
Zero Energy Office, Malaysian Energy Centre, Bangi, Malaysia

To identify business model and business opportunities for Danish companies in the Malaysian market within renewable energies.

Internationalization

Module Exam Assignment

Performed in partial fulfillment of the Master of Management in Technology degree.

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Executive Summary

Solar projects in MY have vast unexploited potential – especially solar cooling has to be considered due to savings in electricity consumption.

Photo Voltaic systems have potential, but not yet from a financial point of view.

Combining different renewable and conventional technologies rather than using just one makes the solution more viable.

The most important stakeholder is the Malaysian government since it controls both the energy sector and determines taxes and financial incentives.

MMA is an obvious choice as service provider within management services by:

- Influencing the political agenda regarding solar energy
- Building bridges between different stakeholders
- Branding MMA as company focusing on Corporate Social Responsibility
- Participating or driving relevant network clusters – example to participate in Suria 1000 project to brand MMA.
- Utilizing MIDA as partner to support Danish companies within renewable energy

Collecting data in Denmark and Malaysia, analyzing the data and the interpretation of data has lead to the confirmation of the following hypotheses:

- Solar cooling has huge potential.
- Solar powered systems typically reduce consumption of electrical power or heat generated by burning fossil fuels and thereby have relatively low if any economical benefits from the possible CER sales.
- Considering PV systems there still exist a huge barrier in terms of the initial capital expenditure, but focusing on solar cooling this barrier are not an issue.
- Although solar cooling is based on known technologies the concepts presented in this report are still at the prototype level.
- The general savings obtainable by applying solar cooling are of such an magnitude that even subsidies of power prices are overcome, and still leaves considerable financial benefits.

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1. INTRODUCTION

Human activities like the increased use of fossil fuels, land clearing, and agriculture have lead to an increase of green house gas (GHG) emissions. Although debated in the scientific and political community this increased emission of GHG is now generally believed to be linked to global warming. Global warming is in turn linked to a range of global changes, including a rising sea level and changes in the amount and pattern of precipitation.

The focus areas of this are illustrated in the green circle below:

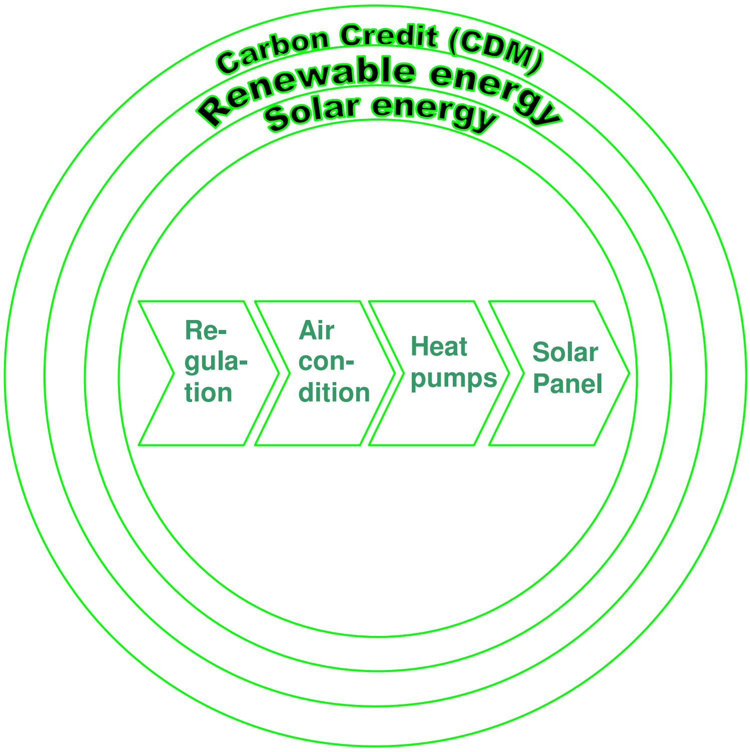

Figure 1.

1.1 Carbon Credit

The negative impact of increased emission of GHG and global warming have lead to an agreement under the United Nations Framework Convention on Climate Change (UNFCCC, reference [1]) where countries commit to reducing their emissions of GHG: The Kyoto Protocol. This has been described in the CDM report from TEM/DTU 2006, and will not be discussed in this report.

1.2 Renewable energy

Figure 2 shows the renewable energy sources of the world and how many times they each can cover the current global energy demand. It also illustrates that solar energy has the greatest potential. This is especially true for the countries near the equator.

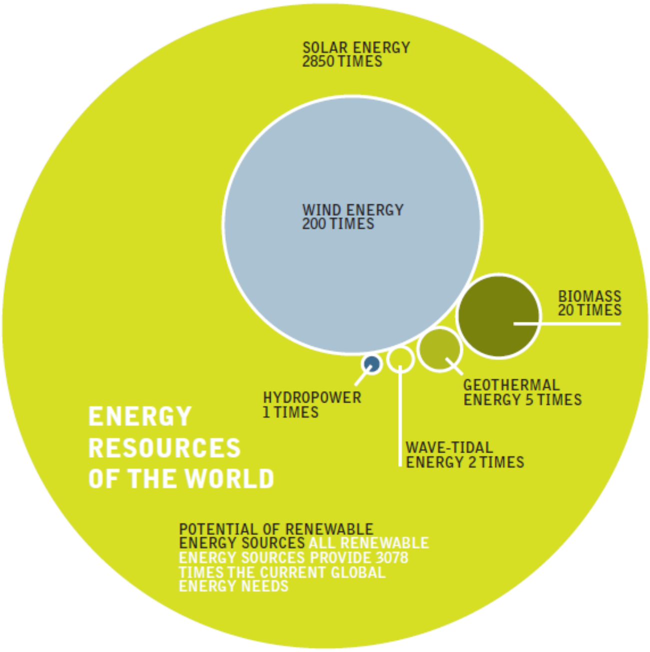

Figure 2. Energy Sources of the World [Energy Revolution]

The average solar irradiation in Malaysia is 4500 Wh/m^2 per day. In comparison it is only 1100 Wh/m^2 in Denmark so the potential for high utilisation rates of solar energy is high in Malaysia.

The potential is yet to be mapped with regards to technologies many of which are still under development. Also, business models will vary from country to country.

This report will identify a business model and business opportunities for Danish companies in the Malaysian market within renewable energy primarily focusing on solar technology.

1.3 Energy overview

Today, Malaysia is self-sufficient with regards to oil and natural gas and is also exporting both. The oil reserve is projected to last another 16 years and the natural gas reserves 30 years [9th Malaysian Plan].

Table 1 shows the projected increase in energy demand though 2010. From 2000 to 2005 the energy consumption per capita increased 17.6% and it is projected to increase another 23% from 2005 to 2010. This poses a big challenge regarding the energy supply.

Source	Petajoules[2]			% of Total			Average Annual Growth Rate (%)	
	2000	2005	2010	2000	2005	2010	8MP	9MP
Petroleum Products	820.0	1,023.1	1,372.9	65.9	62.7	61.9	4.5	6.1
Natural Gas[3]	161.8	246.6	350.0	13.0	15.1	15.8	8.8	7.3
Electricity	220.4	310.0	420.0	17.7	19.0	18.9	7.1	6.3
Coal and Coke	41.5	52.0	75.0	3.4	3.2	3.4	4.6	7.6
Total	**1,243.7**	**1,631.7**	**2,217.9**	**100.0**	**100.0**	**100.0**	**5.6**	**6.3**
Per Capita Consumption (gigajoules)	52.9	62.2	76.5				3.3	4.2

Table 1. Final commercial energy demand by source, 2000-2010 [MEWC & EPU].

In 2005, the transport sector accounted for 40.5% of the energy consumption, the industrial sector for 38.6% and the residential and commercial sector for 13.1%. The main focus of this report is electricity generation and supply and only the fuel sources connected with these activities will be discussed.

To secure reliable electricity supply and reduce the high dependency on natural gas, the sources of fuel for power generation have been diversified with increased use of coal [9th Malaysian Plan]. All coal is imported and roughly 85% comes from Indonesia. Even though the percentage of energy generated from coal is projected to stay constant the actual import is increasing (table 1).

The fuel mix used for electricity generation is shown in table 2 [Energy Commission 2006 Industry Report]. In 2006, 103,994 GWh of electricity was generated. Roughly half of that was used for cooling.

Natural gas	64,80%
Coal	25,60%
Oil	0,30%
Diesel	1,90%
Biomass	0,60%
Hydro	6,10%

Other	0,80%

Table 2.

The gas is heavily subsidised whereas the coal is based on market price. According to Petronas, the cost of producing gas is between RM20/mmbtu and RM25/mmbtu and the current selling price to the power sector is RM14.31/mmbtu [The Star, November 22nd 2008]. This means that the electricity tariff paid by the end users is also heavily subsidised.

2. SCOPE OF ASSIGNMENT

2.1 Background for the Project

The natural setting of Malaysia offers a plethora of renewable energies. Wind, wave and solar resources are abundantly in the nation whereas the Danish companies have access to advanced technologies to exploit these resources.

The TEM report (Hold 8) "How to Implement Your CDM Projects in Malaysia" has described how the clean development mechanisms and the carbon credit trade can be used as incentives to invest in Annex 1 countries.

2.2 Problem description

2.2.1 Purpose of the Project

To identify business models and business opportunities for Danish companies in the Malaysian market within renewable energy primarily focusing on solar technology.

2.2.2 Goal of the Project

The primary driving forces should be identified as well as the possible barriers against exploitation of the opportunities.
Identifying Malaysian partners for Danish or Scandinavian companies.
Recommendation of a business model to sponsor.

2.2.3 Key Questions of the Project

What are the energy demands in Malaysia? (heating, cooling, electricity, etc)
Who needs what in terms of segmentation of the market?
Who are the stakeholders?
How to finance the tech transfer?

2.3 Delimitations

Other renewable energies than solar will not be discussed (bio fuel, wind, wave, geothermic)
Geographic delimitation – Scandinavia and Malaysia only.
The CDM process it self will not be discussed but CDM's might be used in the business case.
Only renewable energy to replace electricity will be discussed.

2.4 Acknowledgements

We want to thank first of all our sponsor Mr. John Madsen at Micro & Macro Approach in Kuala Lumpur for providing us the opportunity to conduct this assignment and for being so hospitable and generous towards us during our stay in Malaysia. Secondly we want to thank all the helpful and kind people and experts we have met in Denmark and in Malaysia during our interviews. Finally we would like to thank Associate Professor Mads Christoffersen at DTU/ TEM for the supervision during this assignment.

3. Methodology and analysis

This chapter describes how the project was approached.

3.1 Hypotheses

The assignment: "to identify business models and business opportunities for Danish companies in the Malaysian market within renewable energies" is based on a hypothesis driven approach. Initially in Denmark, one set of hypotheses was made. During the field work in Malaysia these hypotheses were revisited and finalized in five overall hypotheses:

1. The traditional energy consumption can be minimized by using solar energy.
2. Carbon credit is a key driver in successful implementation of solar energy.
3. The main barrier for implementation of solar energy is capital expenditure.
4. All solar energy technologies are under development
5. Subsidies of the "traditional" energy market (electricity) is a barrier for solar energy (PV, solar cooling)

3.2 Stakeholder analysis

Based on the hypotheses a stakeholder analysis of the energy sector in Malaysia was performed. The most important stakeholder is the Malaysian government since it controls both the energy sector and determines taxes and financial incentives.

Stakeholder	Interest in electrical energy based on solar (5 high)	Stakeholders influence within electrical energy based on solar (5 high)
Malaysian state	5	5
Petronas	4	4
Energy consumers	3	2
NGO	5	1
Local goverments	4	4
Hydro power producer	3	5

Table 3.

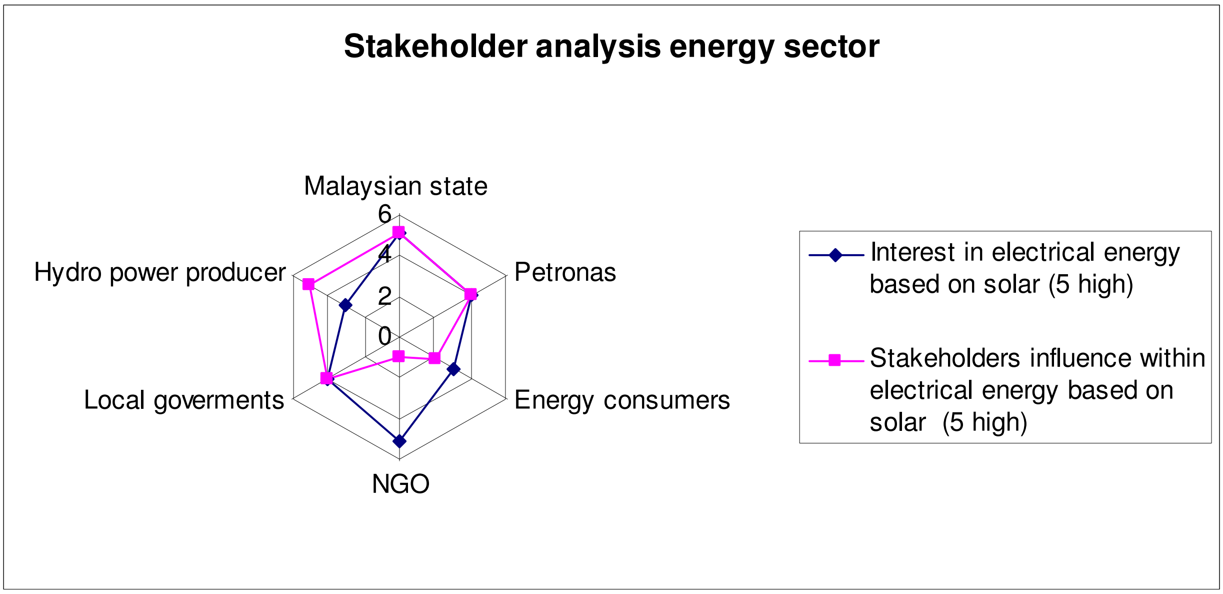

Figure 3.

Other important stakeholders are the end users and the energy producers.

Interviews were conducted in both Denmark and Malaysia to confirm or reject the hypotheses and identify opportunities and barriers for solar energy in Malaysia. The interviews in Denmark were focused on solar technology and best practises whereas the emphasis of the interviews in Malaysia was to understand the energy market.

Interviews:

In Denmark:

- AC-Sun
- ClimateWell
- PhotoSolar
- SolarCap
- Energistyrelsen
- Teknologisk Institut
- Vestas
- Samsø Energi- og Miljøkontor

In Malaysia:

- MMA
- Skaarup & Jespersen
- Aumada
- Danish Embassy
- MIDA
- Two private solar energy customers
- IEN
- KL Sentral Plaza
- Hotel Noble
- Ministry of Energy, Water and Communications

3.3 Extracts from Interviews

In Denmark, two potential partners were identified: AC-Sun and ClimateWell. Both are involved in solar cooling.
AC-Sun is a Danish design and development company and their mission is to develop and commercialize a thermal air conditioning solution driven by solar panels. The AC-Sun air condition plant is based on already known thermal processes but the combination is unique and has been patented. They state they can reduce the energy consumption by 90% compared to conventional AC. AC-Sun is not interested in producing the AC units themselves and is looking for licensing partners for the manufacturing. For additional information visit their website www.ac-sun.com.

ClimateWell is a Swedish company which has developed an air conditioning system driven by solar energy. Their mission is to make a global sustainable energy supply possible by applying ClimateWell's unique heating and cooling technology. The basic principle of the system is absorption using a liquid and lithium salt. The system can be driven by solar panels. It is commercially available. For additional information visit their website www.climatewell.com.

Some of the typical statements from the interviews in Malaysia are:

- Solar energy is great but very expensive
- The initial investment in solar energy is very high
- The ROI should be no more than 2-3 years
- Gas is subsidised which makes solar energy even less competitive
- Solar energy is good for the environment

This shows that there is an interest for renewable energy in Malaysia but that the installation and operating costs at the moment can not compete with the current business model of indirectly subsidised electricity.

The government has started to phase out the fuel subsidies but it is expected to take up to 15 years. They do not want to subsidise new energy sources so to encourage the implementation of renewable energy various financial incentives exist – they are described later in this section. The government is also considering the implementation of feed-in tariffs at the moment.

The statements also show that most people associate solar energy with photo voltaic systems even though the much cheaper solar panels are produced locally in Malaysia.

Three segments of end users were identified from the interviews. These are people or corporations who want to:

- Be socially responsible by safeguarding the environment
- Reduce the electricity bill
- “Show-off” their wealth

These three segments apply to both the private and commercial sectors. From a marketing standpoint they will have to be approached differently.

Corporate social responsibility is becoming more and more important and the government is leading by example. The Ministry of Energy is a Low Energy Office building and the Pusat Tenaga Malaysia building is a Zero Energy Office building.

According to the Malaysian Minister of Energy, the biggest challenge for the power sector is energy security [The Star, November 22nd 2008]. He also states that it is time to look for other sources of energy than the traditional ones – preferably sources controlled by Malaysia.

The Malaysian government is very open to renewable energy and their current goal is to get 350 MW from renewable energy in 2010. According to the Ministry of Energy the target will be much more ambitious in the 10th Malaysian Plan. Various financial incentives already exist:

- Pioneer Status with income tax exemption of 100% of the statutory income over a period of 10 years. Unabsorbed capital allowances as well as accumulated losses incurred during the pioneer period can be carried forward and deducted from the post pioneer income of the company [MIDA]
- Investment tax allowance of 100% on the qualifying capital expenditure incurred within five years. The allowance can be offset against 100% statutory income for each year of assessment. Any unutilised allowances can be carried forward to subsequent years until fully utilised [MIDA]
- Companies which generate energy from renewable resources for its own consumption are eligible for the Investment Tax Allowance as described above.
- Exemption of sales tax and import duty on solar PV systems given to importers.
- Exemption of sales tax on purchase of solar heating systems from local manufacturers.
- 60% of the CAPEX can be deducted when installing energy saving equipment
- Suria 1000. A limited number of grid-connected solar PV systems are offered to the public on a bidding concept. Successful bidders will then install the PV system supplied by the participated PV Service Providers as Building Integrated PV (BIPV) at their premises. Premises can be existing or new houses/buildings. The costs of the PV systems will be borne by the successful bidders at the bidding price and supplemented by the project. This programme is co-financed by the public (owners of the system), Suruhanjaya Tenaga (for the Government of Malaysia) and the PV industry (via discount for the hardware) [www.mbipv.net.my/suria.htm]

Also, the comfort temperature in Malaysia is 22.5 – 25.5°C. There are big savings to be captured by increasing the indoor temperature from the typical 16 – 17°C in office buildings and malls to the comfort temperature. This is illustrated in figure 4.

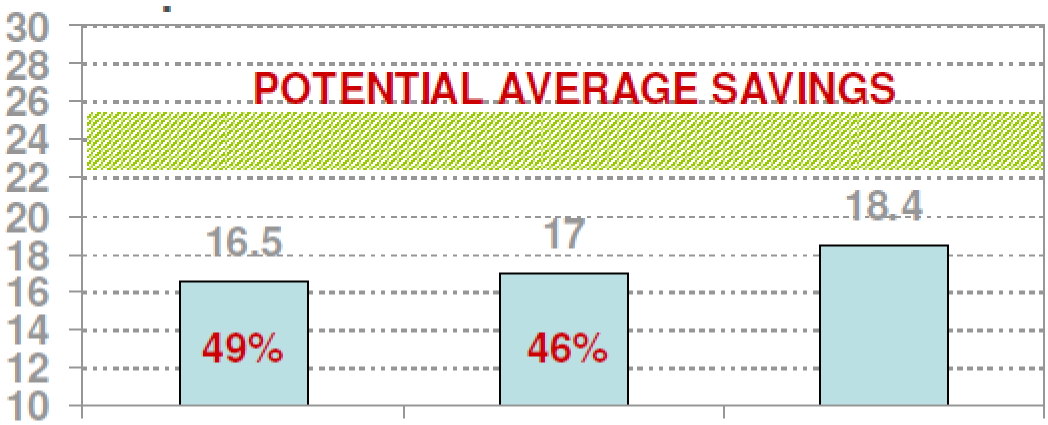

Figure 4 [IEN Consultants, Gregers Reimann]

An official green mark should be established by the government.

Opportunities and barriers identified from the interviews are listed below.

The opportunities are:

- Political focus on renewable energy - 9th Malaysian plan (2006-2010)
- Long term political focus on Photo Voltage technology (PV)
- Tax reductions when implementing renewable energy
- Solar energy can be made more attractive by using carbon credits.
- Recovery of heat from AC for hot water in homes or buildings using AC
- Solar driven cooling as replacement for conventional AC
- Combining different renewable and conventional technologies rather than using just one makes the solution more viable.

It has already been demonstrated by IEN Consultants that combining various technologies can greatly improve the energy consumption. Figure 5 shows the difference in consumption between normal, LEO, EC and ZEO buildings. The additional constructions costs are roughly 5% [IEN Consultants].

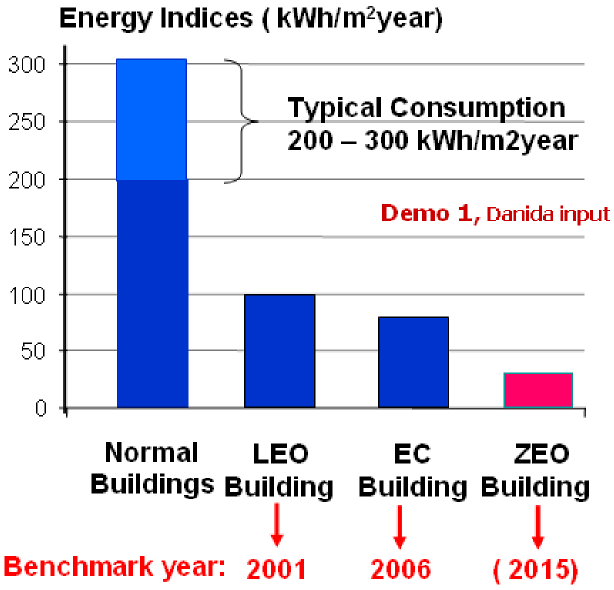

Figure 5. [IEN Consultants]

The barriers are:

- Indirect subsidies on electricity due to direct subsidies on gas
- High initial CAPEX on solar energy systems.
- Low awareness of solar energy in the general population
- Low awareness of the tax reductions associated with renewable energy in the general public
- Due to plenty of natural resources there is no immediate pressure on the government

3.3.1 Discussion of Hypotheses.

Hypothesis 1: The traditional energy consumption can be minimized by using solar energy.

Analysis:
There are several different concepts within solar energy – thermal solar energy, photo voltaic (PV) and solar cooling.

Thermal solar energy is used primarily to heat liquid in a closed circuit and via a heat exchanger transferring the energy to a secondary source most commonly water. These are usually used in households. In Malaysia (MY), there are many different producers within this area – mainly small work shops but there are also a few suppliers who are importing the higher end equipment.

Thermal solar energy in households poses a challenge in respect of existing buildings. Typically, there is only one water pipe for cold water in the rooms where water is needed. Therefore, in the rooms where hot water is needed an electrical heater is installed. This decentralised water heating is a barrier for thermal solar heating since either the utilization of solar heated water is low or additional CAPEX is needed for alternative pipes for hot water. During the field work in Kuala Lumpur several thermal solar systems were seen and this technology has been used for several year in MY.

In general the Photo Voltaic systems transform solar energy to low voltage and via electronic systems it can be used directly in households or industry – or it can be sold into the grid. Due to the Suria 1000 project, several MY companies have started to produce solar cells (PV) and the unit cost has been reduced from about RM 30,000 RM to 26,000 RM per kWp [MEWC]. This project has created a big focus on building integrated photo voltage (BIPV) solutions as intended from government's side.
There are different technological solutions regarding solar cells addressing the utilisation of solar energy, lifetime and production cost. A recently new technology named polymeric solar cells (PEC) is cost effective but so far utilisation is low and the lifetime short. This technology is expected to be developed into a more mature product within a reasonable time.

Solar cooling uses thermal power, e.g. solar panels, to vaporise a liquid and in this process uses the energy needed as cooling system. The traditional systems using salt is actually the system used in refrigerators before the compressor was introduced, thus it is a fairly old technology. The shopping mall by the Petronas towers in Kuala Lumpur uses this technology for AC. This system is also used in a lot of government projects in Spain where ClimateWell have some of their solutions implemented.
The AC-Sun air condition plant is based on already known thermal processes but the combination is unique and has been patented. They are working on a licensing model to transfer the technology.

An example of Low Energy Office (LEO) Building is the Ministry og Energy Building with a 3,3 kWp solar PV solution. The PTM's Zeor Energy Office (ZEO) building is a BIPV showcase with installed capacity of 92 kWp and future "Super Low Energy Office building by ST" with approximately 70 kWp solar PV [MEWC].

<u>Interpretation:</u>
Solar energy can be used to minimise traditional energy consumption confirming the hypothesis.

Attention must be paid to the extent the traditional energy consumption can be lowered since the solar energy solutions have different needs to be met and different utilisation rates.
With regards to thermal solutions for heating of water, one barrier is the one pipe installation for water in a household. Future buildings can overcome this barrier by taking this into consideration during the design phase and if the constructor is convinced of the economical prospect. Most new houses in MY are only shells when sold and the

buyer themselves finish the refurbishment of the house. Thus the constructor has no incentives to make the house more expensive by introducing centralized heating system through pipes.

PV systems though expensive they are still an opportunity. The Suria 1000 project is a very good example of both a technical solution and political willingness. Both the Ministry of Energy's Low Energy Office (LEO) Building and future Super Low Energy Office building by ST shows a big political focus on renewable energy and is seen as one key to increase the use of solar energy.

So far, solar cooling seems to be in early market stage, but it has a vast potential since air condition systems produce a lot of excess heat. By using this as an energy source for solar cooling the traditional thermal heating can be minimised.

The Hotel Noble case will discuss how the excess heat from air condition systems is used for heating water. This is not direct solar energy, but indirect since solar energy demands AC to cool down hotel rooms, and thus recycle heat to hot water.

Hypothesis 2: Carbon credit is a key driver in successful implementation of solar energy.

In respect of the Kyoto agreement many worldwide initiatives have been taken and implemented. Even though, MY is not part of the Kyoto agreement (only annex 1, thus no requirements) this hypothesis follow the lead based on opportunities for Danish companies. They can replace existing non renewable technologies with renewable energy based on Danish export or technology transfer to MY with mutual benefit for both parties.

<u>Analysis:</u>
CER's or Certified Emissions Reductions are a "certificate" just like a stock. A CER is given by the CDM Executive Board to projects in developing countries to certify they have reduced green house gas emissions by one tonne of carbon dioxide per year. For example, if a project generates energy using wind power instead of burning coal, saving 50 tonnes of carbon dioxide per year. Then it can claim 50 CER's (as one CER is equivalent to one tonne of carbon dioxide reduced).

Developed countries buy CER's from developing countries under the CDM process to help them achieve their Kyoto targets.

In India income from CER's are not taxed. The Chinese government has decided to tax the revenue from projects.

There are many gases that contribute to the green house effect. The Kyoto Protocol deals with six categories of them. These six categories are shown in table 4:

Gas	Global Warming Potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (NO_x)	310
Hydrofluorocarbons (HFC_s)	140-11,700
Perfluorocarbons (PFC_s)	7,000-9,200
Sulphur hexafluoride (SF_6)	23,900

Table 4.

Source : IPCC Third Assessment Report. 2001 Climate Change : The Scientific Basis. Intergovernmental Panel on Climate Change

Interpretation: Carbon credit is not seen as a key driver from an economical perspective though carbon credits contributes to the equation in a positive manner. Since the Ministry of Energy is concerned with global warming due to emissions (CO_2 as example) carbon credits are seen as a political important factor addressing Corporate Social Responsibility. The Kyoto agreement and the follow up climate summit in Copenhagen in 2009 is expected to continue to have the carbon credits as a focus area. By using carbon credits, companies can brand themselves as being "green". An example could be hotels branding themselves ad "zero energy" based on recycling of energy or solar energy. In the USA, several hotels brand themselves as "sustainable" attracting environmentally conscious people who are willing to pay more to stay in a green hotel. This can be seen as "life style" products and it should not be neglected. It poses great opportunities since the number of environmentally conscious people is increasing.

According to the Danish energy department, projects aiming at generating value by CER's should at least amount to a annual reduction of GHG equivalent to 5000 tCO2/year (or power savings of 7950 MWh/year), but for the energy department to consider involvement in the project reductions of more than 20.000 tCO2/year (power savings of 31.750 MWh/year) are the trigger level.
The reason for this being the typical initial cost related to approval and monitoring of the project amounts to 325.000 RM.

Hypothesis 3: The main barrier for implementation of solar energy is capital expenditure.

Due to it's geographically location, MY is in one of the areas of the world with the highest solar radiation. Therefore, utilising solar energy makes a lot of sense but due to MY's natural resources such as gas and oil there is no immediate need for alternative energy sources. The cost of implementing solar energy is expected to be a main barrier. Understanding the background for this expected CAPEX barrier is supposed to drive business cases.

Analysis:
In Malaysia, a PV solar cell system of 1 kWp could contribute from about 900 kWh/year to 1,400 kWh/year giving an average of 1,100 kWh/year. In comparison it is 850 kWh/year in Denmark) and 1400 kWh/year in Southern Europe (Spain). The numbers for Denmark and Spain are peak values. In MY, there is daylight 12hours a day all year round and the average solar irradiation is 4,500 Wh/m^2 per day. Thus there is a vast potential for utilising solar energy.

With regards, to thermal solar systems the CAPEX varies for a household from approximately 3000 RM to 12000 RM. This big span is due to locally produced thermal panels versus imported high end systems with higher utilisation. The low end systems have in many cases proved to contribute negatively since the electrical heater (to heat water when no sun or not sufficient temperature in water tank) has used more energy than before the thermal system was introduced. The main cause for this is the design and low end material for radiation and insulation materials.
The costs from 3.000 RM to 12.000 RM must be compared to an average monthly wage of 2000 to 4000 RM for a newly graduated architect. Thus for a typical private household it is a huge percentage of their income if they decide to invest in thermal solar energy. Since gas is subsidised and therefore the electricity is indirectly subsidised the ROI is higher than on normal market terms.

Photo Voltaic systems are very expensive investments and the typical ROI is typical 45 years in MY. Taking the Suria 1000 project into consideration utilising building integrated photo voltage systems combined with lower production cost [MEWC] both political and economical opportunities are available though competing with traditional electricity prices is a lost battle from a ROI and an economical point of view. Investigations though show that peak demand in the grid to some extend can be handled by more decentralised electrical production (say private households) thus a mutual interest between electrical power suppliers (such as Petronas) and the end user exist. Given the right political focus and incentives the ROI on PV could be lowered.

Areas without access to the grid, is another area where PV has value. In these cases, the price per kWh is second priority compared to ensuring electricity. This will not be dealt with in this case since Borneo which has 80-90 % grid coverage is the least grid development area, but it should be considered in urban areas to meet load demand.

Solar cooling is an area with only little official information thus the ROI has been difficult to obtain. The investment for a 10 kW ClimateWell system in Spain is 40.000 € for just the vapour system. The thermal solar panels are parts which have to be added and they are expected to expensive.

Interpretation:
The CAPEX regarding solar energy systems poses a major challenge since the ROI is long. Traditional thermal systems have a relatively short ROI partly due to the various financial incentives offered by the government (it is said that a 5 % tax reduction on CAPEX is expected by MY government) and the technology is mature.

PV systems have a long ROI - close to the lifetime of the product. This is a big challenge and a main barrier for introducing solar energy. Given political incentives or technological break-troughs this is to be considered as a very interesting area where focus has to be assigned.

Systems for solar cooling are expected to be expensive and that would be a barrier. The cases later in the report, will discuss the financials and potentials of this technology. The area is attracting focus from Ministry of Energy. Especially the solution from AC-Sun which they want to license could be built and manufactured in MY resulting in an attractive ROI for new households, factories or buildings in general.

Hypothesis 4: All solar energy technologies are under development

Analysis:
Thermal solar systems are a mature technology and used widely in MY and all over the world. The systems usage ranges from the northern hemisphere with low solar influx to areas with much higher. The areas with high solar intake have a predicament in using thermal solar energy since heating of houses is not required. Therefore, one challenge is to use the traditional thermal solar systems to other things than just heating water for baths. Combining thermal solar energy with other solar energy systems or other renewable energies could create whole new solutions.

PV systems involve many different technological solutions which will not be covered in details in this report. The major challenges are to increase the utilisation and lower production cost to ensure attractive ROI. The PV area is still under development though it has been used for many decades (electricity to remote areas and for satellites).

Solar cooling based on traditional vaporisation (AC-Sun) or by using salts (ClimateWell) should definitely not to be considered as being under development. They are existing technologies that are now used – or reinvented – due to high energy prices or political focus. Though by bringing the existing technology into a new frame one can argue that solar cooling as a general product is under development.

Interpretation:
The hypothesis is only valid for PV and partly for solar cooling since thermal solar energy can not be considered under development. If development is considered embracing different ways of using solar energy in combination with other solutions, especially renewable then one can state that thermal energy as a part of a bigger system is under development.

Even though PV has a history dating back decades due to different technological innovations, especially over the last few years, it should be considered as being under development.

Hypothesis 5: Subsidies of the "traditional" energy market (electricity) is a barrier for solar energy (PV, solar cooling)

Understanding the dependencies of subsidies for both renewable energy and existing energy marked will drive return-of-investments regarding renewable solar energy and will challenge cost/benefit on a strict economical perspective since Corporate Social Responsibility for the moment has no major financial impact.

Analysis:
Natural gas is subsidised by the government and since it is a natural resource in MY it is used to produce electricity. This will have an impact on the business models regarding ROI where the alternative is using electricity from the grid. In MY there has been discussions regarding lowering the indirect subsidies on electricity, but this created a lot of controversy especially in low income areas. The current subsidies are thus a stabilising political factor which is not to be underestimated.

Interpretation:
The subsidies to the traditional electrical power sources are a barrier for solar energy. To turn this barrier into an opportunity the challenge is to reframe the political agenda by looking into the emission from the natural gas and show corporate social responsibility. Another option is to give solar energy a similar subsidy. Various financial incentives already exist for renewable energy but it is a bit of a jungle. Simplifying the processes and communicating the options to the general public would increase the awareness.

4. Business model.

The framework used for the business model is based on "the Seven C's". The business model is focusing on MMA with regards to the activities and competencies necessary for MMA to be able to become a service provider within renewable energy.

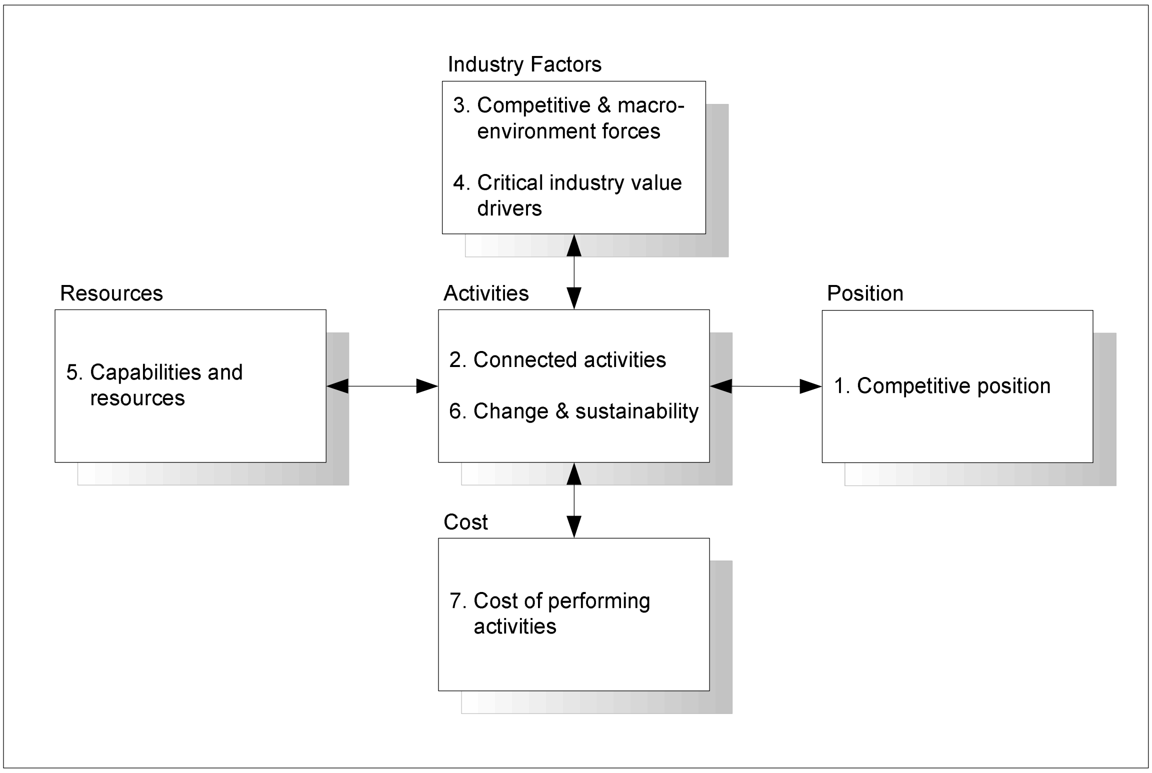

Figure 6. Seven C's business model

The focus will be on capabilities & resources, activities and competitive position using the data and findings from the interview and hypothesis discussion.

The business model can highlight important opportunities and barriers and is thus not used as a final solution.

Competitive & macro environment forces are described in a PESTEL framework:

Political
- Subsidized electricity
- Fiscal incentives for companies using RE
- Exemption of sales tax on solar systems
- Suria 1000

Economic
- Importing coal
- Self-sufficient on oil and natural gas
- Export of oil and natural gas

Social
- 80% in Sabah connected to the grid
- 90% in Sarawak

Technology
- Self-sufficient on oil and natural gas
- PV contract manufacturing
- Hydro power (Borneo)

Environment
- 350 MW from RE in 2010
- No Kyoto goals

Legal
- Subsidized electricity
- CDM's
- Feed-in tariffs in 10th Malaysian Plan

Figure 7 PESTEL

The industry drivers lie outside this task, but attention must be paid towards technological innovation within renewable solar energy combining with the exceptional position and role that MIDA has supporting new entrepreneurial companies or technologies.

4.1 Capabilities & Resources

4.1.1 Internal competences to be met.

MMA must address and overcome the barriers within renewable energy, especially those with root in the political arena. Since gas is subsidised so is the electricity resulting in low prices for the end consumer. Therefore, MMA must by themselves or in cooperation with other stakeholders be able to influence the decision makers. This should be done in en effort to eliminate the advantage currently existing for electricity made from fossil fuel.

It is important to ensure that renewable energy is on the political agenda in MY since at the moment the awareness in the general public is not very high.

CDM and Corporate Social Responsibility as world wide themes must be used to sway the political agenda in the desired direction.

MMA as a service provider, linking suppliers and customers, and as a consultancy will have to create the necessary perspective and brand the area of sustainable renewable energy.

Since the market for renewable energy (solar) has a vast potential in Malaysia due to its geographic location and weather conditions the most important competence to have is the ability to put solar energy on the political agenda. This is more important than the ability to discuss technological solutions. Being able to overcome barriers to ones own advantage requires an in depth domain knowledge within political system. This is of great value and will provide MMA with a sustainable competitive advantage and provide customers with something that they value and are willing to pay for.

MMA has an extensive network within MY and other major Asian countries and this experience and knowledge are rated to be a major asset in terms of connecting political knowledge with business opportunities.

Facilitation of build own operate and transfer (BOOT) projects is seen as a major service to be handled by MMA in terms of management services that are cost effective.

4.1.2 External competences necessary:

Assuming MMA will continue as a consultancy firm and by this build bridges between different stakeholders strong networking capabilities must exist between various stakeholders as well, to mention few: research institutions, manufacturing, suppliers, other service providers, stakeholders political and in general terms of the medias.

Economical resources
MMA being strong within networking and building bridges based on mutual work and benefit there will be no direct investment for MMA as a consultancy firm. However, resources in form of lobbying, travelling to meet the right people and assess potential partners will impose a cost.

Activities to be handled by MMA:

- Influence the political agenda regarding solar energy
- Build bridges between different stakeholders
- Brand MMA as company focusing on Corporate Social Responsibility
- Participate or drive relevant clusters – example to participate in Suria 1000 project to brand MMA.
- Utilize MIDA as partner to support Danish companies within renewable energy

4.1.3 Competitive position.

So far there are no knowledge about competitive firms within the consultancy business which are focusing on Corporate Social Responsibility. Renewable energy is considered to be in the starting phase in MY, even though solar thermal systems have been used in many years. Thus MMA should be able to gain a competitive edge by embracing the different stakeholders within a political frame in MY.

5. Cases

5.1 Case 1: Hotel Noble

Hotel Noble in Kuala Lumpur is a typical budget hotel. It has 130 rooms which are all equipped with running hot water and AC.

Until a couple of years ago, all the hot water was heated by electrical heating. The annual cost of the heating was 100.000 RM. This number is based on a daily energy consumption of 1000 kW, where half of it was just waste due to e.g. poor insulation.

Today, all the water is heated by the excess heat from the AC's. The installation cost of the heat recovery system was 150.000 RM [CEO of Aumada]. The company tax of 28% was deducted from this number which reduced the investment to 108.000 RM.

Furthermore, to encourage the implementation of renewable energy the government offers an additional reduction, where 60% of the CAPEX multiplied by the company tax can be subtracted from the initial investment. In the case of Hotel Noble, that gave an additional reduction of 25.000 RM.

This means that the actual investment for the hotel was only 83.000 RM and the pay back time was less than a year.

At the same time, roughly 220 tons less CO_2 is produced per year which corresponds to 10.700 RM yearly. Branding itself as a "green hotel" could give it a strong competitive advantage among the environmentally conscious customers. Corporate social responsibility is becoming more and more important and the first movers will benefit the most.

The recovery system only uses 10-20% of the excess heat from the AC to meet the hotels hot water demands. Therefore, there is a potential of supplying the surrounding buildings with hot water if the infra structure was in place.

In this case, the AC's are still run by electricity. The electricity could in principal be replaced by either PV's or solar cooling using the system from AC-Sun.

Today, the hotels chillers are using between 1.500 and 2.000 kWh per day when running 24hrs. If only looking at the period of daylight the consumption is 680 kWh.

Table 5 shows the roofing area required for PV's to produce the energy needed for the current consumption, the initial investment and the initial investment deducted the same as above for comparison. The calculations are done for all three consumption levels.

Noble Hotel PV system						
Power consumption		PV system size		Initial Investment	Initial Investment – w/tax reductions	CER value
kWh/day	MWh/year	kWp	m^2	RM	RM	RM/year
1,500	548	498	7.110	12.940.909	7.143.382	10.708
2,000	730	664	9.481	17.254.545	9.524.509	14.277
680	248	226	3.223	5.866.545	3.238.333	4.854

Table 5

Table 6 shows the same calculations for the AC-Sun system. The savings are based on 90% of the current consumption.

Noble Hotel AC-Sun system						
Power consumption		Powersavings	Savings	Initial Investment	Initial Investment - TAX reductions	CER value
kWh/day	MWh/year	MWh/year	RM/year	RM	RM	RM/year
1,500	548	493	147.825	930.709	659.510	10.601
2,000	730	657	197.100	1.240.945	879.347	14.134
680	248	223	67.014	421.921	298.978	4.806

Table 6

It is evident from the tables that the initial investment in PV systems is much higher than for the solar cooling. Furthermore, the hotels roof top is not large enough to accommodate all the PV's required.

This case shows that even with conventional technologies there is potential for large savings and that the first movers with in solar cooling has a competitive advantage compared to PV producers.

5.2 Case 2: Kawan Malaysia Frozen food factory

Factories which have the need for both cooling processes as well as process heat in their production, could lower their energy bill by applying solar thermal cooling combined with heat exchangers and heat pumps.

Frozen food factories could be an example of this.

Today, air conditioning is one of the world's largest consumers of electricity, greatly impacting global emissions of CO_2. The consumption of energy peaks when the sun provides the earth with the most heat. Therefore, it is obvious to use solar energy to drive the water cooling system, thereby minimizing the electricity consumption of the AC unit.

The solar powered AC-Sun solution will save 90% of the electricity consumption compared to conventional AC systems.

The cooling capacity of the AC-Sun concept can easily be varied from small single family household units to large freezing plants at industrial scale. As opposed to other types of solar powered AC plants (i.e. absorption plants), the AC-Sun concept is easily adapted to small units (less than 10 kW cooling capacity).

Already well developed despite a rapid growth rate, the AC market has a number of large players. The competitors can be divided into two major groups: companies supplying wall and window mounted units and companies supplying multi split systems. Both groups are supplying systems based on conventional technologies. Considering the calculated lower production costs of the units and the annual savings on the energy bill, the AC-Sun unit will have a significant competitive advantage.

AC-Sun has made an economically comparison between a conventional 10 KW unit costing 4.000 Euro/19.500 RM and a AC-Sun unit at an estimated price of 7000 Euro/34.000 RM. The former having an yearly power consumption of 9038 kWh (1.675 kWh/month in the summer), and the latter running on 10% of a conventional AC power consumption for pumps etc., both placed in Alanya, Turkey with ambient temperatures around 33°C during the day and 27°C during the night in summertime.
As the technology is scalable, these numbers can be used for a rough estimate of the economical benefits a frozen food factory in Malaysia, will gain from introducing the AC-Sun technology into their production.

The energy consumption in Kawan Malaysia factory in Shah Alam are broken down into three parts, namely freezing/cooling section, heating/baking and general processing section which include office lighting/air condition (Air condition typically accounts for more the 50% of the energy consumption in Malaysian office buildings).

Type	kWh/month	MWh/year
Freezing/Cooling Section	306.000	3.672
Heating/Baking Section	70.864	850
General Processing	136.648	1.640
Total		6.162

Table 7.

The total consumption amounting to 6.162 MWh/year or 2.255.345 RM/year given a price of power of 0,37 RM/kWh.

Introducing an AC-Sun system to the freezing/cooling section as well as to the 50% of the general processing power taken to be used for aircondition, requires a system which compared to the 10kW system are scaled 183 times for the Freezing/Cooling Section and 41 times for the 50 % of the General Processing Section.

	Freezing/Cooling	General Processing	Total
Initial Investment (RM)	6.222.000	1.394.000	7.616.000
Annual Power savings (MWh/year)	3.305	738	4.043
Annual Cost reduction (RM/year)	1.209.557	270.071	1.479.628
Pay Back Time (year)	5,1	5,1	5,1

Table 8.

Other contributions to the economy of the project are the possibility to obtain carbon credits (CER's) and investment tax allowances of 100% on the qualifying capital expenditure. The carbon credits are calculated based on the conversion factor of 0,63 tCO_2/MWh power reduction, and an estimated price on the credit of 7 Euro/34,15 RM. Any cost related to monitoring and approval of the CER's has not been included in this estimate.

	Freezing/Cooling	General Processing	Total
ITA 100% (RM)(at 27% tax)	1.679.940	376.380	2.056.320
CER contribution (RM/year)	71.097	15.875	86.972
Pay Back Time incl. ITA & CER (year)	3,5	3,5	3,5

Table 9.

In comparison with the above, investments in a PV system covering the entire roofing area is considered in the following. In Malaysia, a 1000 kWp PV system will in average produce 1100 MWh annually. Typical PV panels produce 70 Wp/m^2 and with a roofing area of 3900 m^2 this leads to a PV-system in the size of 273 kWp producing 300,3 MWh/year – less than 5% of the annually consumption at the factory. The financial savings contributed from the PV-system are then 109.910 RM/year at a cost of power at 0,37 RM/kWh.

273 kWp PV system	
Initial Investment (RM)	7.098.000
Annual Power savings (MWh/year)	300,3
Annual Cost reduction (RM/year)	109.910
Pay Back Time (year)	64,6
ITA 100% (RM)(at 27% tax)	1.916.460
CER contribution (RM/year)	6.460
Pay Back Time incl. ITA & CER (year)	44,5

Table 10.

The Suria1000 project has lead to a price on PV-systems of 26.000 RM/kWp.

6. Conclusion

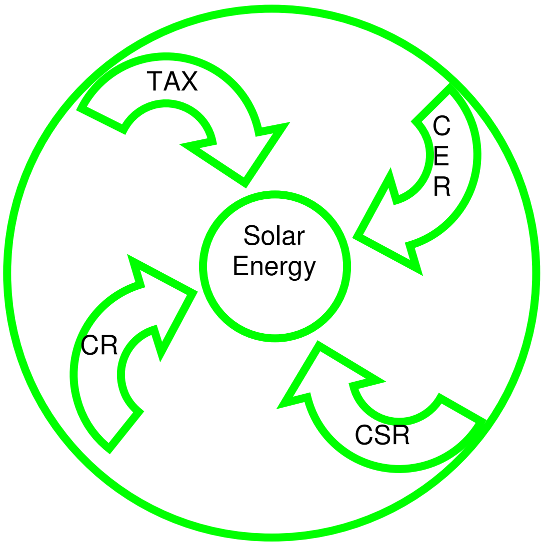

Figure 8.

The Green circle shows which factors must be in place before solar energy will be profitable. (TAX = Regulation from the government, CER = Certified Emission Reduction, CSR = corporate social responsibility, CR = Combined Renewable)

Conclusions based on the hypotheses:

- Solar cooling has huge potential.
- Solar powered systems typically reduce consumption of electrical power or heat generated by burning fossile fuels and thereby have relatively low if any economical benefits from the possible CER sales.
- Considering PV systems there still exist a huge barrier in terms of the initial capital expenditure, but focusing on solar cooling this barrier are not an issue.
- All though solar cooling is based on known technologies the concepts presented in this report are still at the prototype level.
- The general savings obtainable by applying solar cooling are of such a magnitude that even subsidies of power prices are overcome, and still leaves considerable financial benefits.

Additional conclusions:
Judging from the calculations in the cases the AC-Sun system has great potential. The possibility of forming a partnership to manufacture in MY should be further investigated.

MMA is the obvious choice as service provider within management services by:

- Influencing the political agenda regarding solar energy
- Building bridges between different stakeholders
- Branding MMA as company focusing on Corporate Social Responsibility
- Participating or driving relevant clusters – example to participate in Suria 1000 project to brand MMA.
- Utilizing MIDA as partner to support Danish companies within renewable energy

7. References

1) UNFCCC
2) Energy Revolution
3) 9th Malaysian Plan
4) 2000-2010 [MEWC & EPU]
5) The Star, November 22nd 2008
6) IEN Consultants
7) Kyoto agreement
8) Source : IPCC Third Assessment Report. 2001 Climate Change
9) Scientific Basis. Intergovernmental Panel on Climate Change
10) Allan Afuah: “Business Models”, McGraw-Hill Irwin, 2003.
11) CEO of Aumada (www.aumada.com.my)

8. Terms and Abbreviations

Term	Explanation
AC	Air Condition
Annex-I country	A country that has a GHG reduction goal in the Kyoto protocol. Typically a developed country. USA and Australia have not signed the Kyoto protocol are therefore not Annex-I countries.
BIPV	Building integrated Photovoltaic
BOOT	Built Own Operate and Transfer
CAPEX	Capital expenditures
CC	Carbon Credit.
CEO	Chief Executive Officer
CETDEM	Centre for Environment, Technology and Development, Malaysia
CDM	Clean Development Mechanism. http://cdm.unfccc.int
CER	Certified Emission Reduction.
CO_2	Carbon Dioxide (a greenhouse gas).
CR	Combined Renewable
CSR	Corporate Social Responsibility
DANIDA	Danish International Development Agency
DK	Denmark
DNA	Designated National Authority.http://cdm.unfccc.int/DNA
DOE	Designated Operational Entity. http://cdm.unfccc.int/DOE
DSM	Demand side Management
EA	Energy Audits
EB	Executive Board of the UNFCCC CDM.
EC	Energy Commission
EPU	Economic Planning Unit
EE	Energy efficiency
ESA	Electricity Supply Act
ESI	Electricity Supply Industry
ESM	Energy Saving Measures
GEF	Global Environment Facility
GC-BIPV	Grid-connected Building integrated Photovoltaic
GHG	Greenhouse gases
FiT	Feed-in Tariff
IPP	Independent Power Producers
LEO	Low Energy Office
MBIPV	Malaysia Building Integrated Photovoltaic
MEWS	The Ministry of Energy, Water and Communication
MIDA	Malaysia Industrial Development Authority
MITI	Ministry of international Trade and Industry
MMA	Micro & Macro Approach SDN. BHD
MoF	Ministry of Finance

MY	Malaysia
NGO	Non-governmental organizations
PDD	Project Design Document.
PESTEL	Political, Economic, Social, Technological, environmental, Legal
PETRONAS	Petroliam Nasional Berhad
PTM	Pusat Tenaga Malaysia
RE	Renewable energy
RM	Riggent Malaysia
ROI	Return of Investment
SEB	Sarawak Energy Berhad
Solar BIPV	http://www.mbipv.net.my/price2.html
Solar PV	Solar PhotoVoltaic
SREP	Small Renewable Energy Power
SURIA	Name for a program
ST	Suruhanjaya Tenaga
TNB	Tenaga Nasional Berhad
RE	Renewable energy
UN	United Nations
UNEP	United Nations Environment Program.
ZEO	Zero Energy Office

Table 11.

Appendix 1

Questions for the Ministry of Energy

Questions	Response
Information – data	
What do you consider as the most important energy challenges that Malaysia will face in the next 5 to 10 years? **1.1.1 Why these?**	**Challenges:** **1) Fuel Supply Security (due to limited supply of Natural Gas);** **2) Fuel Cost (due to escalation in Coal price)** **3) Environment (contributed by greenhouse gas emissions from burning of Coal and Natural Gas)**
1.1.2 After our meeting with MIDA we understand that renewable energy can help give Malaysia an increased competitive advantage e.g. the new hydro power plant in Sarawak delivering large quantities of cheap, reliable and sustainable energy to high energy demanding industries. What is your opinion of that?	**Sarawak hydro can give large quantities of reliable electricity to Malaysia, but it may not be that cheap for transmission to Peninsular Malaysia.** **Moving energy intensive industries to Sarawak may be an economically attractive option to use cheap electricity in Sarawak.** **Other forms of RE (e.g. agricultural & timber industry as well as solar PV) could also provide a reasonable share of primary energy mix for power generation.** **Of course resorting to cost-justified energy efficiency initiatives, and greater use of co- or tri-generation (electricity, heating & cooling) can help mitigate to some extent the growing demand for secondary energy such a selectricity.**
1.2 Focus on solar energy - solar cells, solar as thermal heater and solar cooling - how do you see this in general?	**Mainly for solar PV – value chain of silicon/wafer/cell.**
1.2.1 What focus does the Ministry of Energy have in this area? Why?	**The Ministry of Energy, Water and Communications (MEWC) is focused on creating a market for issues listed in 1.1 above.**
1.2.2 What solar energy markets/segments do you believe are	Grid-Connected Building Market **Promotes energy efficiency (EE) and demand side management (DSM) which will help reduce peak demand and improve load factor;**

important in Malaysia?	Reduce transmission and distribution losses; No need for land-use which is expensive; Urban areas to meet load demand. Note: Market for off-grid will be limited for the next 5 years (mainly in Sabah/Sarawak) 2. Communications Market: telecommunications tower, relay tower, etc. 3. Manufacturing Market
1.2.2.1 Financial – the incentives are costs related. What are the timelines for payback?	For solar BIPV, the payback > 50 years if there are no incentives offered. More information on average system prices for solar BIPV please visit http://www.mbipv.net.my/price2.html Budget 2009 Incentives: Fiscal incentives are available for companies generating electricity using RE sources either for own use or for sale to the grid; and Exemption of sales tax and import duty on solar PV systems given to importers and exemption of sales tax on purchase of solar heating systems from local manufacturers
1.2.2.2 "Life style product" – people who have perhaps chosen solar energy to show or support renewal energy from a social responsible point of view - or as "luxury"?	For solar BIPV, statistics indicate that those who have chosen to install systems do so for the following reasons: To safeguard the environment; To reduce their electricity bill; and To be able to sell their clean electricity to the utility.
1.2.2.3 Political – is it important for the government to show focus on the area and lead by example?	Yes, it is important. The Ministry has led by example: the Ministry's Building which is a Low Energy Office (LEO) Building installed with 3.3 kWp solar PV, PTM's Zero Energy Office (ZEO) Building is a BIPV showcase with installed capacity of 92 kWp and the upcoming Super Low Energy Office building by ST with approximately 70 kWp solar PV. The GoM committed to implementing the Malaysia Building Integrated Photovoltaic (MBIPV) Project under the 9th Malaysia Plan, in addition to the 5th Fuel Policy and the Small Renewable Energy Power (SREP) Programme. The results of the MBIPV project will lead towards continuous development of the BIPV market under the subsequent Malaysia Plans.
1.2.3 Are you aware of the potential for solar cooling?	Yes.

1.2.4 What is your opinion about integrated building solutions?	Highly recommended. A building integrated PV (BIPV) system will not only produce electricity but will also be an integral part of the building envelope. For example, instead of a normal roof, the PV modules form the roof or maybe part of the window shading device. The cost of the BIPV system will partially be off-set by the cost of the substituted material. In addition, land space for the technology will not pose any issues and BIPV systems will improve the aesthetic value of the building. In Japan, solar housing estates have been successful due to the introduction of industrialized homes where more than 70% of the total installed capacity for solar PV were from pre-fabricated home systems with PV already mounted on them.
1.2.5 What do you consider as the main barriers for using solar energy (thermal, electrically or cooling)?	High capital/investment costs; Lack of awareness or confidence on solar energy; and Lack of enabling environment (no simple end-financing, etc)
1.2.6 What do you consider as main benefit using solar energy?	Source of fuel is free and abundant; Price of solar systems will further reduce in future with advancement in efficiencies of solar cells and technology; and All can enjoy the energy produced from solar-including individuals.
1.2.7 How much annual power would an optimal placed solar cell panel of 1000 kW_p (peak power) contribute in kWh/year? 1.2.7.1 In Denmark it is 850 kwatt hour per year 1.2.7.2 In Southern Europe it is 1800 kwatt hour per year	In Malaysia, it ranges from about 900 kWh/year to 1,400 kWh/year giving an average of 1,100 kWh/year. For more information download reports at: http://www.mbipv.net.my/C3Res.html The average solar irradiation in Malaysia is 4,500 Wh/m2 per day.
1.3 Within the energy sector - who are the stakeholders? 1.3.1 Political	1.3.1 Ministry of Finance (MoF), Economic Planning Unit (EPU), Ministry of Energy, Water and Communications (MEWC), Suruhanjaya Tenaga (ST), Pusat Tenaga Malaysia (PTM), PETRONAS, Ministry of International Trade and Industry (MITI), Malaysia Industrial

stakeholders 1.3.2 Financial stakeholders	**Development Authority (MIDA), Berhad, State Governments.** **1.3.2 Ministry of Finance, Bank Negara, Association of Banks, Private banks, Khazanah Nasional**
1.4 Climate data **1.4.1 How many hours of sun are there on a monthly basis in Malaysia?**	**Daylight of about 12 hours with average peak sun hours of 4.5 hours.**
1.5 What is the goal regarding renewable energy within government?	**9th Malaysia Plan targets 350 MW of grid-connected electricity generated from Renewable Energy (300 MW from Peninsular Malaysia, 50 MW from Sabah).** **A much more ambitious target is under consideration for the next Malayais Plan period and beyond, together with more radical support mechanisms such as a Feed-in Tariff (FiT).**
1.6 How can CDM be applied in the implementation of solar energy?	*For Solar PV, t CO_2 mitigation is defined as the quantity of greenhouse gas emissions that will be avoided by a given PV system. It is calculated by multiplying the energy output of a PV system during its lifetime by the average CO_2 content of the local electricity mix (taken at national level). It is expressed in tons of CO_2 per kWp installed.* Table: EPBT and CO2 Mitigation for Malaysian and Global Applications **Application type** / **EPBT [years]** / **CO_2 Mitigation [ton/ kWp]** Malaysian Roof mounted / 1.6 – 2.2 / 20 – 40 Malaysian Facade mounted / 3.0 – 4.0 / 10 – 20 Global Roof mounted / 1.6 – 3.3 / 0.1 - 40 Global Facade mounted / 2.7 – 4.7 / 0.0 – 23.5 Source: (Jensen, 2006a) **Rule of thumb:** 1 MWh of PV electricity is equivalent to 0.63 tons of CO_2 avoided**.** **Please download the report entitled, “Compared Assessment of Selected Environmental Indicators of Photovoltaic Electricity in Selected OECD Cities and Malaysian Cities” from** **http://www.mbipv.net.my/C3Res.html**
1.7 What do you see as the three most important renewable energies?	**1) Biomass & biogas** **2) Mini-hydro** **3) Solar**

Table: EPBT and CO2 Mitigation for Malaysian and Global Applications

Application type	EPBT [years]	CO_2 Mitigation [ton/ kWp]
Malaysian Roof mounted	1.6 – 2.2	20 – 40
Malaysian Facade mounted	3.0 – 4.0	10 – 20
Global Roof mounted	1.6 – 3.3	0.1 - 40
Global Facade mounted	2.7 – 4.7	0.0 – 23.5

	4) Solid Waste
Political	
2.1 What legislation regarding power supply and energy exist in Malaysia?	**The Electricity Supply Act (ESA)1990**
How is the energy market regulated?	
If you want to start up as a power supplier what barriers exist that you are aware of?	**More information required in order to provide an accurate response.**
Are there any barriers if you want to connect and feed into the grid?	**More information required in order to provide an accurate response.** **This can be done under the SREP programme for RE or the IPP mechanism for bulk power production (through ST & EPU)**
2.2 How do you think solar energy should be rated as an energy form - say compared to nuclear or coal?	**Solar energy should be rated as an important form of peak energy. As part of the RE development under the 5th Fuel Policy, the Ministry of Energy, Water and Communications (MEWC) recognizes the long-term potential of solar energy, especially for PV in buildings. The GoM through the MEWC committed its efforts towards the implementation of the MBIPV Project with the support and assistance from the Global Environment Facility (GEF).**
2.3 Where should the renewable energy effort be focused – in urban areas or rural? **2.3.1 End consumer rural** **2.3.2 End consumer urban** **2.3.3 Industry (manufacturing solar equipment)** **2.3.4 Industry using solar energy**	**The focus should be in urban areas as it is a long term solution.** **2.3.1 End consumer rural - Yes** **2.3.2 End consumer urban - Limited** **2.3.3 Industry (manufacturing solar equipment) - Yes** **2.3.4 Industry using solar energy – Depending on the tariff**
2.4 Today, in rural areas with no power supply (according to the ninth Malaysian plan - Borneo has 80-90 power (electricity coverage)) - have	**Yes,** hybrid systems **(non-grid connected solar energy solutions) have been considered and have already been implemented under Ministry of Rural Development and Ministry of Energy, Water and Communications (with MESITA funding).**

<table>
<tr><td>you considered non grid connected solar energy solutions (decentralized solutions?)</td><td></td></tr>
<tr><td colspan="2">Financial</td></tr>
<tr><td>3.1 We understand that the energy (power) is subsidized. What is the background for this subsidizing? And what are the advantages and disadvantages?</td><td></td></tr>
<tr><td>3.2 What is the consumer tariff for electricity?
3.3 How is the structure?</td><td>For Pen. Malaysia: http://www.tnb.com.my/tnb/tariff/newrate.htm
For Sabah: http://www.sesb.com.my/tariff_rates.cfm
For Sarawak: http://www.sesco.com.my/sesco/english/</td></tr>
<tr><td colspan="2">General</td></tr>
<tr><td>4.1 Do you have any knowledge of companies (producers/ suppliers) within solar energy in Malaysia?</td><td>Yes. Please refer to http://www.mbipv.net.my/C4Res.html and http://www.mbipv.net.my/APVPS.html for more information.</td></tr>
<tr><td>4.2 We have seen that Malaysia uses a lot of chillers - that must be very energy consuming. What are the greenmark recommendations in MALAYSIA?</td><td>MS 1525 states that buildings to consume < 136 kWh/m2 per year to be considered as an EE building.
There is as yet no greenmark mechanism in Malaysia, although steps are ongoing to introduce such a scheme. However, Malaysia has developed energy efficiency (EE) guidelines for non-residential air-conditioned buildings (exceeding 4,000 m2) as Malaysian Standard, MS 1525.</td></tr>
<tr><td>4.2.1 What are your opinion of heat recovery from AC for hot water and district cooling? Or other similar solutions?</td><td>There is potential but it has not been demonstrated yet. Such innovative solutions are definitely worth consideration, if they are cost justified, and particularly if they can be “localized” (for local manufacture).</td></tr>
<tr><td>4.3 Energy supplies - how are energy produced in Malaysia? And what is the split?
4.3.1 Coal</td><td>Table: Electricity generated by type of generator<table><tr><td>Type of generator</td><td>Peninsular</td><td>Sabah</td><td>Sarawak</td><td>Malaysia</td></tr></table></td></tr>
</table>

4.3.2 Hydro power
4.3.3 Gas
4.3.4 Other - if any
4.3.5 Import
4.3.6 Subsidized
4.3.7 Energy - what is the production price of the energy?

4.3.7.1 Is it in any way subsidized?

IPP	6 1.90%	1.90%	2.40%	66.2%
Co-Gen	3.20%	0.50%	n.a.	3.25%
TNB, SESB and SESCO (as generators)	25.70%	1.60%	2.20%	29.5%
SREP	<0.1%	n.a.	n.a.	< 0.1%

Source: Energy Commission 2006 Industry Report

The fuel mix is shown below and indicates that gas is the largest fuel for electricity generation as it represents 64.8% of all fuel used to generate the 103,994 GWh of electricity for 2006.
Table: Fuel Mix

Gas	64.80%
Coal	25.60%
Oil	0.30%
Diesel	1.90%
Biomass	0.60%
Hydro	6.10%
Others	0.80%

Source: Energy Commission 2006 Industry Report

4.3.8 What are the dependencies in energy production in Malaysia (import coal, water for hydro, etc)?

Importation of Coal.

4.4 Energy audits 4.4.1 In the 5 year plan (ninth Malaysian plan) energy audits for energy intensive energy industries are mentioned - can you share information and findings with us?	A number of Energy Audits (EA) have been carried out in government facilities as well as in the private sector industries and commercial facilities. These audits indicate the potential energy savings that can be realized, but little has been done to institute Energy Saving Measures (ESM) in government facilities. A number of private sector users have successfully implemented ESM to benefit from their EE initiatives. Recent revision (enhancements under Budget 2009) of fiscal incentives for EE (& RE) make it more financially attractive for large energy users to adopt EE and RE.
4.4.2 Are there any plans for energy audits for smaller companies - or house holds? Why - or why not?	Proposals for EA have been made on several occasions but the institutional framework does not exist to facilitate such initiatives. A local NGO (CETDEM) has promoted EA for households (under DANIDA supported initiatives) but with little success amongst a small population of households.
4.5 Suria 1000 project 4.5.1 What was the background regarding this interesting project?	The SURIA 1000 project is a component of the MBIPV project. It is a demonstration project to enable the use of building integrated PV systems & to encourage the development of a PV industry in Malaysia, besides "forcing" a reduction in the systems unit cost during the project period. It has succeeded on both counts as 3 major PV manufacturers have established manufacturing facilities in Malaysia, while the unit cost has reduced from about RM 30,000 per kWp to about RM 26,000 per kWp to date. For more information on SURIA 1000, please visit http://www.mbipv.net.my/suria.htm
4.5.2 How was the business case for end-user (auction)?	Analysis of the SURIA 1000 bids are available at: http://www.mbipv.net.my/S3.html
4.5.3 The project ended January 2008 - what was the reason for this? And are there new similar initiatives?	Incorrect. The project has not ended and is currently still on-going upto the end of September 2010. For information on the incentives offered, please visit: http://www.mbipv.net.my/suria.htm
4.5.4 What were the major findings - successes and barriers?	Major findings will be reported upon completion of the MBIPV Project post September 2010. Initial findings show that there is a "willingness to pay" amongst a segment of the Malaysian population to install GC-BIPV sustems, irrerspective of their financial performance. The project

	has also mobilized some housing developers to adopt GC-BIPV as integral features of their high-end housing schemes.
4.6 Infrastructure – power 4.6.1 Which companies are generating the power? National companies or private?	The primary utility companies, Tenaga Nasional Berhad (TNB), Sarawak Energy Berhad (SEB) and Sabah Electricity Sdn. Bhd. (SESB) generate, transmit, distribute and retail electricity. TNB (and its subsidiary SESB) are owned by the Government, SEB is owned by the Sarawak State Government.
4.6.2 If you are a power producer (energy) - can this be sold into the grid?	Yes but subject to negotiations with the utility companies and approval by the Ministry and EPU. Note: Electricity Supply Industry (ESI)-Access & Interconnection: There is no mandatory obligation for the grid operator to grant access and interconnection.
4.6.2.1 What is the "sell back" price to the grid?	Subject to negotiations. If generating from Renewable energy sources, interested parties may apply under Small Renewable Energy Power (SREP) Programme. The 'sell back' price as of Nov. 2008 are: a) Biomass/Biogas at RM 0.21 sen/kWh; b) Mini-hydro and solar at RM 0.17 sen/kWh; and For grid-connected PV (under the MBIPV Project), 'sell-back' price is on net-metering basis with the utility.
4.6.2.2 Any rules or legal issues to be considered?	ESI: Licensing-license is required under section 9 of ESA for any electricity generated and supplied to others (other conditions apply). ESI: Power Purchase Obligation-Retailers will purchase electricity through a negotiated basis – 'willing buyer, willing seller'. ESI: Maintenance – need for registered electrical contractor or a certified competent person according to Electricity Regulations.
4.3 Energy consumption. What is the energy split between factories/industries versus private households? What other segments do you see?	Approximately 83% of all consumers are domestic whilst commercial and industrial consumers make up approximately 16% in 2007. Approximately 80% of electricity consumed (in GWh) is by commercial and industrial consumers whilst 19% consumed by residential consumers in 2007. Other user categories include Mining, Agricultural (from 2006) & Public Lighting.

Future	
How do you expect energy consumption to develop within the next 5 years?	**Energy consumption is expected to develop at a moderate growth rate of 3.5% in average.**