Workshop on Updates on Solar PV Programs in Malaysia

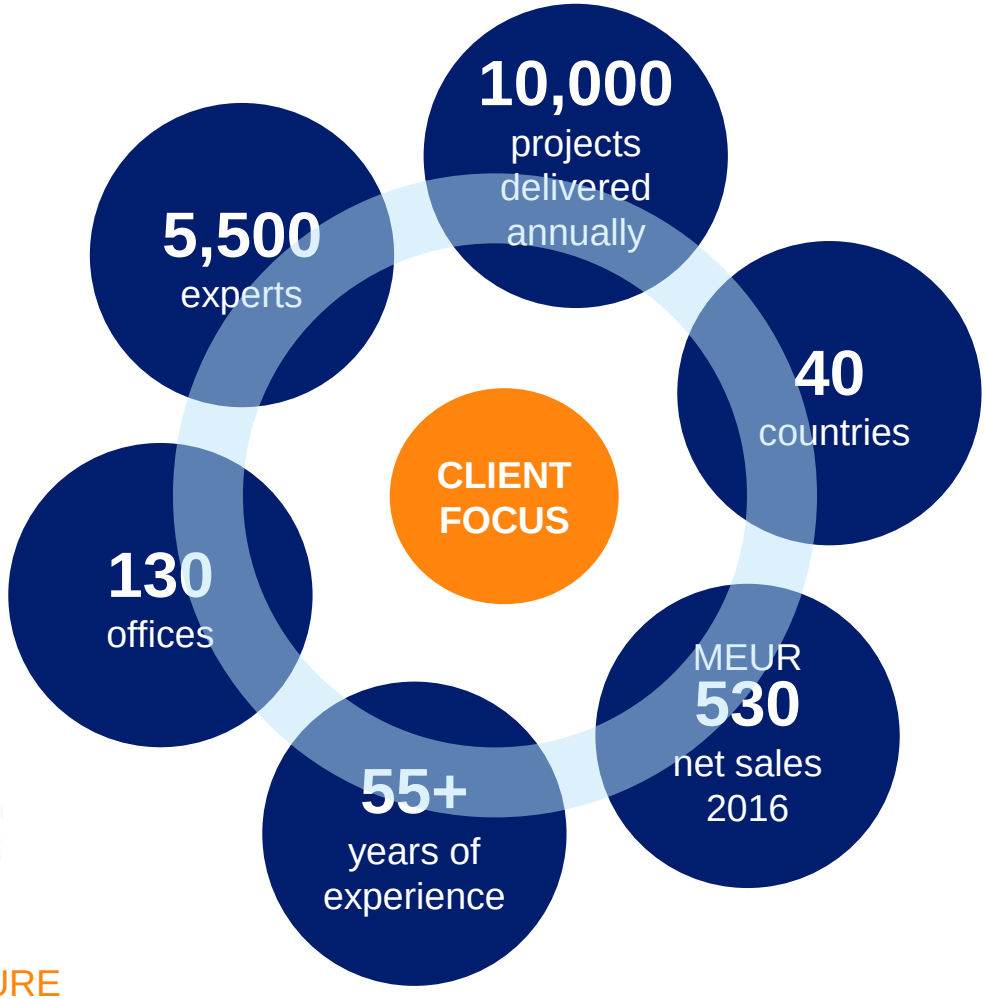
The Sustainable Energy Development Authority Malaysia (SEDA Malaysia)
Malaysian Photovoltaic Industry Association (MPIA)

25 September 2017 (Monday)

Tan Pi Hua

WE ARE PÖYRY – THE CONNECTED COMPANY

Delivering consulting engineering, project execution and operational services.



ENERGY

INDUSTRY

INFRASTRUCTURE

ENGINEERING AND CONSULTING POWER HOUSE

Connecting deep insight and competence across our selected sectors

ENERGY

- Hydropower
- Renewable Energy
- Thermal Power
- Nuclear Energy
- Transmission & Distribution
- Energy Management Consulting

INDUSTRY

- Pulp & Paper
- Chemicals & Biorefining
- Mining & Metals
- Forest Industry Management Consulting

INFRASTRUCTURE

- Transportation
- Water
- Real Estate (Buildings)

PÖYRY

- Energy sector management consulting
- Thermal power
- Renewable energy
- Hydropower
- Power transmission & distribution
- Nuclear energy

* RANKED # 6

in power generation globally *

70%

of Europe's major energy players use our electricity price projections

CONTRIBUTED TO >10%

total hydropower capacity globally

OVER 60 GW

total combined capacity of thermal power plant projects designed & built

INVOLVED IN 200+

solar power projects globally

Consulting. Engineering. Projects. Operations.

* source: ENR 2016 international design firms

WIND AND SOLAR POWER

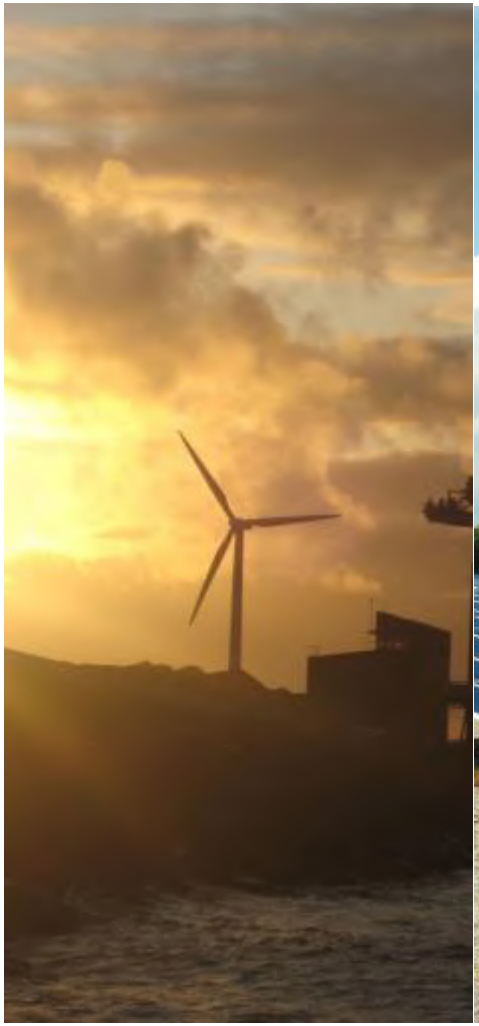
Wind and solar power team in Thailand since 2008

Global competence

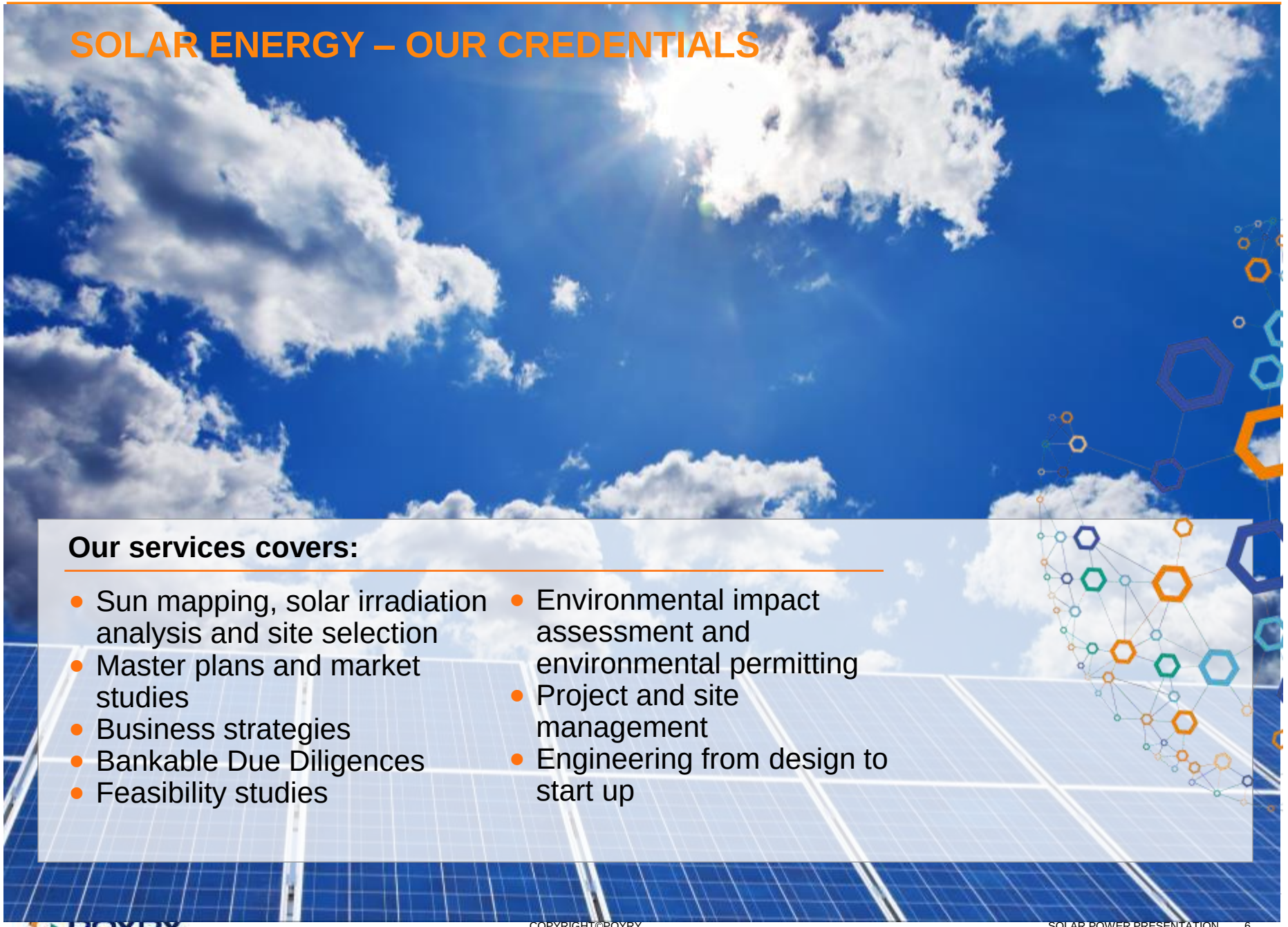
- Solar PV: Involved in more than 200 solar PV project, with more than 10,000 MW in generating capacity
- Wind: Involved in more than 200 wind projects with more than 12,000 in generating capacity

Asia

- One of the leading renewable energy consultants in the region
- 1,000 MW of wind power currently under development or construction



SOLAR ENERGY – OUR CREDENTIALS



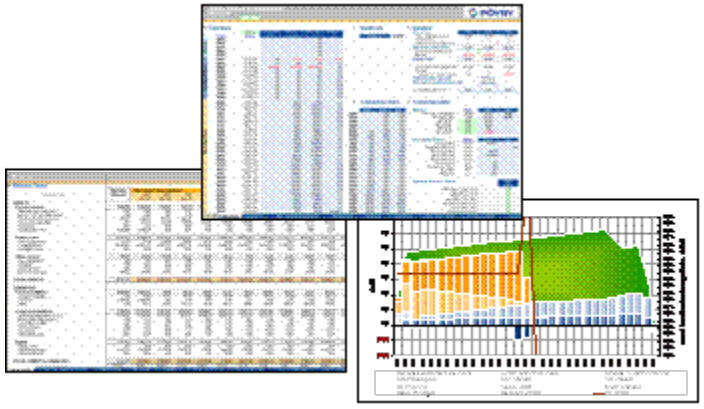
Our services covers:

- Sun mapping, solar irradiation analysis and site selection
- Master plans and market studies
- Business strategies
- Bankable Due Diligences
- Feasibility studies
- Environmental impact assessment and environmental permitting
- Project and site management
- Engineering from design to start up

PÖYRY SERVICES: FEASIBILITY STUDIES

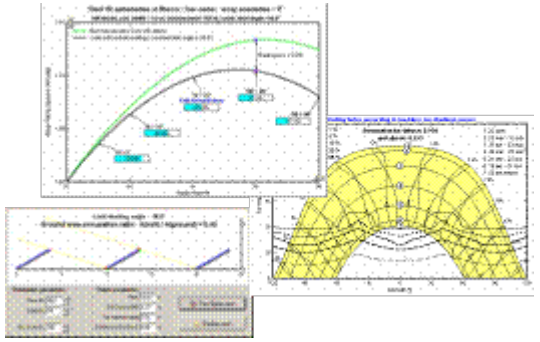
Economical Feasibility Study

- Market analysis and price/tariff projections
- Prepare base case model based on technical information
- Determining the value of the project
- Estimating economical value of risk and design of mitigating measures



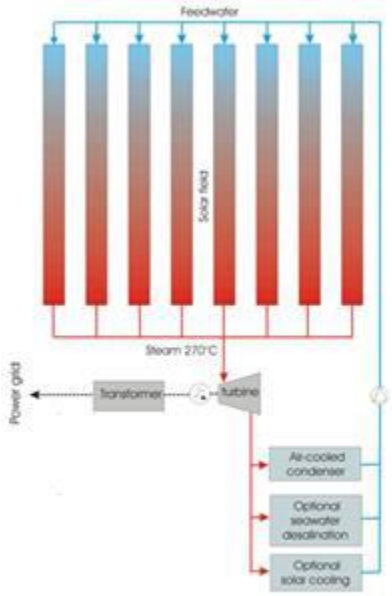
Technical Studies

- Solar Irradiation Measurement Services
- Site analysis and plant engineering
- Permitting support
- Estimating operating issues
  - Capex, opex
  - Technical Guarantees
  - Project planning
  - …



PÖYRY SERVICES: TECHNICAL SPECIFICATIONS AND SUPPLIERS SELECTION

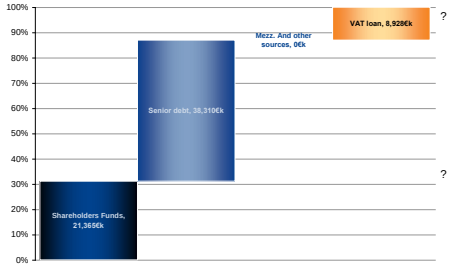
- Drafting of functional specifications for tendering with suppliers
  - Preliminary activities
  - Input data
  - Scope of work and functional requirements
  - Tests
  - Guarantees and Acceptance
  - Design control and training
- Suppliers alignment and selection
- Drafting of MoUs and agreements
- Drafting of EPC and O&M contracts



PÖYRY SERVICES: FINANCIAL NEGOTIATION AND CLOSURE

- Pöyry can coordinate the financing process organising the tender process for the client
- Analysing the different finance structured (Senior debt, VAT, Loan, Mezzanine facility,…)
- Analysing the reputation and experience of the banks
- Ranking the different offers received by the banks, summarising the different terms and conditions of the offer and comparing the effect of the different offers in the IRR of the shareholder.
- Analysing the guarantees required by the fund provided
- Supporting the agent bank when structuring the Project Finance syndication process
- Preparing jointly with the bank the ‘base case’ of the project finance

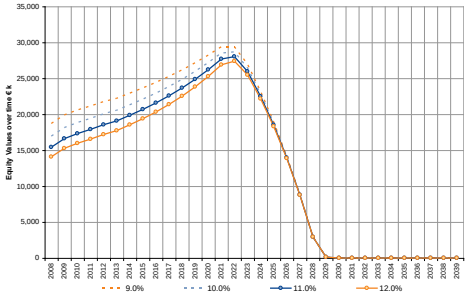
Source of Funds



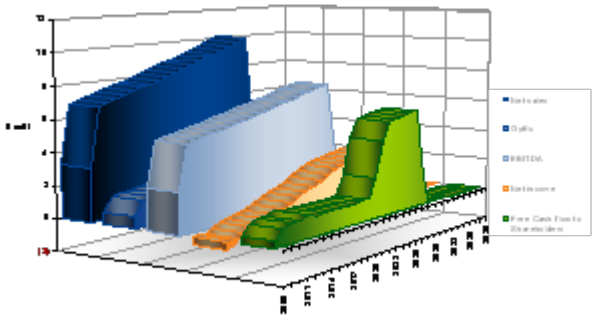
Application of funds (€ k)		
Capex summary	€ k	as %
Tangibles and other	42,281.5	
Dev fee	15,000.0	
Debt related costs	466.1	
Total Capex	57,747.6	96.8%
Prefunded Reserves (DSR)	1,927.8	3.2%
Prefunded Working Capital	0.0	0.0%
Construction VAT	8,928.0	
Total applications	68,603.4	100.0%

Sources of funds (€ k)		
Shareholders Funds	21,365.1	35.8%
Senior debt	38,310.3	64.2%
Mezz. And other sources	0.0	0.0%
VAT loan	8,928.0	
Total Sources	68,603.4	100.0%

Equity Value



Cash flows & Financial



PÖYRY SERVICES: LENDER'S TECHNICAL ADVISOR

Main activities in Lender's Technical Advisor tasks include:

- Technical due diligence
- Construction monitoring
- Review of design changes and variations
- Witnessing performance tests
- O&M monitoring
- Witness the acceptance tests
- Advise the Lenders in all technical and project management issues
- Certify milestones

Picture: Andasol I

SELECTED PROJECT REFERENCES

- 500 MW Solar PV Power Project in Vietnam (TA)
- 29 MW Solar PV Project in Malaysia (IE)
- 29 MW Solar PV Project in Malaysia (OE)
- Solartron 10 MW - 3 Solar PV Power Plants in Thailand (LTA)
- Enmax 10 MW Solar PV Project in in Thailand (LTA)
- EDRA 50 MW Solar Power Plant Project in Malaysia (LTA)
- 2 x 150 MW Solar PV Plant in Myanmar (TA)
- Assessment of market attractiveness for CSP technology in 29 countries (TA)
- 3 PV plants: Karnataka (140MWp aggregate) (TA)
- Halutziot PV plant (55MW) in Israel (TA)
- 4 Solar PV projects in Japan (TA)
- 2 Solar PV plants in Myanmar (TA)
- Tarlac 30 MW Solar PV Project in the Philippines (LTA)
- Roxas 30 MW Solar PV Project (EPCM)
- ESP 129 MW Solar Power Plant Project in Thailand(LTA)
- ESN 126 MW Solar Power Plant Project in Thailand(LTA)
- ESL 127.4 MW Solar Power Plant Project in Thailand(LTA)

ESP SOLAR PV POWER PROJECT, THAILAND

- Client
  - Lenders of EA Solar Phitsanulok including Siam Commercial Bank and other Thai Lenders
- Project:
  - Capacity: 128 MW
  - Location: Thailand
- Services: Lender's Technical Advisory

Period 1: Technical Due Diligence:

  - Review of project contracts, technology, environmental, permits and financial
  - To advise the lenders in technology and project implementation related issues

Period 2: Monitor the Construction

Period 3: Monitor O&M of the Plant and Review Annual Budgets

- Project Period:
  - 2015 - 2026

ESL SOLAR PV POWER PROJECT, THAILAND

- Client (Arial Regular 16 pt., black) :
  - Lenders of EA Solar Lampang, including Siam Commercial Bank, other Thai Lenders
- Project: ESL Solar PV Power Project
  - Capacity: 127 MW
  - Location: Thailand
- Services:

Period 1: Technical Due Diligence:

- Review of project contracts, technology, environmental, permits and financial
- To advise the lenders in technology and project implementation related issues

Period 2: Monitor the Construction

- Construction Progress
- Performance Test

Period 3: Monitor O&M of the Plant and Review Annual Budgets

- Project Period: 2014 - 2025
  - Period 1: Completed
  - Period 2: On-going

SSP PROJECT, SOLAR PV POWER PROJECT, THAILAND

- Client
  - Lenders of Serm Sang Palangngan and Kasikorn Bank and other Lenders
- Project:
  - Capacity: 40 MWAC
  - Location: Thailand
- Services: Lender's Technical Advisory

Period 1: Technical Due Diligence:

Period 2: Construction and Performance Test Monitoring

  - Quarterly site visit for construction monitoring
  - Drawdown certificate
  - Performance test review
  - Certify project completion

Period 3: Operational Monitoring

- Project Period: 2013 - 2024
  - Period 1: October 2013 - February 2014
  - Period 2: March 2014 - Ongoing

ESN PROJECT, SOLAR PV POWER PROJECT, THAILAND

- Client
  - Lenders of EA Solar Nakornsawan including Siam Commercial Bank, Krungthai Bank, Industrial and Commercial Bank of China
- Project:
  - Capacity: 126 MW
  - Location: Thailand
- Services: Lender's Technical Advisory

  Period 1: Technical Due Diligence:

  Period 2: Monitor the Construction
  - Review the turnkey responsibility of EPC contract, key risk factors and performance parameters
  - Review of project contract

  Period 3: Monitor O&M of the Plant and Review Annual Budgets During the Whole Loan Period
- Project Period: 2013 - 2023
  - Period 1: Completed
  - Period 2: May 2013 – April 2014

BSP PHASE 2 PROJECT, SOLAR PV POWER PROJECT, THAILAND

- Client
  - Lenders of Bangchak Petroleum PCL. Including Asian Development Bank and Siam Commercial Bank
- Project:
  - Capacity: 50 MW
  - Location: Thailand
- Services:

Period 1: Technical Due Diligence

Period 2: Construction Monitoring and Certification and Performance Test

Period 3: Operation Monitoring:

  - Report of plant ‘s operation and maintenance
  - Review of project technical assessment, environmental issue, cost performance, financial model
  - Support the lenders to review the annual project operation budget, provide the relevant document and annual report

- Project Period:
  - Period 3: 2012 – 2023

ESN 126 MW SOLAR POWER PLANT PROJECT, THAILAND

- Client
  - Lenders of EA Solar Nakornsawan including Siam Commercial Bank, Krungthai Bank, Industrial and Commercial Bank of China
- Project:
  - Capacity: 126 MW (solar PV plant)
  - Location: Thailand
- Services: Lender's Technical Advisory
  - i) Technical Due Diligence: review project contracts, technology, environmental issues, permits and licenses and financial model and to advise the lenders in technology and project implementation related issues;
  - ii) monitor the construction, test on completion and performance tests, monitor design changes and certify loan draw-downs;
  - iii) monitor O&M of the plant and review annual budgets during the whole loan period for 126 MW Solar PV Power Plants.
- Project Period:
  - 2013

EXPERIENCE WITH MANY OF THE WORLD'S LARGEST LENDERS

LARGE SCALE SOLAR PV POWER PLANT CHALLENGES

- Service Providers / EPCC experiences and technical knowledge limitation
- Limited experiences on documentation
- Products quality and liability challenges in ASEAN region
- Quality of the plant maintenance
- Lender & project company concerns
- Public Education

LARGE SCALE SOLAR PV POWER PLANT CHALLENGES

Service Providers / EPCC experiences and technical knowledge limitation

- Lack of site inspection
  - Soil study, site elevation, available land size, available water, seismic, flood study
- Lack of knowledge on technical design and report.
  - IEC standard, BS standard, MS standard etc.
  - Compliance to local authorities and lenders
  - Details drawing
  - Energy Yield assessment
- Construction methodology details.
- Spare part availability not sufficient.
- Lack of shadow analysis
  - Against land availability, plant performance and product warranty
  - Lack of surrounding object consideration
- Lack of flood protection design
- Road assess availability
  - Efficiency of the engineering work.
  - Fire risk.

LARGE SCALE SOLAR PV POWER PLANT CHALLENGES

Service Providers / EPCC experiences and technical knowledge limitation

- Roles of Owner or Lender's Technical Advisor.
  - Review plant design documents.
  - To ensure the PV plant designed from EPCC according to IEC, BS and MS standard.
  - To ensure the PV designed is safe.
  - To minimize project risk

- Owner or Lender' s Technical Advisor comments level from the report which effected to financial close
  - Acceptable or Approved
  - Acceptable or Approved with condition
  - Recommended / suggested / considered
  - Strongly recommended / suggested / considered
  - Rejected / Reworked

LARGE SCALE SOLAR PV POWER PLANT CHALLENGES

Limited experiences on documentation

- Conceptual design report
  - Site selection criterial list
  - Site characteristic before and after include site preparation
  - Design methodology based on IEC/ BS / MS.
  - Drawings are not consistent among documents.
  - Energy Yield assessment information not consistent to components warranties / guarantees statement.
  - QC / QA control Methodology.
  - Project construction schedule strategy
  - Project management team include number of worker for each task
  - Components' certification & warranties / guarantees
- Construction Progress Report
  - Percentage task completed and non –completed
  - Challenges / solutions
  - Delivery schedule time
  - Parts Quantity report
  - Safety report
  - Quality control report include damages.

- Manpower efficiency & man-hour report
- Training program
- Work planning report
- Testing & Commissioning report
- Punch list
- Updated construction drawing

LARGE SCALE SOLAR PV POWER PLANT CHALLENGES

Limited experiences on documentation

- Operation & Maintenance Monitoring monthly report
  - Plant availability report
  - Components failure report
  - Plant performance report
  - Plant generation report
  - Components spare part list updated report
  - Insurance
  - Expenses & budget planning report
  - Maintenance planning schedule

LARGE SCALE SOLAR PV POWER PLANT CHALLENGES

Limited experiences on documentation

- Roles of Owner or Lender's Technical Advisor.
  - To ensure plant design upto international high standard.
  - To ensure plant liability in good condition and generate revenue
  - To make sure the O&M team well care the plant
  - Process Technical Due Diligence.
  - Process Independent Energy Yield Assessment.
  - Process Construction monitoring report.

LARGE SCALE SOLAR PV POWER PLANT CHALLENGES

Products quality and liability challenges in ASEAN region

- Products issues
  - PV module power failure
  - Module discoloration
  - Junction box in fire
  - Inverter functioning failure
  - Lightning protection failure
  - Earthing failure
  - Mounting structure corrosion or collapse
  - Monitoring failure
  - Connector damage.
  - Soil erosion

- O&M roles
  - To ensure plant availability is high (99%)
  - Non availability report and losses
  - Repair schedule.
  - Maintenance strategy plan
  - Month performance report
  - Cleaning progress
  - Water quality control
  - Component function check (Quarterly or Yearly)

LARGE SCALE SOLAR PV POWER PLANT CHALLENGES

LARGE SCALE SOLAR PV POWER PLANT CHALLENGES

LARGE SCALE SOLAR PV POWER PLANT CHALLENGES

Lender & Project Company concerns

- Lender Concerns
  - Plant and component liability and availability
  - EPC and suppliers experiences
  - EIA and Authorities approval
  - System compliance
  - PPA agreement
  - Project milestone schedule
  - Maintenance planning
  - Project bankability

- Project Company Concerns
  - Project CAPEX and OPEX
  - Experiences of EPC and Suppliers
  - System compliance
  - Project Financial Close
  - Project and equity IRR and bankability

LARGE SCALE SOLAR PV POWER PLANT CHALLENGES

Public Education

- Lack of information solar PV system to public.
- Lack of solar PV system research.
- Current education focus on material research.
- Lack of written report experiences.

- Solution
  - Industrial, NGO, Financial Institution and Education Research Center should to bridge together by SEDA, ST, SIRM and MIGHT to work closely.
  - Beside Industrial Road Map, the policy maker should create industrial and education research road map.
  - Organize more written solar PV system report workshop.
  - Organize more PV system simulation workshop.

SUMMARY

Large Scale Solar PV power Plant Challenges

- Follow IEC / BS / MS standard to avoid negative comments from Owner's or Lender's Technical Advisor.
- Work closely with principle engineering such Electrical, Mechanical, Civil etc.
- IFC report suggestion need to be consider.
- Do more research on PV system collaborate with University / Institution.
  - Such as UTeM, UniTen and UiTM
- Encourage SEDA, MPIA and IPT work closely and organize such as Solar PV System conference paper or journal paper.

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