

Chapter 1

Introduction

1.1 Rural Electrification

Increasing demand of energy and negative impacts of fossil fuels on the environment has emphasized the need of harnessing energy from renewable sources. These sources can create a significant impact in the generation of grid electricity.

55.4 million of people live in Union of Myanmar, but 70 percent of people live in rural areas and earn a living based on agriculture. There are plenty of biomass and agricultural by-products in the country. In order to reinforce the present national grid system and to facilitate power transmission from new generating stations, Ministry of Electric Power (MEP) carried out 21 transmission line projects at present and planned more transmission line projects to be implemented in the near future.

The information below, currently found on the website of the Myanmar Ministry of Energy, has not been updated since the Ministry of Electric Power was reconstituted as two separate ministries in May 2006. However, the data provides a useful picture of the Ministry and its resource as they existed in 2000 and is useful for historical purposes. It also includes map, Figure 1.1 is the locations of 29 hydro-electric projects then on the drawing boards.

The generation of electricity from hydropower plants during 1999-2000 has been approximately 959.46 million kWh constituting about 21 percent of the total power generation. MEP has developed hydropower projects mostly in remote border areas. The electricity generation in Myanmar increases two folds during the last 10 years. As a statistical statement, the figures are not updated and according to the estimation in year 1999-2000, 80 percentage of the total power generation are still in progress with many projects of government.

However, electrical power cannot be distributed to many rural areas in Myanmar. In rural areas, various forms of energy are used. These areas do not have access to electricity; people use wood, charcoal, bamboo, and rice hull for cooking and candles, kerosene lamps for lighting at night. They also use engines and

generators to produce electricity for lighting. Therefore, a rice husk gasifier was constructing operated and studied in 2007.

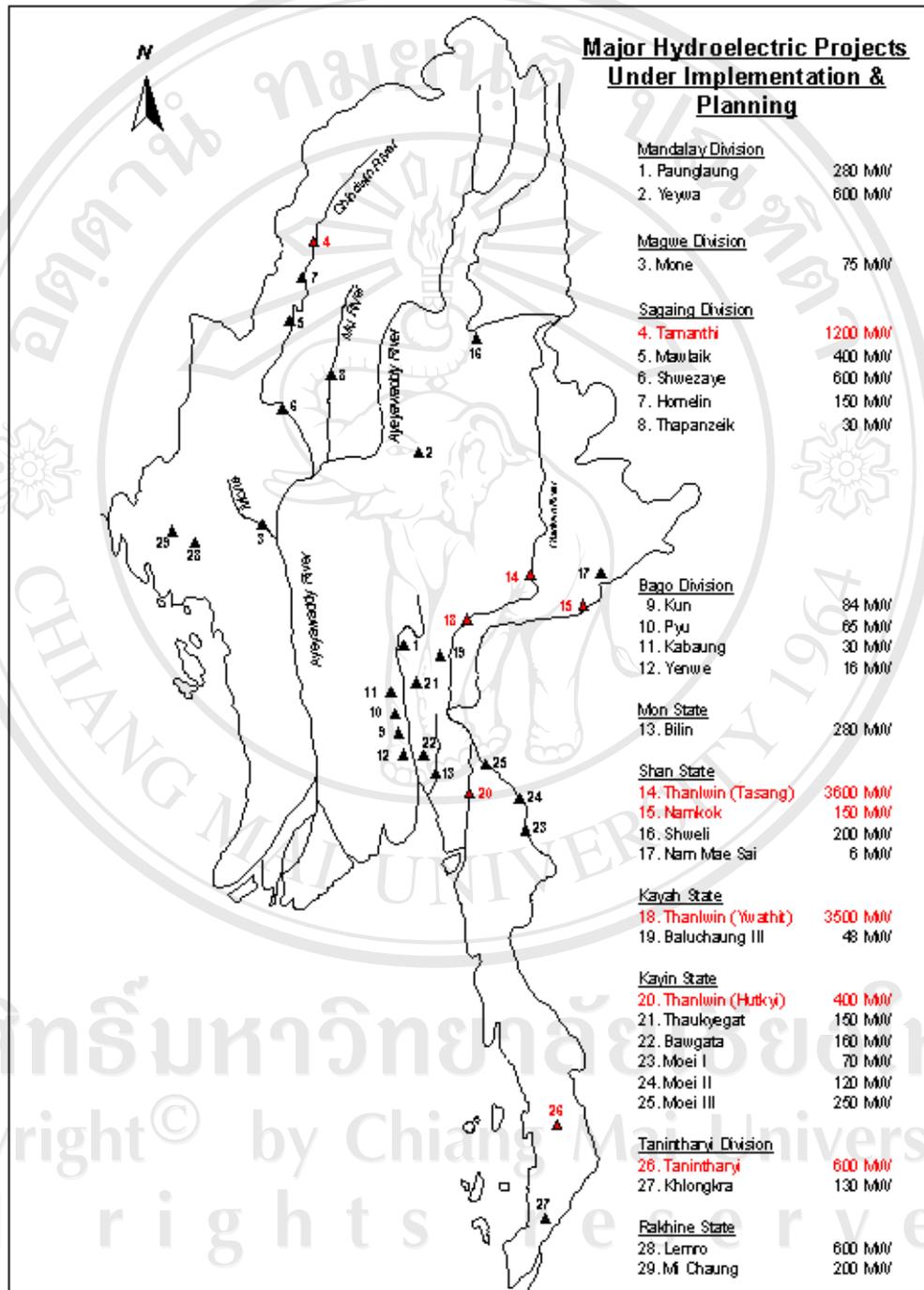


Figure 1.1 Hydropower Potentials of Myanmar (State and Division Wise)

Biomass gasification is basically a conversion of solid biomass into a combustible gas mixture normally called “Producer Gas” (or low Btu gas). The process involves partial combustion of biomass. Partial combustion produces carbon monoxide (CO) as well as hydrogen (H₂) which are both combustible gas. Solid biomass fuels, which are usually inconvenient and have low efficiency of utilization can thus, be converted in to a high quality gaseous fuel.

From cooperation project in energy related projects between Thailand and Myanmar under Ayeyarwaddy - Chaophaya - Mekong Economic Cooperation Strategy (ACMECS), the Government of Thailand has approved financial assistance on study and demonstration of biomass gasification for electricity project. The project aims to provide electricity to a local community in Myanmar in order to improve their living standards. A community in Twantay Township, Dagoon Daing Village, was selected. The community consists of two villages, which are Dagoon Diang Village and Alehsu Village. A rice hull gasification unit is constructed and operated. The gasifier is coupled with a diesel engine to drive an electric generator. An electricity grid and street lighting were installed in the community. The system is able to distribute electricity to 304 houses with the population of 1,496 people.

1.2 Literature Reviews

1.2.1 Small distributed generation

Distributed generation (DG) has been defined in many ways, creating some confusion in terms of regulatory rule applicability. It is most commonly defined as the generation of electricity near the intended place of use. Some parties define it with size limitations, other exclude back up generation, and yet others make no distinction between generation connected to the transmission system or the distribution system. The Energy Commission assumes the following definition: DG is electric generation connected to the distribution level of the transmission and distribution grid usually located at or near the intended place of use. (M. Marks, 2002)

For this report, staff defines DG as electricity production that is on-site or close to a load center and is interconnected to the utility distribution system. In practical terms, this limits the definition of DG to less than 20 megawatts (MW) since

systems larger than this would typically be interconnected at sub-transmission, or transmission system voltages. (M. Rawson and J. Sugar, 2007)

The performance and impact of a decentralized biomass gasifier-based power generation system in an unelectrified village are presented. The system consists of a 20 kW gasifier-engine generator system with all the accessories for fuel processing and electricity distribution. Technical, social, economic and management-related lessons learnt are presented. (N. H. Ravindranath, H. I. Somashekar, S. Dasappa and C. N. Jayasheela Reddy, 2004)

1.2.2 Biomass gasification

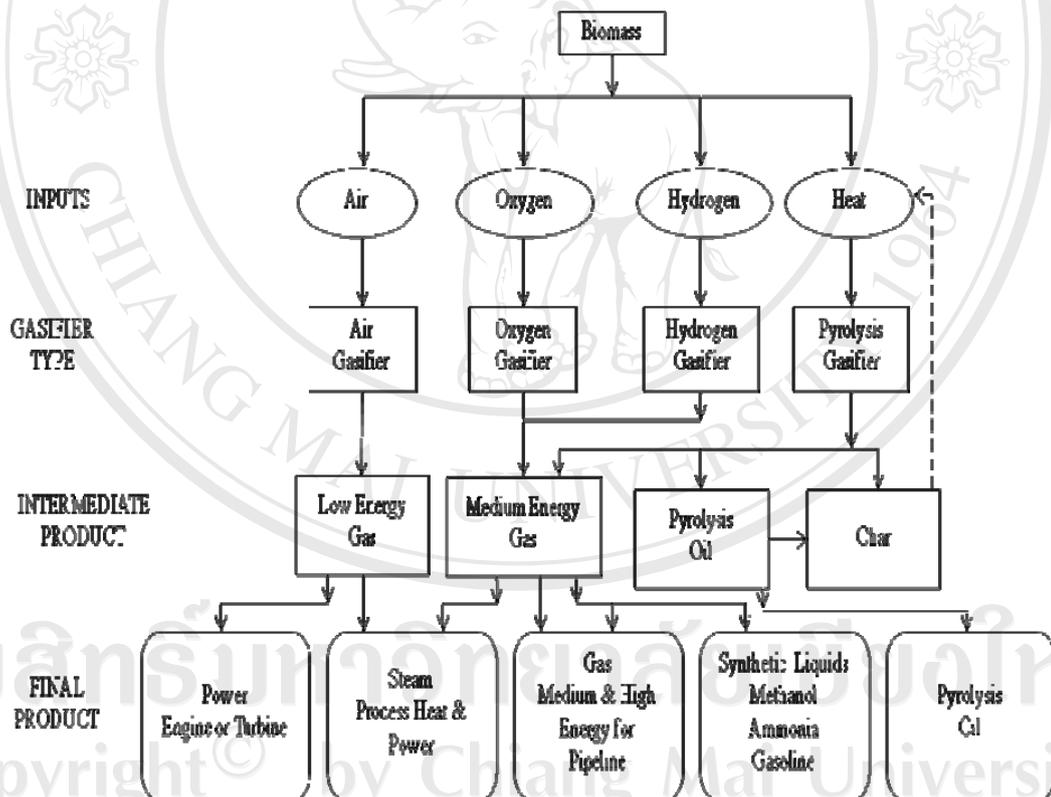


Figure 1.2 Gasification Processes and products

Handbook of biomass downdraft gasifier engine system explains how biomass can be converted to a gas in a downdraft gasifier and gives details for designing, testing, operating, and manufacturing gasifiers and gasifier systems. Criteria include gasifier application, the availability of suitable equipment, biomass fuel availability

and fuel-source reliability, regulations, operator availability, and of course cost and financing.

The spark ignition engine operating on gasoline achieves a thermal efficiency of 25%-30%. The same engine operating on producer gas may achieve 15%-25% thermal efficiency, depending on how well the engine is converted to producer gas. A diesel engine using diesel typically achieves 30%-35% thermal efficiency. Operating on 90% producer gas, it can be expected to give 25%-30% thermal efficiency. The overall efficiency of the system must be computed from engine efficiency and gasifier efficiency. (T. B. Reed and Agua Das, 1988)

The efficiency of the engine-generator set was generally lower and the total energy input to the engine was always higher on the dual fuel operation. The maximum engine-generator set efficiency with dual fuel operation achieved was 14.71%, while pure diesel operation gave 22.41% efficiency for the same load. (S.C. Bhattacharya, S.S. Hla, H.L. Pham, 2001)

Biomass gasification for obtaining gas and further the liquid fuels, of course, will be a very good alternative because of the introduction of renewable energy concept. There are several kinds of gasification processes in accordance with the different gasification agent. (L. Wei-ji, Z. Da-lei, R. Yong-zhi, 2002)

Coal, wood and charcoal gasifiers have been used for operation of internal combustion engines in various applications since the beginning of this century. A major problem could result from the slow carbon build-up in the engine's cylinders as a consequence of traces of tar or dust in the gas. Whether this is due to too low engine loads or to a defective glass fibre cloth filter remains to be tested. (B. Kjellstrom, 1986)

Studies on the effect of size, structure, environment, temperature, heating rate, composition of biomass and ash are reviewed. From the foregoing review, the following observations could be arrived at: Biomass is a compound consisting of C, H, and O in major quantity. The composition of C, H and O is more or less same in all biomasses. The calorific values are also nearly same. Environment results in pyrolysis or complete gasification of biomass. Heating rate influence the quality of gasification and quantity of products. Porous biomasses are gasified completely into ash at

temperatures less than 600° C. (V. Kirubakaran, V. Sivaramakrishnan, R. Nalini, T. Sekar, M. Premalatha, and P. Subramanian, 2007)

Surveys of rural household energy use activities incorporating the production and utilisation of woody biomass, and of the forest products industries incorporating forest harvesting, wood processing and residues generation, were undertaken to assess the availability of wood biomass that could be utilised in biomass-electricity systems in Kenya. Biomass gasifier demonstration programmes should give preferences to sites where adequate technical skills, sufficient fuel resources, and skilled operator availability coincide with direct economic interests. Specific sites meeting these criteria for small scale biomass-electricity systems were identified in this study. (K. Senelwa, Ralph E.H. Sims, 1999)

The principals of gasification, and old and new types of gasifiers, are discussed for both power and heat applications. The downdraft gasifier may be summarized as follows;

- High amounts of ash and dust particles remain in the gas because the gas has to pass the oxidation zone, where it collects small ash particles.
- The moisture content of the biomass must be less than 25 percent (on a wet basis).
- The relatively high temperature of the exit flue gas results in lower gasification efficiency.

The main difficulties are in the gas cleaning systems (preferably at high temperatures) and meeting all requirements set by gas turbine manufactures in adapting gas turbine to low calorific gases. (P. Quaak, H. Knoef, H. Stassen, 1998)

The slow pyrolysis of rice husk has been investigated at temperature of 350°C to 450°C. The primary results are the following:

- (a) An average yield of 10% dry tar, 27% water, 18% gas and 45% char.
- (b) The charred rice husk has a slightly higher heating value of 16 MJ kg⁻¹ compared to 15.3 MJ kg⁻¹ for rice husk.
- (c) The energy fraction lost due to charring amounts to 45-55% on a dry basis.
- (d) The rice husk char consists of approximately 45% ash, 45% carbon and 10% remaining volatiles.

Rice husk ash does have a very high softening temperature ($>1400^{\circ}\text{C}$), but nevertheless tends to slag if the fuel bed structure is disturbed by high superficial gas velocities. (A. Kaupp, 1984)

The rice husk gasification use of a water jet scrubber gives a satisfactory tar removal from the producer gas. This gasification unit is very simple to be operated by a low skill operator. The main tack in order to maintain the satisfactory gasification process is the regular cleaning of the gas cleaning and cooling as well as piping line. The use of rice husk as an energy substitution by means of the gasification process can reduce the diesel oil consumption by 70%. A particular economic analysis shows a big opportunity to supply electricity profitably by using this system. (R. Manurung, H. Susanto and Sudarno H., 1986)

1.2.3 Impacts on people

Electricity for lighting in all houses has helped school-going children in their studies and women in their household chores. The unique feature of the project in Hosahalli is equitable sharing of benefits by all the households and reliable provision of services on most days in a year, contributing to improved quality of life for all. (N. H. Ravindranath, H. I. Somashekar, S. Dasappa and C. N. Jayasheela Reddy, 2004)

In the present study, potential assessments of all the available energy sources is carried out and found that the conventional diesel power plant can be replaced by renewable energy sources in self-sustainable manner to achieve energy independent in a remote island. It is suggested to replace existing 400kW diesel generating plant and 50 kW solar power plant by 100 kW biogas power plant, 150 kW biomass gasification plant and 200 kW solar PV system. Such development will also ensure that there is no adverse impact on environment and socio-economic life of the habitants. (S.K. Singal, Varun, R.P. Singh, 2007)

1.3 Objectives

The required necessary information for self-electricity and to develop model of rice husk gasification in rural region of Myanmar are vital intentions for this project and specified ranges are as follows;

- To survey energy related data of rural villages for power plant installation

- To test the gasifier power plant
- To evaluate economic and social impact on villager's livelihood

1.4 Scope of the thesis

- ❖ The study focuses on three types of biomass only.
- ❖ The study site is in Yangon, Myanmar.
- ❖ The power plant is community sized of 50 kW.
- ❖ Compare technology and cost between systems with diesel and diesel/producer gas as fuel.
- ❖ Analyze technical and social-economic of the system.