



# Grid and Off Grid Electrification

Energy Consulting  
20 March 2014

**Imagination at work.**

# 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**



# GE Energy Consulting

Centers of Excellence with Global Reach

## Power Economics

Policy & Planning

Investment Analysis



## Power Systems Operation & Planning

Transmission & Distribution

Commercial & Industrial



## Global Power Projects

Thermal & Renewables

Controls & Communications



## Software

Commercial Software

Specialty Software



## Education

Power System Energy Courses

Customized Training



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

## Rationale

- Myanmar is on a path of growth that requires the evolution of the energy sector to power the growing economy
- 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
- GE is focusing on Electric Power System planning and expansion, design, engineering, operation and regulatory structure

## Purpose

To aid in developing a practical implementation roadmap to transition the current power system into a sustainable driver for economic growth.

## 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





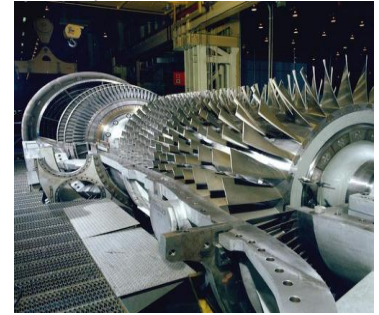
# Generation, transmission and distribution planning

## 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

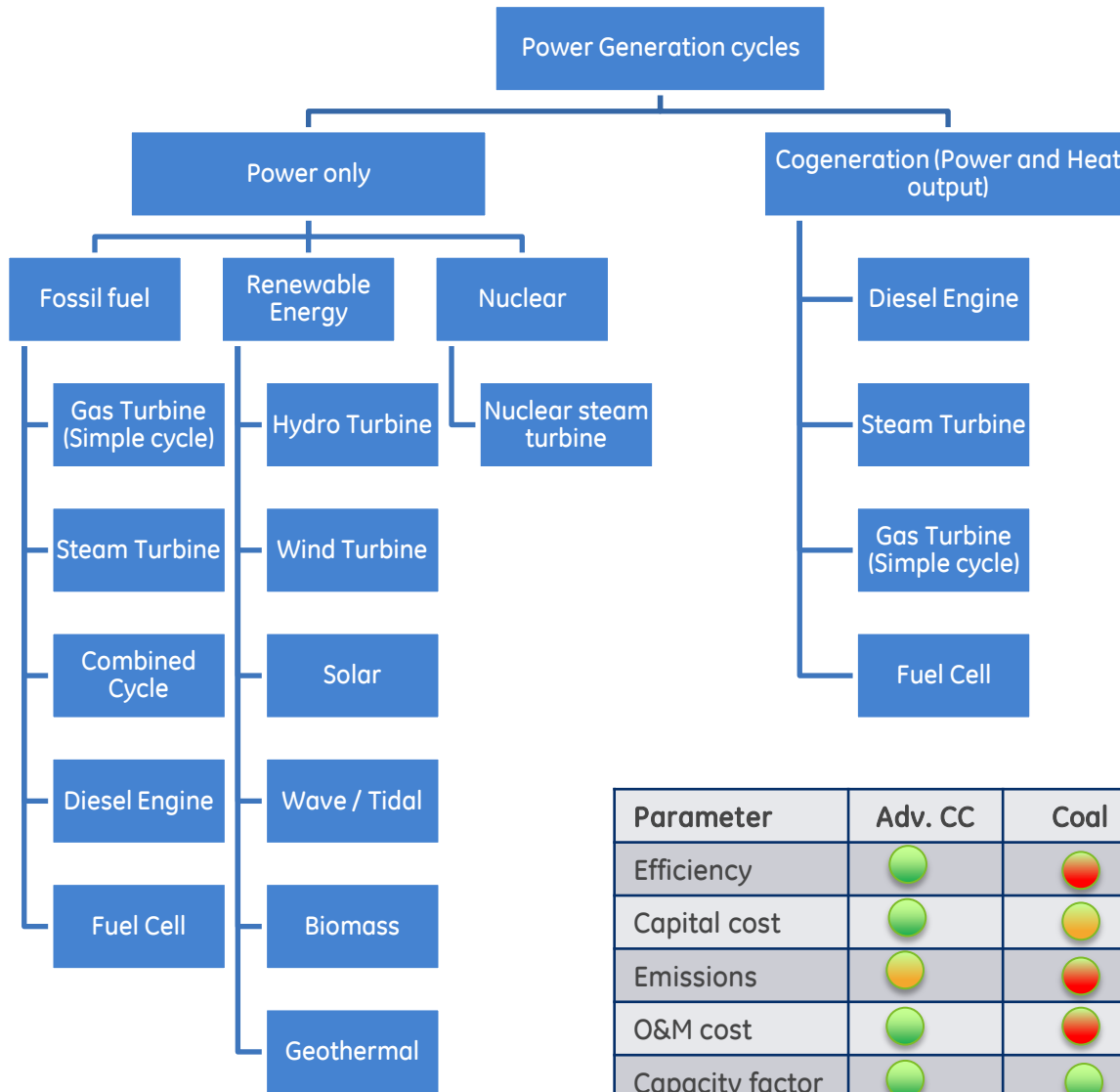
- Broad overview of required policy and regulatory framework to incentivize the implementation of rural electrification projects in Myanmar.



# Grid Connected & Off- Grid Generation Technologies



# Types of power generation cycles

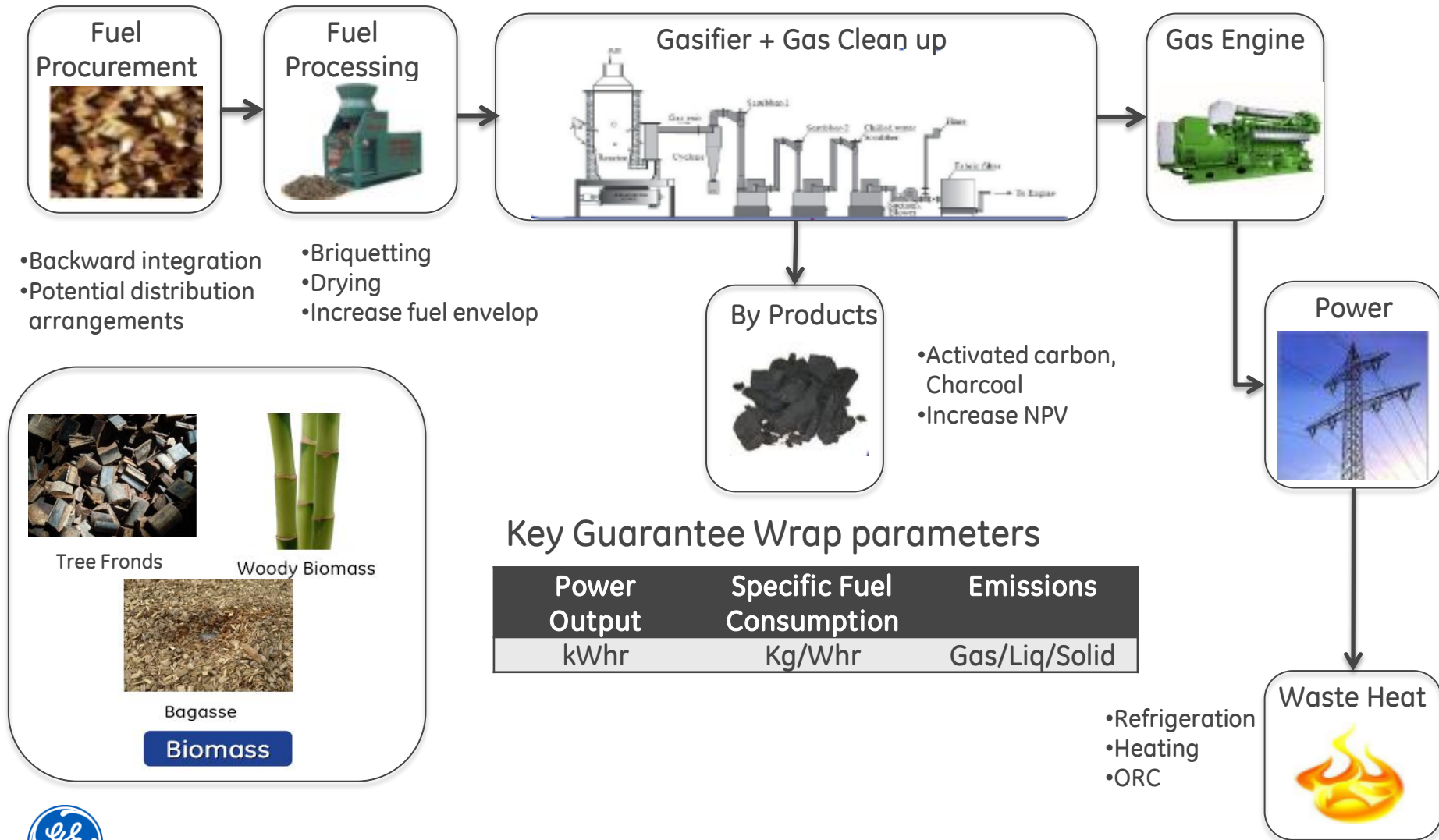


Parameter	Adv. CC	Coal	Nuclear	Wind	Hydro
Efficiency	●	●	●	N/A	N/A
Capital cost	●	●	●	●	●
Emissions	●	●	●	●	●
O&M cost	●	●	●	●	●
Capacity factor	●	●	●	●	●



# Biomass gasification Solution...

## Overall integration is a key for success



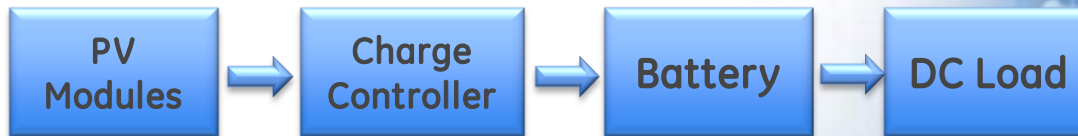


# Off grid solar PV System Applications



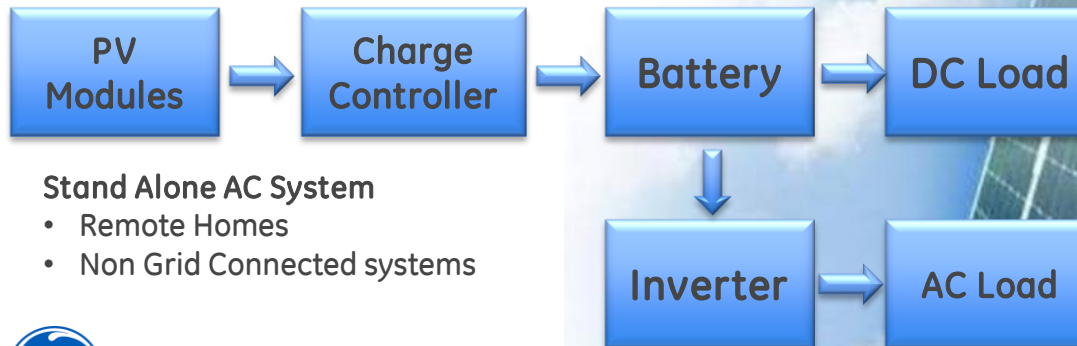
## Solar Direct Systems

- Water Pumps
- Fans



## Stand Alone DC System

- Message Board
- Street Lights
- Traffic Monitoring



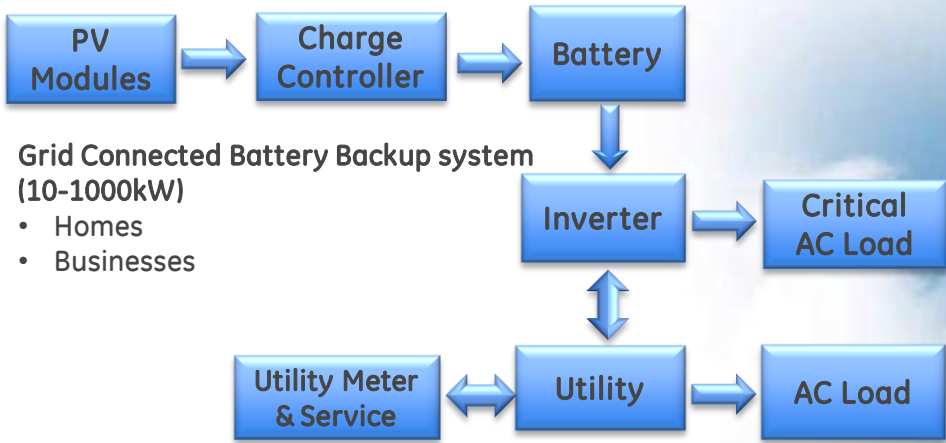
## Stand Alone AC System

- Remote Homes
- Non Grid Connected systems

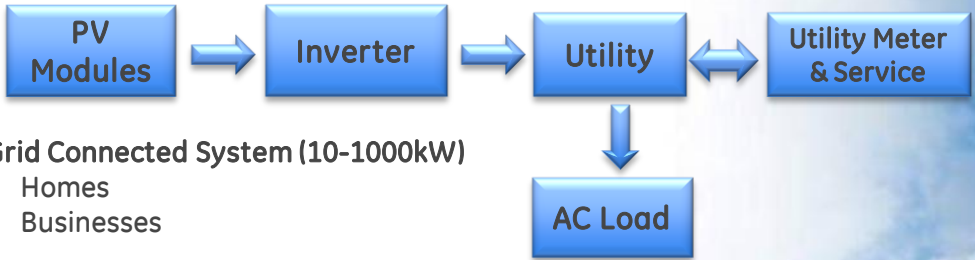




# Grid connected solar PV System Applications

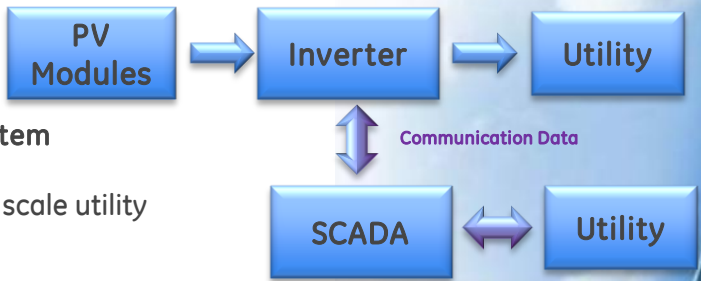


**Grid Connected Battery Backup system (10-1000kW)**  
 • Homes  
 • Businesses



**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



