Agenda

• Introduction – CSR & Energy Consulting
• Myanmar Electricity Planning study
• Grid Connected Technologies
• Off-Grid Technologies
  ✓ Biomass
  ✓ Solar
GE CSR – Scope, progress and updates

• June ’13 - $7 million commitment for training and capacity-building

• GE Corporate Programming
  • Leadership development - MELP
  • Advancing the Rule-of-Law

• Healthcare programming
  • Maternal and infant care
  • Rural healthcare pilot project
  • Biomedical engineer training program
  • Yangon General Hospital – New Training Center

• GE Power & Water Programming
  • Electricity planning study
For nearly a century ... Solving global electric power industry's most pressing challenges ... driving greater affordability, reliability, and efficiency
Myanmar electricity planning study
Summary of proposed scope

<table>
<thead>
<tr>
<th>Rationale</th>
<th>Purpose</th>
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<tr>
<td>• Myanmar is on a path of growth that requires the evolution of the energy sector to power the growing economy</td>
<td>To aid in developing a practical implementation roadmap to transition the current power system into a sustainable driver for economic growth.</td>
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<td>• GE committed to deliver components of an electricity master plan as part of Corporate Social Responsibility and at the request from the senior gov’t officials</td>
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<td>• GE is focusing on Electric Power System planning and expansion, design, engineering, operation and regulatory structure</td>
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**Themes**
- Education and training
- Generation and transmission planning
- Distribution System Planning and Engineering
- Electricity Structure, Regulation and Policy
- Technologies for Rural Electrification.
- Best practices across all areas
Capacity building - Education and training

- Customized training courses for engineers, system operators and planners in MOEP, MOE, MOI, MNPED, YESB and private companies in Myanmar

- Course content from the **Power Systems and Energy Course** (PSEC) offered to a global audience at GE’s world-class Energy Learning Center located in Schenectady, New York.

- PSEC has a respected 64-year history of developing the world’s energy leaders

### Modules proposed

- Power System Fundamentals
- Transmission Planning and Analysis
- Distribution Systems Planning and Engineering
- Strategic Generation Planning
- Power Plant Financial Modeling and Evaluation
- Distributed Energy, Renewable Energy, Energy Storage and other Alternative Energy Applications
Generation, transmission and distribution planning

Development of Myanmar grid model (66kV and above)
– Transmission system analysis...load flow, contingency and short circuit study

Generation and transmission system planning
– Demand forecasting
– Future plan and scenario development
– Representative practices in generation and transmission planning

Distribution system planning and engineering
– Representative model development
– Distribution load flow analysis
– Distribution reliability assessment
– Review of operating and maintenance requirements

Electricity sector structure, regulation and policy
– Myanmar grid code
– Representative practices for electricity structure, regulation and policy
Technology solution for rural electrification

Evaluation of suitable technologies for rural electrification
– Development of village power or micro-grid applications for areas with limited grid connectivity, based on GE’s technology experience in other parts of the world.

Technology options for rural electrification
– Biofuels or Biomass based distributed generation
– Wind turbine based generation
– Diesel generating sets (as a standby option)
– Small hydro
– Solar Photo Voltaic (SPV) based generation
– Hybrid option (a combination of the above technologies)

Best practices
– Identification of rural electrification projects implemented successfully in other countries including development of micro-grids for rural electrification.

Regulatory and policy recommendations
– Broad overview of required policy and regulatory framework to incentivize the implementation of rural electrification projects in Myanmar.
Grid Connected & Off-Grid Generation Technologies
Types of power generation cycles

Power Generation cycles

- Power only
  - Fossil fuel
    - Gas Turbine (Simple cycle)
    - Steam Turbine
    - Combined Cycle
    - Diesel Engine
    - Fuel Cell
  - Renewable Energy
    - Hydro Turbine
    - Wind Turbine
    - Solar
    - Wave / Tidal
    - Biomass
    - Geothermal
  - Nuclear
    - Nuclear steam turbine
- Cogeneration (Power and Heat output)
  - Diesel Engine
  - Steam Turbine
  - Gas Turbine (Simple cycle)
  - Fuel Cell

Parameter | Adv. CC | Coal | Nuclear | Wind | Hydro
--- | --- | --- | --- | --- | ---
Efficiency | 🟠 | 🟠 | 🟠 | N/A | N/A
Capital cost | 🟠 | 🟠 | 🟠 | 🟠 | 🟠
Emissions | 🟠 | 🟠 | 🟠 | 🟠 | 🟠
O&M cost | 🟠 | 🟠 | 🟠 | 🟠 | 🟠
Capacity factor | 🟠 | 🟠 | 🟠 | 🟠 | 🟠
Biomass gasification Solution...
Overall integration is a key for success

Fuel Procurement
- Tree Fronds
- Woody Biomass
- Bagasse

Fuel Processing
- Briquetting
- Drying
- Increase fuel envelop

Gasifier + Gas Clean up
- By Products
  - Activated carbon, Charcoal
  - Increase NPV

Gas Engine
- Waste Heat
  - Refrigeration
  - Heating
  - ORC

Key Guarantee Wrap parameters

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<tr>
<th>Power Output</th>
<th>Specific Fuel Consumption</th>
<th>Emissions</th>
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<tr>
<td>kWhr</td>
<td>Kg/Whr</td>
<td>Gas/Liq/Solid</td>
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Off grid solar PV System Applications

Solar Direct Systems
- Water Pumps
- Fans

Stand Alone DC System
- Message Board
- Street Lights
- Traffic Monitoring

Stand Alone AC System
- Remote Homes
- Non Grid Connected systems

Grid connected solar PV System Applications

Grid Connected Battery Backup system (10-1000kW)
- Homes
- Businesses

Grid Connected System (10-1000kW)
- Homes
- Businesses

Utility Power On - System sells power back to the utility company when load < supply
Utility Power Off - System Shuts down for Safety, Anti-islanding protection

Utility Scale System (10-1000kW)
- Small – Large scale utility