EXCUTIVE SUMMARY

The Thai Solar Thermal Industry Outlook

Solar Thermal applications in Thailand is currently limited to water heating application in the residential sector while the large market potential in the commercial and the industrial sector remains untapped. Presently there are approximately 15 to 20 active Solar Thermal (ST) companies in the market, however, only few companies have intensive experience and are capable of providing design and installation for large solar systems. The outlook of the Thai solar thermal market over the past recent years has been positive due to the recent fuel price escalation. It was estimated that the sales of solar water heater was around 6,800 m^2 in 2005 and 8,500 m^2 in 2006. The key local industry players estimate an average market growth of about 10% per year.

The Soltherm Thailand Project

the Market Development Solar Thermal Applications in Thailand project (Soltherm Thailand) is funded by the EU-Thailand Economic Cooperation Small Project Facility (EU-SPF) and jointly implemented by the Joint Graduate School of Energy and Environment (JGSEE), the International Institute for Energy Conservation (IIEC), and the Fraunhofer Institute for Solar Energy Systems (ISE). The project aims at identifying all related technical and non-technical barriers prohibiting the effective development of the SWH market in Thailand through detailed situation analysis, and developing a set of solutions, guidelines, measures and recommendations for related government agencies and industry stakeholders. The project also aims to enhance a mutual market access for existing European, Thai and EU-Thai joint-venture ST companies as well as stimulate and facilitate more EU-Thai partnerships and investments in ST technologies in Thailand.

The Soltherm Thailand project activities were successfully implemented during the course of one-year project implementation, April 2006 – March 2007, and the project activities can be classified into two broad categories:

1. Information research and verification activities conducted through questioners, interview and site visits.
2. Information analysis and dissemination activities were organization of meetings and seminars throughout the project implementation. The project website (www.soltherm-thailand.net) has also been the key channel of information dissemination.

To fulfill extensive information required, the project team comprehensively reviewed past studies and demonstration as well as undertook numerous field trips to twenty (20) commercial and industrial facilities in seven (7) larges provinces throughout the country. Additional 6 meetings/workshops were also organized to solicit more information and verify usefulness of the findings.

Approaches Involved in the Project Activities

With the aim to remove barriers for SHW market development, the project has conducted a through review of past studies and other project activities that have implemented in the past 25 years history of solar hot water market development in Thailand. The project team also further investigated and assessed technical barriers through a series of site visit to exiting installations. Non-technical barriers which involve policy measures and economical barriers were identified and analyzed when the project team conducted interview with financial institutions, policy makers, solar companies and customers. Research methodologies used in this project are listed below:

- Review of past studies
- Questionnaire through phone interview
- Personal interview
- Survey of potential sites
- Visit to existing solar installations

Major Findings

The Thai Solar Water Heater Market and Industry

Development of SWH in commercial application in Thailand was initiated by the government 25 years ago by installing SHW systems on public hospitals. The campaign has somewhat triggered the market that several private hospitals and hotels installed SWHs during that time. The equipments were mainly imported until 10 years later, local fabrication of solar collectors became a cheaper option, though less efficiency, to Thai customers. Origins of the solar collectors were mainly from Australia until recently the imported SHW parts and collectors have shifted to China, Germany and Israel. The CIF import values have been increasing over the past couple of years in line with rising of crude oil price in world market.

The existing market of SHW in Thailand is relatively small and only limited number of SHW suppliers is available. Moreover, SHW is not a core business for most suppliers. A study by NEPO/DANCED reported that there were 12 companies involve the SHW market in 1995. After the economic crisis in 1997, there were only 9 companies could remain active. Our recent market survey found that currently there are approximately 20-25 companies operating in the market.

Technical and Non-Technical Barriers

- Technical barriers

- *System design and sizing*: many solar companies are small and sometime specialize in other area i.e. import. These companies often install solar systems without knowledge of proper system design and sizing resulting poor performance of the solar system that can not serve the actual hot water demand.
- *Quality and selection of materials:* wrong selection of materials that when soldering together cause corrosion and result in water leakages at joint and seeming of tank and pipes. Cheap material used in the system could also shorten the system life time.

- *Water quality:* some areas of Thailand, well water are a major water supply for even tourist cities like Chiang Mai and Phuket. Sediments from water have been a major problem for solar hot water with open-loop configuration installed in these areas.
- *Installation:* small companies often hire installers which sometime do not have knowledge in solar water heater or even plumbing. Wrong installation mostly fails the solar system instantly in just days after first operation. In many cases, owners who have no technical knowledge are not aware that their systems are not operating.

- **Non-technical barriers**
  - *High investment cost and long pay-back period:* due to limited size of market, solar companies need to mark up cost at high price in order to cover for the company's expense. The cost of SHW in Thailand is relatively high as compare to countries that have success solar hot water installations.
  - *Lack of quality control scheme:* Thailand does not have sufficient standards, testing and certification or any other scheme that could control quality of solar water heater in the market. Poor quality of systems and improper installations lead to system failure and customers unsatisfactory and untrusting of the solar thermal technology.
  - *Lack of effective policy support from the government:* the Thai government, from time to time, supported solar hot water in forms of demonstration and subsidies to limited number of systems. However, these financial supports did not link with quality control and only resulted in more solar systems failure. Other policies that can result in a more lasting and steady support to the market such as tax incentives and awareness campaign have not been introduced.

Quality and Standard Issue

- **Europe experience**
  - Quality of installation
    In European countries, safety requirements are imposed on mechanical and electrical components of solar thermal systems. As solar systems provide service hot water, hygienic regulation requires that water has to be regularly heat up to 60C to avoid Ella bacteria. Apart from training to designers, installers, manufacturers, and users that regularly offered for quality design and installation, some European countries e.g. Germany and Austria has specific trainings for "certified solar planner" and "certified solar installer" which extend regular planners and installers towards higher level of expertise in the solar thermal systems. The certification program in Germany is voluntary, however, the certified installers is required in France. Commercial simulation programs e.g. TSOL and POLYSUN are widely applied in the planning phase for the optimization of solar system.

  - Test standards
    In the European countries, there are several independent institutes to perform mechanical load tests and performances tests on solar thermal collectors in accordance with national standards and European standards. Until 1994, a harmonization of European standards was carried out based on existing

standards and recommendation e.g. ISO 9806. Current standards practiced for solar thermal collectors and systems are listed as follow:

EN 12975 – Solar Collectors

Part 1: General requirements; Part 2: Test methods.

EN 12976 – Factory Made Systems

Part 1: General requirements; Part 2: Test methods.

TS 12977 – Custom Built Systems

Pat 1: General requirements; Part 2: Test methods; Pat 3: Storages

In some European countries, standards are tied to public funding scheme i.e. only collectors tested according to the EN 12975 are approved for funding in Germany.

- Quality label and certification

  In 2003, a uniform European quality label for solar thermal products, the Solar Keymark, was established as a tool for customers to easily identify quality solar thermal products. After the initiation, there are more than 100 Solar Keymark licenses issued to qualified products, an indication of successful quality scheme. Furthermore, Germany is considering connecting its public funding for solar thermal to the quality label. More information on the Solar Keymark and approved certification laboratories may be found at the website if the European Solar Thermal Industry Federation (ESTIF) www.estif.org.

- **Thailand experience**
  - Quality of installation

    The lack of training courses to system designers, installers, manufacturers, and users in Thailand has resulted in slacked quality of installation. Our project survey of existing systems installed in many hotels found that many systems are wrongly configured i.e. most of the storage tanks are placed in horizontal position instead of a vertical position that allow stratification. Open looped configuration is often applied to minimize investment cost; however, poor quality of water has caused corrosion in tanks. Most systems are also lack of safety components such as air vent and weather protection for pumps. The percentage of system failure shortly after installation in Thailand is remarkably high. It is recommended that Thailand initiates a program for improving local knowledge and capacity and raises the awareness of quality installation to prevent more solar thermal systems failure in the future.

  - Equipment standards

    In Thailand, there is a standard related to solar thermal collector issued by the Thai Industrial Standard TIS 899-2532. However, it is clear, that the standard is being applied to local and imported collectors available in the market.

  - Test standards

    There are 4 test facilities for indoor and outdoor solar thermal collectorat the following academic institutions.

    1) Asian Institute of Technology (AIT)
    2) King Mongkut's University of Technology Thonburi (KMUTT)
    3) School of Renewable Energy Technology (SERT), Phitsanulok
    4) Chiang Mai University (CMU)

The test facilities are not continuous in operation due to the low national production level of collectors and commitments from manufacturers.

- Quality label and certification
  Presently, quality label and certification for solar thermal are not available in Thailand.

Economic and Financial Feasibility

- **Economic of solar thermal system**

Criteria for design and optimization of solar thermal systems which is crucial for the economic viability of solar hot water are

- Solar radiation: Thailand has an average solar radiation at 4.5-4.7 kWh/m^2 per day which is higher than the economic profitability figures for solar thermal systems. Monsoon season cause seasonal variation of solar energy that should be taken into account when designing a solar system
- Load pattern and continuity of demand: applications that have demand during daytime and operate all year round gain most economic benefit. Some industrial applications fall in this criterion that could have return on investment as soon as 3 years.
- Working temperature and types of collectors: working temperature below 70°C can use low-efficiency collectors that are economically suitable for solar systems. Three types of solar collectors available in Thailand are unglazed, flat plate and evacuated tubes can be used at this working temperature.
- Solar fraction: solar fraction is a percentage or portion of annual energy demand meet by solar energy. It is recommended that solar systems are design not higher than 60% of solar fraction for the most cost effective implementation.

- **Pay back period**

A market survey by the Soltherm-Thailand project team reported that average system cost for domestic SHW is 29,000 baht/m^2 and 23,000 baht/m^2 for large systems in commercial and industrial applications. The pay back periods for solar systems are varied depends on types of fuel replaced and applications. Calculation of pay back periods based on the survey system cost and the current fuel prices are shown in the table below.

Table E.1 Pay back period for difference fuel types in 3 applications

Sectors	Pay back periods (years)		
	Electricity	LPG	Fuel Oil
Residential	5-6	-	-
Commercial	3-5	7-8	6-8
Industrial	-	-	4-8

- **Sensitivity analysis**

There are several economic factors that have impacts to year-to-positive cash flow or pay back time. Analysis of the impacts lead us to more understanding of how pay back time can be shorten to an acceptable range among Thai investors and what financial measures are needed to achieve the target. Three parameters are

selected for the analysis: energy delivered from solar system, initial cost and annual operating cost. Results from sensitivity analysis show that reduction of initial cost has the most impact to pay back time. The only case that the solar system can pay back within 4 years is replacing electric heater in hotel applications. Other applications require more than 4 years for return on investment. In order to achieve 5 years target pay back time, a reduction of system cost are needed as 30% of residential and 50% of the present cost of commercial and industrial systems.

Potential of Solar Water Heater in Thailand

Energy demand at low-medium temperature (60-150°C) in 3 economic sectors in Thailand is estimated around 1,200 ktoe/year, a 1.9% of the total final energy consumption in Thailand in 2005. Assuming market penetration for solar water heater are 20% in residential and commercial sectors and 10% in industrial sector, a potential market size is estimated at 1.5 million square meter of collector area.

Table E.2 Technical and economical potential of solar thermal energy in Thailand

Sectors	Energy demand in low-medium temperature (ktoe)	% penetra -tion	Potential of solar hot water (ktoe)	Electri- city (GWh)	LPG (kg)	Fuel oil (liter)	Collector area (m^2)
Residential	314	20	62.8	730.36			608,637
Commercial	18.5	20	3.7	12.91	2,158,333		22,872
Industrial	874	10	87.4			92,856,232	847,052
Total	**1,206.5**		**153.9**	**743.27**	**2,158,333**	**92,856,232**	**1,478,561**

The economic potential of 1.5 million m^2 of solar collector can save energy approximately 153 ktoe and 500,000 tons of carbon emission can be avoided per year.

Solar Thermal Related Policies and Measures

Many energy and greenhouse gas reduction related policies are results of national and international commitments to reduce energy and greenhouse gas to the target goal such as a recent European Council meeting has announced a target to increase a share of renewable energy to 20% of primary energy consumption in Europe by 2020. To achieve the objectives, there are measures being implemented as follow:

- Financial incentives such as subsidies and grant are mostly needed to boost up the market at the initial phase. A success case of growing solar market in Greece has shown the influence of the subsidy measure.
- Tax incentives e.g. tax credit and import duty exemption can help bring the cost down particularly for imported products. The classifications of solar water heater components that are currently grouped together with other electric equipments have made it difficult to exempt import duty. The Thai Customs Department has recommended that solar water heater should have a separate code; however, this would require changes at a global level. Importers of solar products in Thailand pledge that should the import duty be exempted, the cost of solar system can be lower as much as 20%.

- Regulations are often tied to building code such as mandatory installation of solar water heater in new buildings. A sample of success implementation of the measure is Israel where solar water heater is required for buildings higher than 27 meters.
- Quality assurance can ensure sustainable growth of solar thermal market. Standards and testing requirements can be tied to government incentives to assure that only quality systems will be installed. Success cases are Germany, Austria and Israel.
- Demonstration projects can effectively promote solar thermal systems in the country or area that have low acceptance of the technology.
- Research and development is available in many countries, mostly through academic or research institutions to improve efficiency of solar collector and innovative design that could ultimately lower the cost of the technology.
- Awareness campaign in raising concern of the energy cost saving and greenhouse gas reduction can bring attention from public and remove the misconception of technology ineffectiveness.

Key Recommendations

To establish a sustainable solar thermal market in Thailand, the following policies are recommended.

Policy measures	Addressed problems	Measures / Schemes
1. Quality assurance	- Substandard quality of materials	- Training for manufacturers
	- Improper design and sizing	- Training for system designers
	- Quality of installation	- Training for installers
	- Lack of maintenance	- Training for users
2. Financial incentives	- High investment cost - Long pay back period	- Subsidy for investment cost.
		- Tax incentives i.e. credit for income tax, corporate tax - Tax exemption i.e. import duty, VAT
3. Awareness campaign	- Unaware of cost effective energy saving potential – Misconception of the technology	- Awareness campaign through advertisements and other media.
4. Demonstration	- Unaware of technological potential	- Demonstrations of solar hot water systems in different applications