded all Concordes. Similarly, the breach of the Japanese reactors will end new nuclear plant construction in most countries. Will Thailand be one of those which opt for cleaner, safer and cheaper energy production? We'll have to wait and see.

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The last sentence in the article says a lot: "However, the government will be the one making the decision to build or not to build a nuclear power plant, Mr Kurujit said Mr. Kurujit, a member of Thailand's Nuclear Power Project Development Office said yesterday (in response to a demonstration by Kalasin villagers against having an N plant) "The government will be the one making the decision to build or not to build a

nuclear power plant." In other words, Mr. Kurujit says it's the government, not the little people who live in the adjoining villages, who will make the decisions about whether and where to build N power plants in Thailand. Spoken like a true autocrat. I wonder if Mr. Kurujit would mind having a nuclear power plant built next door to his house.

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Kurujit Nakornthap, deputy permanent secretary of Thailand's Energy Ministry, said in mid-April 2011 in response to a demonstration by Kalasin villagers against having a nuclear plant: "The government will be the one making the decision to build or not to build a nuclear power plant" (BP, Mar 16).

In other words, Mr Kurujit says it is the government and not the little people who live in the adjoining villages, who will make the decision about whether and where to build N-power plants in Thailand.

Spoken like a true autocrat. I wonder if Mr Kurujit would mind having a nuclear power plant built next door to his house?

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When the situation at Fukushima is reasonably stabilized, with relatively low radiation emissions, probably all the reactors at that site will be flattened, and entombed with sand - then covered by cement. It will then be a dead zone for....? ....for roughly 40,000 years. Would you allow your kids to build sand castles at the beach there?

The average N reactor has a life span of 30 years. The average decommissioning cost of a functioning reactor is just under a billion dollars - though the UK's Nuclear Decommissioning Authority estimates it will cost at least ?70 billion to decommission its 19 existing sites in the UK. That's about 4 billion US dollars per site. At that rate, a 30 year old reactor's decommissioning cost would be $463,000 per day. Has EGAT budgeted nearly a half million dollars per day for decommissioning costs of each of the five reactors it wants? Plus, is there insurance, and if so, who pays it and what does the policy specify?

Let's look to a new clear future, not a nuclear future. Let's not saddle our kids and their kids with decommissioning costs for nuclear power plants they'll regret were built.

Here's a question for the Thai business VIPs who are hell bent on making Thailand go nuclear: Have they figured in the costs for decommissioning the four nuclear plants they want for Thailand's sea shores, and the one by a large lake up-country? Even if the reactors function well for their estimated 30 years of service (which is a big 'if') then there is the cost for responsibly dealing with spent fuel, and the decommissioning of the radioactive premises. The average nuclear reactor has a decommissioning cost of just under a billion dollars - though the UK's Nuclear Decommissioning Authority estimates it will cost over 100 billion dollars to decommission their 19 existing sites. That's about 5 billion dollars per site.

One Canadian N plant (Quebec) had a decommissioning cost which amounted to $140,000 for each day it was in operation.

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The May 8, 2011 Bangkok Post Business Section had the lead article titled; "Major Parties Not Ruling Out Nuke Power" – which covered a high level meeting of political talking heads titled; "Sustainable Energy Security."

Ken's comment: It was like getting a group of beer company executives together and asking them what sort of beverage should be provided at a party. If a meeting is organized for deciding on Thailand's future, then it should include at least one objective speaker. Similarly, such a meeting should include opinions that might differ from the mainstream, business-fixated perspective. There was not one environmentalist nor one alternative power expert on the panel. All appeared to be well-connected career polititians with vested interests in seeing Thailand go nuclear. In the half page article, there was not one peep about all-important conservation measures or using less energy. Yet there were several mentions of 'better educating the public about nuclear energy' which, in translation means; perfecting the richly funded bogus science apparatus for convincing the general public that nuclear is the best choice for Thailand's future electricity needs.

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The following is an open letter from a physicist and professor at Sunway campus of Monash University in Malaysia.
Title: **Should we go the nuclear way? No, thanks**
By Lan Boon Leong

Malaysian Energy Commission (EC) chairman, Tan Sri Dr Ahmad Tajuddin Ali, said recently that nuclear power is preferred to solar power to help meet Malaysia's rising energy demand. The crux of his argument was, firstly, the cost of nuclear power is lower than the cost of solar power.

Secondly, according to Ahmad Tajuddin, "even if we cover the whole of Peninsular Malaysia with solar panels, it is still not enough" to fulfil energy demand.

I will examine these two claims in reverse order. Firstly, a quick back-of-the-envelope calculation shows that the second claim is not true.

To produce 2,000Mw of power using solar panels, would require 100 sq km of land, if 10 per cent efficiency is again assumed. A much smaller area would be needed if cutting-edge solar cells with efficiency of much greater than 10 per cent were used.

If Concentrated Solar Power (CSP) technology were used instead of solar panels, the land area required would be significantly smaller for the same power output.

In the CSP method, sunlight is concentrated using a system of mirrors or lenses to produce heat to drive a turbine in order to generate electricity.

Secondly, the EC chairman's first claim about costs may be true at this time. However, the cost of electricity produced using either solar panels or CSP is declining and is expected to be competitive with the cost of electricity produced using fossil fuels in the near future (source: Greenpeace).

Hence, the pertinent question in this energy debate is: How would the projected costs of solar power and nuclear power compare in the near future, say, in 10 years time? (2021 is the proposed date for Malaysia's first nuclear power plant).

Though the cost of electricity generated by nuclear power plants is rising, the cost of solar-generated electricity is likely to be lowering.

Moreover, nuclear power has a potential additional cost due to accidents involving the reactor or the radioactive waste. The ongoing crisis at the Fukushima Daiichi nuclear power plant in Japan is a reminder of such grim possibilities. The potential cost includes priceless human health and lives affected by radioactive radiation.

Malaysia's choice is clear. We must not go down the potentially-hazardous waste-laden nuclear path.

Instead, we must take the increasingly viable clean sunny path that will lead to a bright energy future.

Lan Boon Leong
Published in New Staits Times, April 2011

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EGAT'S THAITANIC

Why Thailand Should Not Go Nuclear

Written by Ken Albertsen / ken@adventure1.com

FASTING FOR YOUR HEALTH AND YOUR HIGHNESS – details the best methods for healthy and safe fasting, and articulates the real benefits to health and spiritual development.

Adventure1.com