ADB Capacity Development Technical Assistance (CDTA)

Republic of the Union of Myanmar:
Institutional Strengthening of National Energy Management Committee in Energy Policy and Planning

/ DRAFT / **Myanmar Renewable Energy Policy**

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Japan Fund for Poverty Reduction

CONTENTS

Page

CURRENCY EQUIVALENTS (as of 1 April 2014)

Currency unit – Myanmar Kyat (MMK)

MMK	1.00	=	US$	0.00104
US$	1.00	=	MMK	962.973
EUR	1.00	=	MMK	1325.79

ABBREVIATIONS

ADB	–	Asian Development Bank
EDC	–	Energy Development Committee
EMP	–	Energy Master Plan
FES	–	Fuel efficient stove
FIT	–	Feed in tariff
GoM	–	Union Government of Myanmar
MoAI	–	Union Ministry of Agriculture and Irrigation
MoE	–	Union Ministry of Energy
MoECaF	–	Union Ministry of Environmental Conservation and Forestry
MoI	–	Union Ministry of Industry
MoM	–	Union Ministry of Mines
MoEP	–	Union Ministry of Electric Power
MoLFaRD	–	Union Ministry of Livestock, Fisheries and Rural Development
MoST	–	Union Ministry of Science&Technology
MES	–	Myanmar Engineering Society
NEMC	–	National Energy Management Committee
NEP	–	National Energy Policy
NGO	–	Non-Government Organization
OBA	–	Objectives Based Assistance
PV	–	Photovoltaic
PCM	–	Project Cycle Management
RE	–	Renewable Energy
REA	–	Renewable Energy Agency
REAM	–	Renewable Energy Association of Myanmar
REP	–	Renewable Energy Policy
RET	–	Renewable Energy Technology
TA	–	Technical assistance
WBG	–	World Bank Group

1. Policy Development

Objective

The National Energy Management Committee (NEMC) and the Asian Development Bank are preparing Myanmar´s Energy Master Plan (EMP). This plan also considers Renewable Energy options for solar, hydro, wind, and biomass electricity generation both, for grid connection and off-grid applications. The objective of this Technical Assistance is to strengthen the National Energy Management Committee in Energy Policy and Planning in view of the use of Renewable Energy technologies.

This document will formulate the Myanmar Renewable Energy Policy (REP) with support measures, actions and timeframe.

1.1 Executive Summary

This National Renewable Energy Policy describes the intention and direction of the Union Government of Myanmar (GoM) for the renewable energy sector.

It is dedicated to the provision of energy services in Myanmar by using Renewable Energy Technologies (RET). These RET are understood as devices converting natural and non-depletable resources such as water, wind, solar and biomass to productive energy. It defines the position of GoM, of the citizens, private enterprise and other national and international stakeholders and indicates actions and priorities.

- The RE Policy aims to facilitate a stream of RE projects with equal opportunities for qualified partners and viable technologies. It states simple, clear support regulations which shall encourage project developers and energy consumers.
- For grid connected RE generation, a set of measures is proposed which are financed through power purchase arrangements at no direct cost to GoM.
- For off-grid energy services cost is minimized to a connection premium sustainability subjected to a national office responsible for monitoring and evaluation.
- Domestic biomass use and emerging RE technologies are at the care of public / private cooperation.

The draft Renewable Energy Policy is presented to the board of the NEMC for consideration.

1.2 Rationale for a Renewable Energy Policy

Ever since the energy sector was shaken by oil-crisis and nuclear accidents it is finding itself in a serious transitional process. This is enhanced by significant emission problems related to fossil fuels. Conventional sources of energy are experiencing unpredictable supply and long-range rising costs.

Renewable energy technologies have become essential contributors to the energy supply portfolio, as they stabilize energy security, reduce dependency on fossil fuels, and provide opportunities for growth, employment and long-term development.

Traditional fossil fuels are being replaced by clean, endless sources of energy. Renewable energy technologies which were a subject of science and technology only 20 years ago, are today major players in the international energy portfolio which has shifted

investment to 57% renewables, 40% fossil and 3% nuclear. Another important change is that 58% of the renewable energy investment is now provided by private developers.

Myanmar is in the process of setting up a new energy infrastructure. This brings the advantage that not so much severe and costly changes from established power have to be made. In recent years, Myanmar has already made significant progress in improving access to modern energy and the share of renewable energy sources in electricity generation. To make this progress available on a national scale, a renewable energy policy is required to appreciate changes and trends in the energy sector and to propose mechanisms which will address the new challenges efficiently.

1.3 Priority Action

Recommendations for policy measures and actions for RE are shown in Table 1 (below) with desired outcomes and target dates. Tab.1 compiles these actions according to priority in timely sequence:

Tab.1 RE Priority Action

2015 is the fiscal year April 2014-March 2015, 2016 (April 2015-March 2016) and 2017 (April 2016-March 2017)

Action / Indicator	time
National Renewable Energy Institution established and operating in 2014	2015
RE Training, certification and information started in 2014	2015
Most practical and affordable household cooking devices identified	2015
Emerging RE market preparation coordinated with private sector in 2014	2015
Clear and transparent rural electrification regulation available by 2014 stating procedures for funding, qualification, operation and transition	2015
Clear and transparent grid power investment regulation available	2015
General Feed-in Tariffs published in 2014	2015
National advisory structure on design and service functional	2016
At least 40 RE advisers in solar, biomass wind and hydro trained within 2015	2016
Framework on financing, tariffs and taxation prepared by 2015	2016
Most mature RE technologies identified by 2015	2016
Standards, specifications and rules of conduct prepared by 2015	2016
Wind measurements in at least 10 most prospective sites conduct from 2015	2016
RE planning database established, published by 2015	2016
Energy audit to public buildings conducted	2016
Capacity on RE thermal use in design and installation developed	2016
Information about benefits and recommend cooking alternatives published	2016
Availability of firewood alternatives by market and production incentives assured	2016
RE thermal use in hotels and housing requested	2016
RE based generation regulations published in 2015	2016
Quality of installation, operational service and maintenance assured by 2015	2016
Curriculum RE for University courses and post-graduate certificates established	2016
Laws and regulations on RE development promulgated by 2016	2017
Thermal energy demand of public buildings covered by RE to 50%	2017
Pilot RE installations commissioned by 2016	2017
Public grid connection ratio from 24% raised to 45% by 2020 and to 60% by 2025	2020 2025
Use of firewood reduced to 50% by 2020 and to 20% by 2030	2020 2030

1.4 Preparation of the Renewable Energy Policy

The development and draft of the Renewable Energy Policy was led by the National Energy Management Committee (NEMC) with the assistance of the Asian Development Bank (ADB) and a team of international and national experts.

Review of the present energy situation and structure was done with the help of representatives from the key energy ministries comprising the NEMC, from NGOs active in the energy sector and from private sector enterprises who have put forward much initiative to strengthen the Myanmar energy perspective.

The REP is a result of a five month consultation process :

- Broad direction provided in strategic government documents such as the NEP and the National Energy Master Plan.
- Discussion and guidance from key management in the relevant Ministries and subsequent information from representatives
- Discussion with key stakeholders from NGOs and associations as well as private enterprises engaged in energy projects.
- A thorough review of documentation and past reports relating to Myanmar's renewable energy sector.
- A cooperative consultation process through a series of national consultation workshops which involved all of the key stakeholders (Ministries, States, private sector, public institutions, NGOs)

1.5 Status of Renewable Energy in Myanmar

The Government of Myanmar has a long history in embracing the benefits of RE as it is harnessing hydro-power to a significant extent. With such strong technical leadership, other RE technologies were finding less attention. Determined to provide more open opportunities, GoM is inviting partners to implement a consistent and sustainable RE policy.

The RE Policy follows the National Energy Policy NEP, which was presented early 2014 and provides for the first time an overview of the Energy Sector in Myanmar and the on-going work program. The REP is being formulated during the deliberations of the National Electricity Law, which will further clarify the roles and responsibilities in the energy sector. The REP may then require further laws and regulations in order to create a stable ground of confidence for long term engagements.

Myanmar has the privilege to enter the RE sector at a time where RE technologies are mature, demand less investment and are proven to operate reliably (late mover advantage). Now the results of those learning curves can be applied to forge a harmonious RE strategy which will allow a beneficial combination of social support, affordability and reliable operation. A wisely applied policy will not have to forcefully shift from fossil to renewable, but can incorporate the right, long term orientation in the energy road map.

1.6 Structure, Goals, Visions of the RE Sector

The Union Government of Myanmar recognizes that the challenges faced by the energy sector in integrating RET in the national energy portfolio are best met when they are open to a broader base of energy service providers.

International policy analysis supports the insight that the acceptance of public services and projects is enhanced by decentralization, establishing more regional responsibility. The union structure of the Myanmar administration provides the right support for such federal approach and is constitutionally founded.

As a further step, Myanmar is increasingly embracing Community Driven Development, enabling rural communities to determine the most important development needs and contributing responsibly to the activities of this development. Renewable energy implementation will positively benefit from this approach in terms of collaborative financing, operation and maintenance of RE installations.

Enabling States and Regions, Communities, and Private Enterprise as responsible actors will create an energy architecture which is more demand driven, more socially acceptable and on the long range more sustainable. As this diversification requires a new quality of coordination, GoM will establish a Renewable Energy Office working with the line Ministries under the NEMC.

The structure of the new Renewable Energy sector will comprise of five major contributors:

- The Ministry of Electric Power MoEP is mandated to coordinate the national power distribution network and generation facilities of more than 30 MW
- The 20 States and Regions plan and implement (RE based) energy service projects. They work closely with the MoLFaRD as being mandated for rural development, so as to to listen and respond to regional demands. A strong regional capacity in energy planning, RE system design and service operation will be built.
- The strategic component of Community Driven Development (CDD) will have the communities contribute to the selection and prioritization of energy supply models. Their tasks will include operation and maintenance of the systems as well as fee collection for spare parts and service. Local organizational and technical capacity will enable communities to efficiently perform these duties.
- The private enterprise and NGOs will be encouraged to build operate and own grid connected RE generation systems at equal terms with public power providers. In rural electrification they will cooperate with States and communities directly to implement village supply systems. They will be certified through capacity building measures on planning and installation standards and will train user communities.
- The Renewable Energy Office will coordinate national policy, rules and regulations, capacity building and certification, planning, monitoring and service. It will also be responsible for permits and incentives.

In building Myanmar´s new energy architecture, the contribution of Renewable Energy to the national energy mix can achieve these major goals:

- Constitute a vital element of Myanmar's energy diversification
- Contribute to the sustainable Energy Supply of Myanmar
- Contribute 27% to the new generation exposure until 2030
- Cooperate in public-private partnerships on purpose and target
- Condition a conducive financial, legal and administrative framework

An indicative assessment of the anticipated share and volume of the various RE technologies to electricity generation leads to the following distribution towards the year 2030. The overall RE contribution to the newly installed generation capacity (without large Hydro) will then be 26.8% or 3,995 MW compared to a total capacity of 14.9 GW.

Total		26.8 %	3,995 MW
Hydro Power	off-grid	1.3 %	198 MW
Wind Power	grid connected	3 %	446 MW
Solar Power	grid connected	17.8 %	2,658 MW
	off-grid	3.7 %	544 MW
Biomass	grid connected	1 %	147 MW
(biogas, gasification)	off-grid	0.02 %	3 MW

- Biofuel for non-electric use such as transportation and production is anticipated to reach a share of 5 % of the national consumption.

The objectives of this policy

- for the citizens of Myanmar seeking access to energy
- for the entrepreneurs offering to provide sustainable solutions, and
- for the Government giving priority and guidance,

can be summarized in the following 5 points vision for a stable and predictable renewable energy policy framework:

- Provide citizens with **adequate** energy at **sustainable** cost
- Encourage citizens to **contribute** to electricity service, help the Weak
- Give **priority** to viable distributed generation from Renewable Energy Sources
- Prefer **private** to public development in Renewable Energy generation
- Ensure proper **standards**, attractive **financing** and continuous **capacity** development

2 Myanmar Renewable Energy Policy

In the current economic development of Myanmar a sustainable energy mix demands a clear view on the role of renewable energies and their position in the country´s development. The Union Government of Myanmar GoM wishes to state its position to RE and provide guidance for consumers and investors alike.

This chapter will focus on the main fields of activity and the targets envisaged. Among technologies of equal maturity, it will as much as possible not prefer or defer certain applications, rather create a conducive environment allowing the most beneficial use.

The sections will emphasize status and issues of major RE uses, suggest the appropriate policy activity and necessary action.

A summary of the most pressing priority action is presented under Pos.1.3

2.1 Domestic Energy

The largest use of renewable energy in Myanmar is based on biomass for cooking. GoM is determined to reduce this consumption significantly by providing more sustainable alternatives. More than 8 Million households are using traditional wood stoves for cooking which is hazardous and polluting and holds no future.

In quantity this is by far the dominant energy consumption in Myanmar. Individual firewood collection however, is not a threat to the national forest, nor to the CO_2 balance. It is only developing into a problem with industrial production, harvesting and marketing of firewood. Providing more forest for more firewood is not addressing the task of lowering this consumption.

Business as usual would solidify and expand a firewood industry which inevitably infringes the forest, and leads to increasing wood prices at the cost of sustainability and well-being of rural citizens.

The issue of household energy has been handled by the Ministry of Environmental Conservation and Forestry (MoECaF) but with the understanding of its consequences reaching far beyond forestry, the need for a lead office in this important field has come up.

Alternatives exist with fuel efficient stoves of various designs, briquettes and pellets of various compositions, advanced gasifier stoves and cooking from biogas, LPG or electricity. Many of these solutions are well established, many are mature but not deemed attractive. Best designs can be identified and actively promoted. Supply with household LPG can be supported until a stable market is formed. Firewood use can be curtailed.

2.1.1 Issues

- Household energy has nationwide significance, but no responsible actor
- Threatening growth of firewood industry infringing on forest reserves
- Existing solutions fall short on information, acceptance and policy support

2.1.2 Policy

A strong support and leadership shall ensure that GoM is on top of this issue of national importance and that it is sending clear signals to people depending on basic energy provision. The initiatives of many NGOs and rural organizations are appreciated and are supported with due information and endorsement.

2.1.2.1 To this end the GoM shall invite manufacturers and distributors in 2014 to establish a road map household energy which is targeted to reduce the use of firewood to 50% by 2020 and to 20% by 2030. Accomplishment of the targets shall be reviewed in scheduled intervals.

2.1.2.2 Viable options by cost and practicability shall jointly be identified and published. These include available alternatives and sources.

2.1.2.3 Increase availability of improved cooking devices and fuels by direct output-based assistance (OBA) to manufacturers

2.1.2.4 Discourage the use of firewood publicly as an untimely hazard and a health threat by increasing information on the negative effects and the available alternatives

2.1.2.5 Reduce urban use of firewood with high priority and monitor results.

2.1.3 Activity

- Use of firewood reduced to 50% by 2020 and to 20% by 2030
- Most practical and affordable household cooking devices identified by end 2014
- Information about benefits and recommend alternatives published from 2015
- Availability of alternatives by market and production incentives assured by 2015

2.2 Thermal Energy

The demand for thermal energy apart from meal preparation and steam generation for power amounts in Myanmar to about 2 MtOE.

Much of this is low-intensity energy used for purposes such as water heating for cooking or cleaning. Often it is prepared by fuel wood, gas and oil or even electricity. This does not hold commercial value, so alternatives have to be made available and encouraged.

Hot water demand e.g. for industrial process heat, in the hospitality sector and also in public institutions like hospitals and schools often can be supplied by inexpensive solar water heaters. Solar energy then would save on energy resources, reduce pollution and relieve pressure on the sensitive energy balance.

As an alternative to stand-alone solar heating, the waste heat from all power generators is a valuable energy source. Particularly in industrial plants thermal co-

generation can increase overall efficiency. Generators from biogas are frequently designed to use the generators heat for productive purpose.

The market for solar water heaters (SWH) is not well developed in Myanmar. Reasons can be found in the low price for energy, so boilers and geysers appear cheaper in the short term. Another reason is limited information about solar water heating and the understanding of quality, as well as insufficient experience of installers.

Radiation for solar heating is generously available throughout Myanmar, although flat-plate collectors would be preferred to concentrating design because of the high percentage of diffuse radiation particularly during the rainy season.

Highest penetration of solar water heating was achieved in countries where SWH were encouraged by a premium or enforced by the building code (e.g. in Yunnan even in cities other hot water sources are banned)

2.2.1 Issues

- Much energy is spent on low-intensity use e.g. for water heating
- Solar Water Heating is little known and practiced
- Efficient heat generation, professional training and quality standards are not supported

2.2.2 Policy

An important element of the RE policy of the GoM is a strong support to RE used for thermal energy. A strong RE leadership will arrange for information and training on using waste energy and solar energy. Incentives and regulations may strengthen the application

2.2.2.1 GoM shall demonstrate solar heating to all public buildings and institutions with hot water demand, such as hospitals, barracks and schools.

2.2.2.2 Solar water heating in hotels and larger housing units shall be a mandatory requirement of the building codes

2.2.2.3 A waste heat utilization plan shall be a mandatory requirement of generator operating permits

2.2.2.4 GoM shall arrange education and training for installers and designers on efficient RE thermal energy use.

2.2.3 Activity

- Energy audit to public buildings conducted from 2015
- Thermal energy demand of public buildings covered by RE to 50% by 2016
- RE thermal use in hotels and housing requested from 2015
- Capacity on RE thermal use in design and installation developed from 2015

2.3 Grid Connected Renewable Energy

The provision of adequate and reliable electricity services is a highly valued factor in the desired economic development of Myanmar. Immediate needs demand that generation based on fossil fuel is undergoing a major but also costly upgrading. Along comes the challenge that this may increase the country's dependence on highly volatile and vulnerable energy sources.

Traditionally, hydropower generation as a strong renewable source has been providing a major amount of the national electricity generation. Other renewable resources however, exist in abundance and during the last decade have achieved the status of mature and viable generation technologies.

Grid connected RE technologies which internationally receive the most attention and investment are wind, solar and biomass. To this point, none did find utility scale use in Myanmar. Government does not underestimate this new potential and will see that entrepreneurs find no barriers to timely application.

Wind power in Myanmar is challenged by generally low wind regimes with best potential in the coastal and eastern hills regions. Power conversion will be limited in regional availability and seasonal distribution. Low wind season is the dry season, which resembles hydropower generation. Within these limits, viable locations for appropriately designed wind parks can however, justifiably be explored.

Solar radiation is exceptionally good all over the country. The annual peak is in dry season which strengthens the energy balance as it complements the hydro generation curve. Photovoltaic (PV) generation appears of primary interest as it has short build time and high cost reduction potential. Concentrating solar plants (CSP) have limits with the high degree of diffuse radiation, which cannot be concentrated.

PV plants at this time are the first new RE technologies in Myanmar with already existing building contracts. On a national scale, a distributed generation with PV plants is preferred, with more moderately sized plants instead of few big installations. Such distribution facilitates power management, balances weather conditions and can support weak grids.

Internationally, strongest growth and best operational stability is experienced with a wide distribution of small private PV installations. For economic and social reasons, such energy supply landscape with small and very small power providers (VSPP) is desirable as a community driven development and has political merits. The support measures therefore emphasize SPP and VSPP.

Biomass power generation in an agricultural country like Myanmar can enjoy ample feedstock and a consequently good potential. The challenge will be in overcoming logistical constraints. For utility size generation from biogas, the need for a constant feed may emphasize applications which are using agricultural and urban waste, more so when they have the potential to utilize the surplus heat generated.

The production of biofuel is an important development task as it increases energy security, reduces climate gas emissions and can mitigate oil price spikes. Most ASEAN countries are making inroads in biofuel production but are also challenged for the adverse impacts on environment, food security and land use. The existing knowledge in Myanmar will need support to address these impacts and develop a responsible commercialization of sustainable biofuels.

As long as international fuel prices are low, biofuel will best be used regionally, where biomass is nearby and fuel costs are comparatively high.

Gasification of woody biomass or agricultural waste like rice husks will similarly have a preference in regional application for remote or off-grid generation.

BioPower in all forms is a despatchable technology, can be adapted to demand patterns so as to supplement expensive peak generation.

Grid connected generation from renewable energy mostly follows a build-operate-own (BOO) model so the financial and operational risk is with the entrepreneurs and GoM has the responsibility to contribute guidance and overall power management.

2.3.1 Issues

- Renewable Energy Technologies RET are underused, underestimated
- Grid connected RE alternatives are not fully explored and supported
- Entrepreneurs find outdated barriers in planning, permits, operation
- Open policy questions increase risk and impede long-term financing
- Planning capacity is limited and tends to slow down decisions

2.3.2 Policy

Government recognizes that Renewable Energy Technologies offer a valuable contribution to the national electricity production and to energy security, as

- Myanmar has a favourably high potential of renewable sources, namely water, solar, biomass
- RET are environmentally beneficial and reduce overall emissions
- RET are a sustainable addition to the generation portfolio and the target of diversification as they are independent from fuel price cost and shortages
- RET can provide distributed generation and thus improve the grid balance

In view of a strongly growing supply by experienced RET developers GoM sees an attractive field for private sector contribution, which will also release GoM from immediate investment exposure. It can thus concentrate on the supervision and regulation of a National Renewable Energy Action Plan which will contribute to sustainable electricity production in defined tiers of generation size.

GoM will follow a liberal policy on electricity generation from all viable Renewable Energy Technologies, providing straightforward and non-bureaucratic application procedure, namely

2.3.2.1 VSPP : For installations up to 50 kW erected by owners on their legal premises all electricity produced and not used for own consumption or that of neighbors can be freely fed to the grid. The responsible grid operator will mandatorily issue a permit within 2 months from application, if applicable standard of the generation equipment is demonstrated. Connection by the grid operator will be completed within 1 month from "ready for commissioning" notice by the owner. Investment for the generator shall be tax-deductible.

2.3.2.2 SPP : For Installations from 50 kW up to 1,000 kW erected by owners on their legal premises all electricity produced and not used for own consumption or that of neighbors shall be metered and purchased by the responsible grid operator, who will mandatorily issue a permit within 3 months from application, if applicable standard of the generation equipment is demonstrated. Connection by the grid operator will be completed within 1 month from "ready for commissioning" notice by the owner.

Generators of this size could affect the grid performance. GoM will take a liberal view on these installations as long as they total below 10% of the national generation, but may impose regulations for power management and power purchase. Applicable standards of the generation equipment therefore include e.g. an adjustable power factor and a facility for remote power management (gradual shut-down) by the grid operator. The power purchase agreement will compensate losses caused by such shut-down. RE based generation shall be preferred to conventional generation

2.3.2.3 IPP : For installations from 1 MW up erected by owners on their legal premises the electricity produced and not used for own consumption or that of neighbors shall be metered and purchased by the responsible grid operator, who will mandatorily issue a permit within 3 months from application, if applicable standard of the generation equipment is demonstrated. The generation equipment will need to have adjustable power factor and power management facility.
The power purchase agreement will be negotiated by GoM on the basis of tendering a concession, where the bidder with lowest feed-in tariff shall be preferred. GoM will tender for concessions of 200 MW annually to be installed in different parts of the country in order to benefit from the favorable effects of distributed generation.

Installation Size	Registration	Power Purchase	Power Management	Concession
Up to 50 kWp	**x**	**x**	**-**	**-**
50 to 1000 kWp	**x**	**x**	**x**	**-**
above 1 MWp	**x**	**x**	**x**	**x**

2.3.2.4 Active Support

GoM shall provide developers access to grid planning data required for project planning. Generally, this includes information on grid capacity and extension plans; for hydropower data on head, flow rate, watershed are needed; for wind power data on wind measurements.
Government shall help to clarify issues of land ownership, water rights and right of way.

2.3.2.5 Distributed generation

GoM will observe the operational and financial regulations of utility-scale power generation and effectuate subsequent improvements. In general, a number of moderate installations would be preferred to a few larger plants. Distributed PV is not only less dependent on regional weather events, it greatly benefits the grid performance and spreads the operational and financial risk.

There is also the risk of power management reducing plant output severely and often, which will conflict with any investor, because any hour of RE not used is free energy lost. It is therefore imperative that PV grid-feeding is assured of the highest priority.
Due to the structure of line distribution in Myanmar, PV plants in the upper part of the country can easier be balanced with hydro power, while PV in the southern capital region can be balanced with gas plants. This corresponds with international studies which recommend generation from gas as the ideal match for PV generation.

2.3.2.6 Feed in tariff

Power purchase by application of a feed-in tariff FIT shall be valid for a period of 20 years from the date of first connection. With due notice, GoM reserves the right to adjust the tariff for additional generators in order to account for lower cost and efficiency gains. Likewise, tariff bonus can be granted for feed-in at peak hours. Tariff shall never be reduced retroactively.
FIT shall be determined in due consideration of the real generation cost and in recognition of the macro-economic effect on electricity prices. Tariff shall encourage self-consumption. For the benefit of planning, a uniform tariff of 150K/kWh shall be proposed. Variations may be established for generators of different size and technology. GoM will publish the FIT for the next period in due time, beginning in 2014.
Cost of connection and lines to the next suitable connection point if so required shall be borne by the RET owner.

2.3.2.7 Financing

In order to facilitate long-term financing for RE investments, a financing window at development banks shall be made available. Generation equipment may be considered as collateral with its marketable value. GoM shall provide a financing volume at interest reflecting government rates.
Taxing of income from private RE generation shall be equal to the taxing of public generation.

2.3.2.8 Technical regulations

A regulation to the standards of the generation technology and in particular for the grid-feeding power converters shall be formulated and published in 2014. Internationally accepted standards may be applied, so internationally certified equipment can be used.

2.3.2.9 Technical training

Installations shall be planned and approved by at least one suitably trained and certified technician. Certification will be granted after passing a written and practical test. Internationally approved certifications will be accepted. A National training and certification program will be designed and started by mid-2015.

2.3.2.10 Quality Assurance

For all equipment used in RE installations the supplier shall demonstrate that it conforms with applicable standards, that the supply of replacements and spare parts is secured, and that responsible recycling of obsolete components is arranged.

2.3.2.11 Piloting

While GoM prefers private sector investment for RE generation facilities, it shall demonstrate at the same time latest technology application in own generation facilities. These will serve as pilot plants and reference where standards will be demonstrated, power management and grid control will be applied and potential investors as well as general public will be familiarized with latest progress.
For hydro power, such pilot installations are already existing. Pilot plants for other major RETs would have moderate utility size, e.g. 100 kW in biogas, 1 MW in solar PV, 20 MW in wind power.

2.3.3 Activity

- A clear and transparent power investment regulation available by 2014
- RE based generation regulations with preference over conventional generation published in 2015
- Financing facilities for RE generators established in 2015
- General Feed-in Tariffs published in 2014
- Pilot RE installations commissioned by 2016
- Training and certification operable by mid-2015

2.4 Off-Grid Renewable Energy

The modernization and reform program of Myanmar is to bring about substantial improvement in the national electrification, particularly in the rural areas. The lowest electrification rate in SEA is an extraordinarily hard predicament which can only be addressed by extraordinarily strong action.

The vision of an eventually fully grid-supplied Myanmar takes significant cost and time and until it can be reached, faster and less costly solutions will have to be applied. The MoEP committed to the task of raising the access to grid connection from 24% at present to 45% by 2020 and 60% by 2025. This is an ambitious target because for 42,476 villages and 8.2 million households this means an average of 388,125 new household connections per year or 1065 households each day for the next 20 years.

Grid expansion in Myanmar has progressed impressively and will continue swiftly but will meet limits in finance and installation capacity. The further inroads expansion will go, the more time and resources will be needed. With the average low rural household demand of 235 Wh/d remote grid-lines often lose viability beyond 10 km distance but still have to bear cost for repair and maintenance and the not cost-covering price of electricity. For small and remote locations, grid electrification will be the costliest option.

On the beneficiaries' side, villages on the electrification list may not want to wait for 20 years and the 40% not on the list have no vision to begin with. The Department of Rural Development DRD of the MoLFaRD therefore has embarked on an RE based electrification program, which is mostly using PV stand-alone systems and mini grids. Currently DRD is distributing these systems for free, so soon the need for finance will constitute an impediment. Free gifts, often also were observed to lower the perceived value of the supply option, leading not to sustainable operation but to early failure.

Private enterprises active in RE rural electrification as a rule request a contribution from the beneficiaries for the system cost and the operation. Internationally, this requirement has proven the only sustainable model. The RE policy shall provide equal support for both, the public and the private option to give recipients a choice and assure the most efficient accomplishment of the enormous task of rural electrification.

Rural electrification must not be an attempt by government alone, it will need strong and cooperative effort by the private sector. Such approach can reach the task of adequate electricity supply at considerable lower cost than grid electricity.

Rural electrification will still meet limits such as quantity, quality and affordability, but RE can push such limits when private sector will be enabled as a partner. Many partners can achieve a substantial contribution to the overall target, and they will afford the valuable determination and willingness of the village recipients. Up to now, slow growth has enticed rural citizens to engineer their own supply solutions. Private enterprise and NGOs have contributed to a large extent. Their major challenge is the required financial long-term exposure. A solid financing base at terms matching Government conditions should help this predicament. All this activity however, will only be preliminary

in absence of clear planning and guidance. An updated electrification plan declaring when which village is due for the public grid would help in identifying alternative solutions.

An overall weakness of rural electrification is service quality, compromised not so much by the delivery model but by remoteness and lack of trained service personnel.

This applies to grid electrification as much as to off-grid models. But while grid operation has established maintenance routines, these often are not in place for off-grid models. Proper maintenance requires Government supervision and a corresponding institutional set-up.

Off-grid RE delivery models have been proven in many countries and can be applied in Myanmar with the advantage of learning from these experiences. Learned design and service will bring it to best use and people's satisfaction.

2.4.1 Issues

- Rural electrification is an impossible task for the public sector alone
- Private sector RE electrification needs supportive regulation
- Service and regular maintenance for sustainable operation not institutionalized
- Financial burden for developers and low-income rural households exists
- Low technical knowledge and operational experience impede performance
- Difficulty to obtain necessary planning data and permits raises planning risk

2.4.2 Policy

Off-grid Renewable Energy applications find their dominant use in rural electrification. While the GoM considers countrywide grid electrification the ultimate goal, it will strongly encourage RE solutions in order to achieve rural electrification targets as swiftly and efficiently as possible. These solutions shall include local power generation from hydro energy, solar radiation, and biomass, depending on the economic and operational preferences.

Both, public and private sector shall be entrusted with the implementation in the form of energy service providers and they will cooperate in planning and operation. The cost shall be borne jointly by GoM and the users. An efficient performance supervision shall be established by GoM through certified regional RE Advisers.

Cognizant of the important role the Myanma communities need to assume in rural electrification, GoM will enable villages to sustainably operate and maintain energy systems. To lessen the burden for rural citizens, GoM shall apply the tool of a connection premium to public and private developers. As an Objectives Based Assistance (OBA), the premium shall be disbursed directly after installation commissioning and acceptance by the recipient village.

2.4.2.1 GoM shall publish an off-grid electrification support regulation, describing duties and eligibilities of energy service providers and consumers, procedure and standards applicable as well as funding and timeframe available.

2.4.2.2 New electricity connections in clusters of at least 20 households shall be built, operated and maintained for long-term by operators, who may be village committees or private entrepreneurs.
Operators will seek to connect a maximum number of households for best efficiency, but are free to determine connection priority.

RE installations providing at least 200 Wh daily all days all year shall be eligible for a connection premium of K150,000 per newly connected household. The remaining cost, each newly connected household shall contribute in lump or loan. Operation and maintenance shall be organized on village level and a sufficient O&M fee be collected from users.

2.4.2.3 For the financially weak households who cannot afford a connection, the operator shall be eligible for a premium of K15,000 per new household for providing a suitable charging facility for batteries or lanterns. Households will pay a suitable fee when charging these devices.

2.4.2.4 Planning
For proper site selection, planning and evaluation, GoM shall provide an updated inventory of un-electrified villages with data on contact, location, access and number of households as well as priority and date of planned connection to the national grid.
In case of prospective hydropower sources, this inventory shall include confirmed data on flow duration, head and topography.

2.4.2.5 Transition
GoM is aware that currently numerous rural generation systems are existing for which the upgrading, repair or conversion into hybrid generation using RE technology will be the least cost alternative. For these the same connection premium of K150,000 per newly connected household providing at least 200 Wh/d from RE all days all year shall apply.

In case the national grid will eventually be connected, the continued operation of the RE supply system as a valuable and reliable resource shall be assured. The system operator shall secure that the existing system will not interfere with grid standards like voltage and frequency, shall act as retailer of the grid electricity and shall retain the O&M fees practiced prior to connection.

2.4.2.6 On financing, technical regulations and quality assurance the conditions per 2.3.2.7 ff shall apply.

2.4.3 Activity

- Clear and transparent rural electrification regulation available by 2014 stating procedures for funding, qualification, operation and transition
- RE planning database established, published by 2015
- Mechanism for sustainable and social financing established by 2015
- Quality of installation, operational service and maintenance assured by 2015
- Training and certification for designers and installers operable by mid-2015
- National advisory structure on design and service functional

2.5 Energy Research

Science and Technology holds a very prominent role in the RE development of Myanmar, as it

- Explores improved application of existing technologies
- Establishes an updated data base on RE resources, namely wind and hydro
- Tests and probes biofuels and feedstock
- Develops domestic solutions for emerging technologies
- Educates engineers, technicians and project management for the tasks of RE service.

Energy research and education in Myanmar is the mandate of the Ministry of Science and Technology MoST. While mature and viable RE applications are already existing and applied to varying degree, efficiencies often can be enhanced by applied research. Other technologies had drawbacks and need improvement, some meet not so much technical but institutional barriers. As an example, biogas generation will improve if the heat produced can be utilized for drying, cooling or process heat.

The use of biofuel derived e.g. from Jatropha would be more efficient with higher yielding crops and improved extraction technology. Biofuel production from cane or palm-oil has to overcome environmental, excise and marketing concerns. Target-oriented applications research by MoST will help to identify and support most promising localized solutions.

Private sector initiative has already demonstrated remarkable results in many RE related areas, be it in private rural electrification, in the development of bio fuel production, biogas digestion, biomass gasification or in the many initiatives improving traditional wood-burning-stoves. There is however room for closer cooperation between science and industry. GoM wishes to support these initiatives where there are benefits, and to improve where there are challenges.

One of the main impediments of RE dissemination in Myanmar is the limited knowledge on RE technologies and their application. Education will have to provide capacity in design, operation and service.

Currently RE is not part of regular education, and training of skilled technical personnel is rarely available. MoST can provide this urgently needed managerial and technical capacity and can incorporate RE in appropriately adapted curricula.

2.5.1 Issues

- Need for target-oriented applications research
- Little cooperation of public and private sector on RE technology development
- Demand for institutionalized and comprehensive RE education and training

2.5.2 Policy

2.5.2.1 GoM shall conduct research on improving existing technologies and rendering emerging technologies viable and marketable.

2.5.2.2 GoM shall facilitate regular coordination meetings of research and private developers in order to improve market penetration

2.5.2.3 Research and private sector will jointly evaluate the status of technology development, determine technologies most mature and name the missing elements, and will prioritize research demand.

2.5.2.4 GoM shall actively improve data on RE resources e.g. by conducting wind measurements in prospective areas

2.5.2.5 Research and private sector will exchange research data and determine fields of most promising cooperation

2.5.2.6 GoM shall establish RE courses at Universities and colleges to establish a profound knowledge base

2.5.2.7 GoM shall develop and offer training courses with certification for designers, technicians and installers, in cooperation with professional institutions e.g. the Myanmar Engineering Society MES.

2.5.2.8 GoM shall encourage cooperation of education and private sector e.g. by providing students to contribute to field monitoring and evaluation.

2.5.3 Activity

- Most mature RE technologies identified by 2015
- Next steps for market preparation coordinated with private sector in 2014
- Wind measurements in at least 10 most prospective sites conduct from 2015
- At least 40 RE advisers in solar, biomass wind and hydro trained within 2015
- Curriculum RE for University courses and post-graduate certificates establish by 2015

3 Renewable Energy Institution

The RE policy described in this document identifies targets for a national RE development and names priority actions required to achieve these targets. The final and most important measure remaining is to establish an actor who will initiate, monitor and develop these actions on a national level for considerable length of time.

To date, institutions are not attuned to fast track implementation, replicability, rapid scale-up and viable long-term electricity service. More often, RE projects are handled one by one and devoid of a sustainable long-range development concept.

To date, private enterprise does not find clear economic conditions in terms of financing and tariffs. They do not find supportive laws and regulations, and face a complicated institutional structure making project development a challenge.

To date, there is no lead office attending to the national RE development: MoEP has the mandate for utility-scale hydro projects, MoST for non-viable RE technologies and DRD for rural installations. The immense and challenging field of mature RE technologies which internationally have proven to be viable and will be so important for the development of Myanmar´s energy sector are not yet mandated.

The Myanmar energy sector was often described as impaired by inappropriate structure and regulations. The RE policy component now has an entirely new range of tasks and can use this opportunity to create a compact and efficient national supervisory structure. Institutional fields of responsibility can be seen to :

- Build a National office responsible for national and international Renewable Energy development as a one-stop service unit
- Establish a firmly rooted legal and regulatory base for Renewable Energy
- Cooperate with private enterprise to commit long-term investments
- Prepare and update the RE database needed for planning and evaluation
- Organize operational project supervision, monitoring and evaluation, training and certification
- Arrange maintenance, service and quality assurance for all national RE installations
- Coordinate the financial activities with FIT tariffs, electrification premiums, project financing
- Organize social, economic and environmental impact assessments

The following section on Institutional Arrangements describes in detail the tasks and options of such an organizational structure. The RE Office (REO) can have the legal form of a public office, a private corporation or a social facility.

A social enterprise such as a cooperative has the advantage of GoM, private sector and recipients being voting members with fair and equal rights.

Implementation will require an efficient institutional structure which has a solid capacity and mandate and the confidence of the public and private stakeholders. A reliable long term RE vision will need strong leadership and will have to act independently from the constraints of political hues.

Any Ministry would be a difficult host as they currently are in the process of divesting from operational obligations, concentrating on policy and project support rather than project installation. Also, projects under 30 MW which is the typical RE range will fall under the mandate of the States and not the Union Ministries.

A National facility like REO will necessarily report to and cooperate with the Union Energy Ministries. To this purpose, the national Energy Management Committee NEMC has been established and is well suited, as energy policy development and energy planning are part of NEMCs prominent tasks.

3.1.1 Issues

- National RE lead office not established
- Mandate, law and regulation for national RET unclear
- Complicated, expensive and slow project development
- Single project vision hindering national RE development strategy
- Scalability and viability in institutional framework not established

3.1.2 Policy

With the goal to fully utilize the opportunities of mature RE technologies, GoM is setting up a strong institutional support with a solid mandate and clear, transparent and efficient procedures.

For the energy related Ministries, the States, and the villages as well as for national and international project developers and investors REA shall be tasked the one-stop shop facilitating rapidly and with a long term sustainable vision.

3.1.2.1 GoM shall establish a National Renewable Energy Institution which supervises the wide-scale national RE implementation with a network of trained advisers.

3.1.2.2 GoM shall provide laws and regulations to facilitate national RE development

3.1.2.3 GoM shall install financing mechanisms for RE projects at competitive terms

3.1.2.4 GoM shall cooperate with private enterprise to commit long-term investments

3.1.2.5 GoM shall prepare RE based training and education to establish national capacity in design, installation, operation and service.

3.1.3 Action

- National Renewable Energy Office established and operating in 2014
- Training, certification and information started in 2014
- Standards, specifications and rules of conduct prepared by 2015
- Framework on financing, tariffs and taxation prepared by 2015
- Laws and regulations on RE development promulgated by 2016

ADB Capacity Development Technical Assistance (CDTA)

Republic of the Union of Myanmar:
Institutional Strengthening of National Energy Management Committee in Energy Policy and Planning

/ DRAFT / **Institutional Arrangements**

September 2014

CONTENTS **Page**

Institutional Arrangements

Objective

The National Energy Management Committee and the Asian Development Bank are preparing Myanmar´s Energy Master Plan. This document will give an outlook on the required framework on capacity and institutional arrangements.

1. Executive Summary

This document looks at the organizational management of RE projects in Myanmar, identifies gaps and recommends a suitable administrational structure. It introduces a Renewable Energy office, the tasks and organizational set up required and the embedding into the National energy administration.

The initiative aims to create an enabling environment which supports a sustainable stream of RE projects which is carried by private initiative.

1.1. Priority Action

For the institutional tasks below Tab.1 recommends measures and actions with desired outcome and dates are listed. Actions are according to priority in timely sequence.

Tab.1 RE Priority Action

2015 is the fiscal year April 2014-March 2015, 2016 (April 2015-March 2016) and 2017 (April 2016-March 2017)

Action / Indicator	time
Renewable Energy Office established and operating in 2014	2015
Project data consolidated and experience background evaluated	2015
Workforce for planning, training, monitoring established	2015
Project development procedures and the necessary regulations prepared	2016
RE project developers, project managers and technicians trained	2016
Project development and national project expansion facilitated	2017
RE in mainstream energy policy integrated	2017

2. Institutional Background

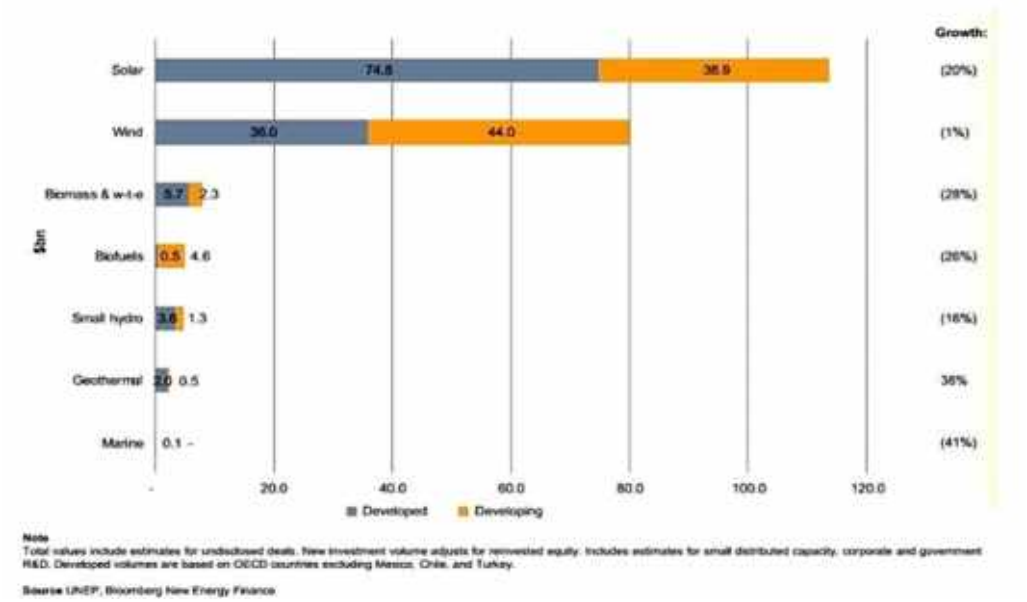
The energy administration in Myanmar was originally formed for oil, gas and coal exploration and generation primarily based on hydro energy. Through time as the tasks expanded, so did the administrative structure and has reached a complex, sometimes fractured structure which is deemed by the GoM too faceted for the challenges ahead.

These challenges include a definition of the energy mix which places Myanmar in a sustainable position for the changes ahead in energy supply and demand. While energy demand is explored by the ADB´s 2014 Energy Masterplan initiative, the energy supply assessment needs to consider the opportunities of Renewable Energy sources beyond hydro power. These include grid connected and off-grid technologies.

Both offer the advantage that they are indigenous and unlimited resources, which render the country free from importing energy in highly competitive and volatile markets, using valuable foreign currency.

Grid connected RE internationally has shown a tremendous development in recent years. It is by now representing the major field of energy investments with the additional advantage that most of this investment is provided by private developers.

Fig.1 Global New Investment in renewable energy: Developed vs. Developing Countries 2013



The dominating technologies for RE investment are utility size plants on solar, wind and biomass energy, usually for electricity generation. In Myanmar, to date none of this installations is existing yet and no policy or lead office is in place.

Off-grid RE technologies offer the opportunity to provide energy access to unelectrified, remote locations which is particularly beneficial in a large country like Myanmar with a widely dispersed population. Off-grid solutions enable rural people to put energy to practical use right at the place of consumption without the need for long and expensive grid lines or transportation of fuel.

Even if a strong and determined grid electrification initiative will eventually reach many of those locations, RE supply can reach there earlier and will have exposed and trained people to efficient energy use.

All NEMC Ministries have experience in off-grid systems. Mostly, it is based on projects funded by donor assistance, where the respective Ministries were kind enough to volunteer for the implementation. Generally, off-grid projects were done diligently, often with substantial personal effort. A common shortcoming however is the absence of funds for monitoring and service, so little is known about the current status. A list of existing RE projects would therefore not be useful, as it necessary were incomplete because official lists do not include the numerous small projects done by private companies and donors, and not include the substantial number of private home installations. This document will rather describe the fields where the various Ministries are active.

Ministry of Electric Power (MoEP)

Plans, installs and operates grid based hydropower projects generally above 30 MW. As the constitution since 2005 grants sovereignty to the states MoEP considers power projects below 30 MW as the states responsibility. Where state energy departments do not have the capacity to do such projects the MoEP promises to assist. The NEP refers for some time already to a number of 98 MH projects for which States and MoEP also seek foreign assistance.

MoEP is also answering to wind power projects. Given that the few wind data available indicate mostly moderate wind speed, few projects along the coast have been earmarked and are under negotiation with potential developers.

Ministry of Industry (MoI)

Plans, installs and operates off-grid PV projects and has probably the widest experience in PV. Since 2000 it operated a manufacture of thin-film CIS based PV panels and installed a number of pilot systems, some with international assistance. The concept of a national manufacture is inoperable today, as it is outdated and not competitive to state-of-the-art manufacture available on the market. The existing quality control (flasher) might however be used to perform tests and certifications on panels for on-going projects.
MoI also operates some biomass projects. It cares to keep the existing installations operable but does not avail of a budget for operation and maintenance.

MoI is the lead Ministry for Energy Efficiency and Energy Conservation and has formed an EEEC Directorate in 2014.

The ADB's Energy4all project was started in 2013 with MoI handling the first stage of project planning. 2014 it was transferred to MoLFRD.

Ministry of Livestock, Fisheries and Rural Development (MoLFRD)

The former Ministry of Border Affairs is present in 14 States and 284 township offices, was in 2013 assigned the duties of rural development and formed a Department of Rural Development (DRD). As such it supports the construction of roads, bridges, water supply and electricity generation.

Leading the national rural electrification initiative, it is installing numerous systems for village electrification, PV accounting for about 93% of the projects.
On micro-hydro systems it will cooperate with MoEP, on installations using biomass it seeks cooperation with the MoST.

Installation and operation is currently being transferred to the States and Regions. For coordination with the ongoing line electrification efforts, DRD and MoEP seek cooperation in an Executive Secretariat for Electrification.

Ministry of Science and Technology (MoST)

The Ministry is mandated to provide the education on (Renewable) Energy and to explore RE technologies which have not reached viability. Officially named as the lead Ministry for RE, there have been wind and solar installations and there are currently projects on biomass.

Ministry of Agriculture and Irrigation (MoAI)

Using the ministry´s agricultural irrigation systems, MoAI is operating a number of hydro power systems which are used for electrification of villages and farms. As these micro hydro installations compete with the core purpose of irrigation particularly during the dry season, their output is characterized by a strong seasonal profile. This reduces viability and requires additional generation capacity.

An important role of MoAI could be bioenergy projects (biofuel, biogas) Such projects require agricultural supply management more than technical operation, will need support from the ministry. Large scale energy crops agroindustry has become hardly justifiable, but the use of by- and waste-products from agriculture leaves attractive opportunities, which first of all require a smart logistical structure.

Ministry of Environmental Conservation and Forestry (MoECaF)

Biomass for cooking, mostly from firewood and charcoal, represents more than 80% of the country´s RE use and is the major energy concern of the Ministry. While rural collection of firewood is not critical, the growing demand in villages and cities has given rise to a growing firewood industry which the Ministry finds difficult to control. Research on fuel efficient stoves (FES), on efficient production of charcoal and on briquettes have produced encouraging results, but are now discontinued.

As an alternative to forest exploitation for firewood, forest management could provide a substantial source of biomass e.g. for gasification from forest waste (tops and logs), much of which remains currently unused.

State Governments

The Myanma Constitution grants the 20 States and Regions sovereignty on power projects below 30 MW, which applies to most RE projects. As a consequence, the line Ministries are transferring execution of such projects to the State level. This transition will separate RE projects gradually from the Ministries, but may complicate a national RE supervision and monitoring.

The RE project experience in the different States varies, with micro hydro projects having the most extensive background. Others like e.g. Mandalay Region are handling PV and biomass projects already.

The recent ADB RE Consultation included energy officers from the States and they expressed a strong need for clear guidance and engineering capacity with RE projects. They would need RE advisers for development of the different technologies and for the villages demanding best option advice. Added the requirement for national monitoring and evaluation, the State engineering departments will have to establish additional staff to perform the tasks demanded in rural RE projects. A national RE institution will have to train and support these RE advisers in all 20 States and Regions.

Private Sector / NGO

In Myanmar as anywhere else private enterprise takes the lead in innovation. It is experienced, internationally versed and also prepared to take risk on a new technology. Installations are most often commissioned by international partners / donors.

NGOs mostly have private partners for implementation. Private communities / villages as well have to rely on private enterprise to install their privately funded local projects. Private sector also answers the tenders to install for the various Ministries.

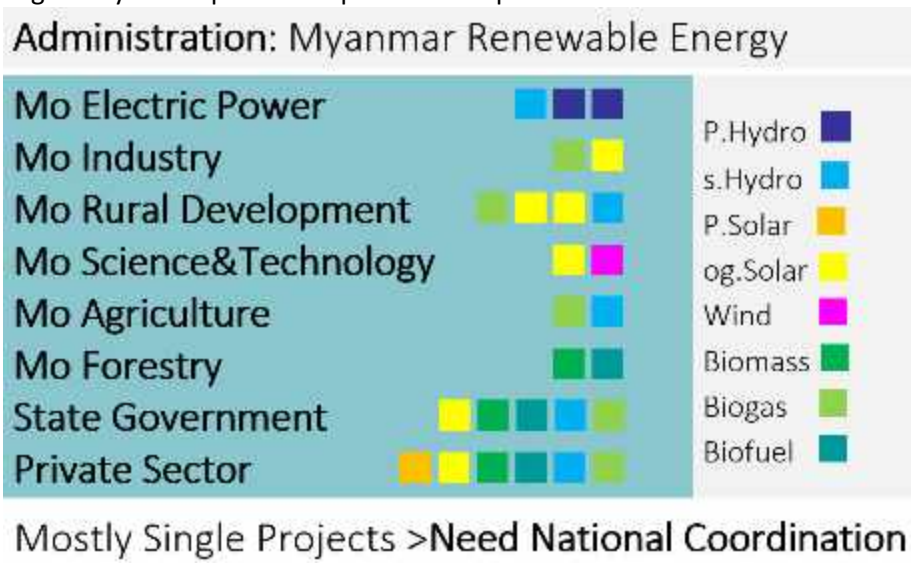
The most extensive RE experience in terms of years and engineering challenge is with hydropower. As however the opportunities are changing, also the number of specialists in this field is diminishing and existing knowledge is effectively being lost.

Biomass based RE activities similarly see reduced enterprise engagement. Donor engagement, once strong on bio-digesters and fuel-saving stoves is no longer a strong economic factor; biofuel engagement was effectively stopped with international competition and national restrictions; gasifiers find the market increasingly difficult with more restrictions.

The dominating business today is solar PV electricity generation (solar thermal being almost insignificant) since enterprises find PV easier to implement throughout the country and financially more attractive. The market has developed tremendously with PV panels at internationally competitive prices very visible all over the country.

But also the PV market is facing restrictions with public projects beginning to be distributed in large scale and free of charge.

Fig.2 : Myanmar public and private RE experience



2.1 Project cycle management

The experience with RE projects to date has provided valuable technical insight. For a sustainable, viable and adequately scaled distribution however, two impediments were observed:

- Most projects are single, one-off initiatives, handled with significant input of time and effort, and terminate when external funding is ended. Viability mostly is no factor so replicability is low.
  A large scale national roll-out will require a smooth coordination which creates a self-sustaining and expanding stream of projects.

- Most projects do not follow a project cycle, which spans from development to implementation to evaluation and feed-back and will typically last several years. Projects rather concentrate on installation and often end when difficulties arise.

Project cycle management (PCM) follows distinct steps and aims to learn from the experiences along the way in order to improve the next cycle. This evolutionary approach was developed for rapid scale up of dispersed distribution projects and has shown reliable results. It applies to public and private projects, to grid connected and to off-grid applications and to all technologies. It requires consistent project supervision and a dedicated budget for monitoring and evaluation.

1. PCM starts with the technical design and the development of a viable project model.
2. The following project preparation seeks to select most appreciative recipients who are willing and able to perform the project technically and economically. Clear rules have mutually to be committed. Most prosperous communities are the best start, weaker recipients will follow when the project conduct is established and stable.
3. Only when commitments are met, procurement and installation of hardware will follow. Longevity and serviceability of material are important. Recipients should know where to get service and replacements.
4. Operation starts with a mutually agreed commissioning document. Performance data will henceforth be noted and remitted, in the early phase more often than later in a stable condition. Operation data are most important for a useful feedback. They allow early detection of problems and a continuous improvement for all. In spite of clear benefits, monitoring is often neglected.
5. Service is a scheduled inspection, before costly repairs become necessary. For cost reasons, this service visits are done in levels of intensity, the most simple servicing to be performed on recipient´s level. Service has a cost, and recipients have to be ready from start to shoulder this cost.
6. The evaluation of monitoring and service reports is critical to determine whether the original design and project model is useable. All improvement enters into pos.1 and closes the project cycle.

Fig.3 : RE experience development with project cycle management (PCM)

Components of an Energy Service Structure :

System	Develop	Prepare	Procure	Install	Operate	Maintain	Service
Power Hydro	Public+ private	n.a.	yes	yes	n.a.	mostly	yes
Small Hydro	less	Indivíd.	yes/indiv.	yes	yes	occasion	repair
Power Solar	proposals	one	-	-			
OffGrid Solar	begun	plan	yes	yes ...	village	open	no
Wind	test	-	-	-			
Biogas	some	difficult	yes	yes	no	no	no
Biogasif.	yes few	yes	yes	yes	yes	op	yes
Biofuel	test	pilot					

Myanmar RE projects follow this cycle to differing degrees. Utility scale hydro power projects by the MoEP follow the cycle quite diligently. PV and wind power projects are not yet operational. Biofuel projects have not gone beyond pilot phase. Small hydro and biogas projects are focused on installation and performance data are mostly unavailable. So are data on numerous small PV projects. New PV electrification projects under the DRD are installed at larger scale, have developed models and preparation procedures, but no provision for service, monitoring and evaluation.

All international experience including that of neighboring countries like Bangladesh, Thailand, Vietnam and Philippines, has shown the importance of maintaining this cycle. It always was possible with strong public support to concentrate on installation alone, but it always failed sustainability. As soon as structural problems arose, projects had to enter into costly repair measures or abandon the entire plan. Myanmar has experienced such a corrupted approach with its large scale Jatropha program. From today´s view, this could have been successful with structured project management.

The institutional setup for project management will vary for the technologies and also from country to country based on organizational capabilities, available budget, geographical extent and administrational support.

Generally however it follows the rule of starting small in an easy environment, improving decisively with strong monitoring and evaluation, and then scaling up fast.

2.2 Institutional Gaps

RE technology development in Myanmar is handled by the responsible institutions in different ways, according to technical requirements and mandate.

Utility scale hydropower as an established technology is the responsibility of the Ministry of electric Power. Emerging and non-viable technologies are at the attention of the Ministry of Science and Technology.

This is consistent with the vision of the International Energy Agency IEA:

Fig.4 : Generations of Renewable Energy

IEA defined 3 generations of renewable energy technologies:

1st generation which is long time established, like hydropower in Myanmar

2nd generation which has matured within the last 20 years to a reliable source, such as solar and wind plants, large biogas installations. Existing regulations, have not always kept up and planning capacity needs to be updated on these technologies. This is where this TA will set the focus.

3rd generation which is continuously developed, but has not always reached maturity and viability. This will need further public support.

MoP clearly represents the established generation which in Myanmar is hydropower. MoST is clearly mandated for the third generation, which needs further attention and sometimes research to establish viability. MoST also is responsible for training and education which for RET is a key factor.

The 2nd generation which is on mature RETs however, which are solar, wind and biogas, and today internationally represent the most dominant field of energy investment and receive the highest capital investment foremost from private operators, is still marginalized to undefined "others" in the National Energy Policy:

"If on the basis of studying made by the directorate indicate feasibility for construction of electric power plant for other industries, the said project would be transferred to other relevant ministries or other interested private parties"

It is this 2nd generation of RET where Myanmar is most lagging behind and is in need for a strong lead office. These technologies are readily available and commercially proven internationally to hold an important potential to economic development and technological world standard.

The energy related Ministries in Myanmar are in a process to divest from implementational tasks and rather concentrate on policy and supportive framework.

The RE lead office for mature energy project development therefore will be founded closely attached but independent from the existing Administration.

2.3 Institutional Requirements

In the attempt to fully utilize the option of today's mature RE technologies, GoM will need to set up a strong institutional support with a solid mandate and clear, transparent and efficient procedures.

In order to become successful and use the limited resources efficiently, a National Renewable Energy project management has to include both, public and private project initiatives.

The good work of the various Ministries in the RE field has the benefit that Administration is aware and exposed to technologies, and this should be continued by all means. In order to share experience to the national RE development, monitoring and service of these systems have to be bundled and evaluated.

1. As the first step, available data on RE project experiences throughout the institutions will be compiled and evaluated. The evaluation will cover technical, economic and institutional aspects. This will require limited personnel resources. Good results were achieved using students from technical colleges.

2. In a Second step the evaluations serve as a basis for the formulation of project development procedures and the necessary regulations. This will need to adapt to Government procedures and consider financial arrangement. So legal and economic capacity will be required. The regulations will be coordinated with the relevant offices in Government, particularly DRD and States energy planning as well as with private sector actors.

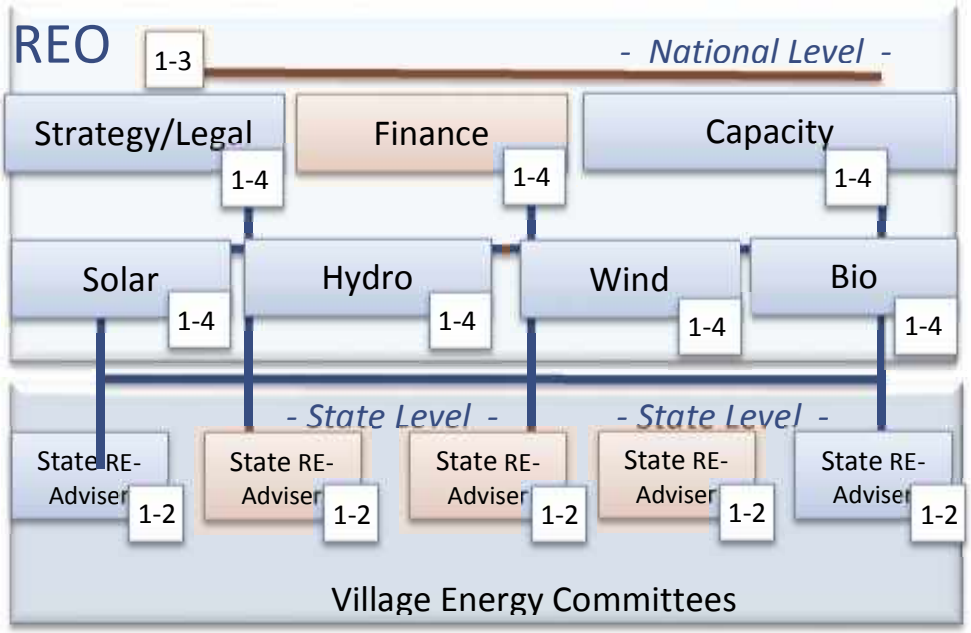
3. As the Third step a detailed training program will familiarize RE project developers, project managers and technicians with the procedures and regulations. In addition, technical advisers and technicians will be trained in project design and economics. Target group will be public energy administration, State engineers, private enterprise and NGOs as all these stakeholders will have to contribute to a National program. This will require extensive training capacity and suitable facilities.

As the number of projects will rapidly expand, so will the need for trained project management and monitoring and the need for trained project design and development. As projects will increasingly be designed and implemented by the 20 States and regions, all State engineering offices will need trained RE advisers.

3. The Renewable Energy Office

The institutional body to perform this development and training needs to be of a National scale and independent of political and commercial constraints.

Fig.5 : Renewable Energy Office



The proposed organizational structure is shown in Fig.5.

Only an independent institution can provide the required service:

- Consistent design and application of standards and quality control
- Consistent performance monitoring and evaluation
- Consistent financial management and sustainable operation.

Such an office is not yet existing and needs to be established. In this document it will be dubbed the Renewable Energy Office (REO) and can be set up in different legal forms, as will be detailed below.

REOs personnel requirement could start with about 8 qualified staff in the first step, and would expand to 90 specialists when National operation is fully developed. Added would be staff to perform the regular monitoring tasks.

The present activities on RE projects are deeply rooted in the various ministries. It is therefore unlikely to assume that this engagement will be changed within a short time frame in favor of a centralized handling of RE, as this is the case in neighboring countries. This pertains in particular to hardware acquisition and new installations.

Repair and upgrading is less favored as is regular maintenance. This leaves a serious gap for service, advice and information which needs to be addressed with utmost urge and importance. The need for such a body is acknowledged by the GoM and addressed in the NEP by the commitment to a RE directorate.

The final size and structure of the REO will depend on the legal background and position within the national energy administration. An important factor is the extent of nationwide actions, as can be gleaned from the task list below.

3.1 REO National Activities

- Prepare and maintain a nationwide inventory of RE installations
- Organize and supervise a nationwide network of monitoring staff who will at regularly and at scheduled intervals review RE systems and their performance and report in a standard format to the REA
- Provide a nationwide service for RE installations with regular, scheduled maintenance to ensure proper performance.
- Arrange for data sheets and installation instructions to be commonly available and to be distributed with the sale of RE products
- Monitor the project data and facilitate necessary action
- Establish standards of RE components by selection and adaptation of international standards and regulations
- Maintain standards in the design, procurement and installation od RE systems
- Arrange certifications of RE components by testing compliance with standards

- Issue labels of compliance to mark products of tested quality
- Assist in the assessment, planning, and installation of RE systems supplied by government, private companies or NGOs
- Assist in the sourcing of suitable spare parts, appliances and add-ons to RE systems
- Assist village energy committees in operation and maintenance of systems, collection of service fees, formulation of rules and efficient upgrade and expansion of energy services
- Advise GoM in tendering RE projects according to national and international practice
- Establish and summon regular and scheduled meetings on the steering committees on environmental issues, biomass management, biofuel development, and household energy
- Establish standards for training and certification of RE designers, technicians, service advisers
- Develop and improve curricula for training interventions
- Arrange for regular and scheduled training courses for RE designers, technicians, advisers
- Advise MoST in the development of syllabus and curricula on RE technology in technical Colleges and Universities.
- Arrange for information campaigns on RE for the benefit of suppliers and end-users by radio, TV, print media and suitably targeted brochures and leaflets

While hardware acquisition and installation will likely remain with ministries and states, the REO will concentrate on providing the knowledge to sustain the country's enormous RE options.

Many of the services described above need to be performed centrally, such as data management, training, certification and information. Many however, must be provided locally, side by side with the state planning and close to the people and villages. This calls for a regionalized network of knowledge and advice.

GoM has an opportunity if not obligation to form a workforce of knowledge and highly skilled service, creating an RE employment demand in the process where before it was solely providing material.

3.2 REO Legal Options

A Renewable Energy institution, her for consistency called REO, needs to have full Government support and also confidence from private enterprise and development partners. REO may have different legal forms, from a public office to a private corporation or a more socially oriented cooperative.

During the creation of the National Energy Plan NEP the extent of REO´s tasks and responsibilities were not mentioned in detail, so at that time the proposal of a Government Directorate appeared to be appropriate. In the light of the need for an efficient energy service unit as described above, there may be alternative options to be considered:

1. Government Directorate

Strength: GoM has staff experienced with RE and can detail them with little budget constraint. By power of the NEMC board, the REO can be vested with authority and mandate. Likewise, cooperation of NEMC ministries can be assured.	Weakness: Yet another Government body may not instill confidence with non-government partners. Public officers are not always motivated. Swift and efficient action may lose momentum in bureaucracy. Inter-governmental changes may hamper a long-term work program.

2. Private corporation

Strength: Confidence from business community and international partners. Qualified personnel easier to recruit. Independent from political movements. Efficient operation and adaptation to demand.	Weakness: Government supervision must be provided. Personnel cost may be higher. Preference for commercial solutions vs social welfare.

3. Social corporation

Strength: Confidence from end-users and international partners. Democratic standards: Government and users share responsibility. Qualified personnel motivated not only by salary. Independent from political movements. Operation efficiently also by social standards.	Weakness: Government is only paying member. With social goals, cost will be permanent issue. Various members will have various, maybe conflicting views. Good and respected leadership is crucial.

Each of these options has its merits and risks. The third option of a social enterprise like a cooperative has the advantage that GoM, private sector and recipients are responsible members.

Although in view of the on-going activities and the demand for clear signals on RE development there is a need for a decision.

As a fourth alternative, the options can be combined. There are good reasons to centralize tasks like data collection and performance monitoring, like standards development, certification and training.

But advisory services and maintenance service can be regionalized in social corporations such as cooperatives. Other than in highly centralized countries like Thailand or Malaysia the federal system of Myanmar would support a regionalization. India e.g. has numerous regional service corporations working in cooperation with the national REO.

3.3 REO Integration

Whichever organizational model is chosen, it is imperative that a Renewable Energy office must be firmly integrated in the Myanmar Energy Administration and enjoy a clear and robust mandate. The tasks and interventions related to Renewable Energy in many ways need institutional support and orientation. In the on-going restructuring of the energy sector GoM will be determined to streamline frame conditions and procedures and establish responsible mandates. An important step is the creation of the Executive Secretariat on rural electrification which secures high-level support, but for the day-to-day cooperation REO will be indispensable.

The most appropriate administrational link of REO to the energy administration would be the National Energy Management Committee NEMC.

Fig.6 : NEMC Institutional Framework (as shown in National Energy Plan)

As stated in the National Energy Policy, the NEMC has a wide variety of tasks :

Duties and functions of National Energy Management Committee **[NEMC]**

1. To formulate National Energy Policy based on energy demand, production and fulfillment of energy requirement on energy matters of the State,
2. To formulate Energy Regulation for ensuring implementation of energy development of the State accords with National Energy Policy,
3. To supervise the facts and figures on energy for ensuring qualified and accurate statistics,
4. To coordinate with Privatization Commission and Myanmar Investment Commission for changing the ratio between state-owned and private-owned sectors through privatization,
5. For development of electrical sector, to fulfill the current requirements by laying down short-term plans,
6. To lay down long-term plans based on sustainable development of industrial sector of the State and GDP to be able to meet the increased demand for electricity,
7. To generate electricity with the use of COAL as in many other countries as there has been greater demand for electricity and to use Clean Coal Technology (CCT) aimed at placing emphasis on environmental conservation,
8. To strive for generating electricity depending on regions and topographical situation with the use of solar power, hydro power, wind power, geothermal, bio mass and bio fuel to be able to meet the public demand for electricity,
9. To formulate necessary measures for adequate supply of energy for development of industrial sector,
10. To take systematic measures in laying down development plans to be able to cover three sectors as energy, industrial and electrical sectors are mutually dependent,
11. To prioritize and supervise oil and natural gas and natural resources to be able to meet domestic demands,
12. To carry out oil and natural gas production through local and foreign investments To sell value-added petrochemical products rather than unrefined ones,
13. To coordinate natural gas and electricity generation in order to meet Urea fertilizer demand of the agriculture sector,
14. To adopt convenient pricing policy for both consumers and investors depending on international prices,
15. To explore environmental impact and social impact assessment ahead of the implementation and to release information the people should be informed of,
16. To enforce energy sufficiency ambition in industry, transport and household sectors and cut energy wastages,
17. To invite foreign and domestic investments in energy development and increase FDI in accord with international norms,
18. To conduct necessary assessment to participate in civil nuclear energy activities in ASEAN,
19. To adopt National Energy Security Strategy that envisages the future generations, apart from the current energy issues
20. to make arrangement for drafting necessary law, rules and regulations to be able to implement in accordance with the National Energy Policy and National Energy Security Strategy
21. to invite the President Office, Union ministers, representatives of Pyithu Hluttaw (Member of the Natural Resources and Environmental Conservation Committee) and Amyotha Hluttaw

Consolidating these tasks leads to the following key responsibilities of NEMC :

- Formulation of National Law. Energy related rules and regulations,
- Policy development for energy development. Prepares short-term and long term plans and systematic measures to ensure energy sufficiency
- Energy development RE solar, hydro power, wind power, geothermal, bio mass and bio fuel
- Energy development, industrial sector
- Tariff development on tariff structure, pricing
- Energy Planning and data management ensuring qualified and accurate statistics
- Business development, invite foreign and domestic investments, privatization
- Impact assessment, environmental and social

To be able to fulfill these responsibilities the NEMC will best assume six completely new functions. At present many coordinating functions are handled by representatives of the Ministries to the NEMC. The organizational set up shown below will place the NEMC closer to the line Ministries and provide immediate access to the capacity of the NEMC.

Fig.7: Renewable energy Integration into NEMC

NEMC was established in 2013 as an inter-ministerial support office to develop a more coordinated approach. With the formulation of the National Energy Policy NEP the responsibilities of the NEMC have increased in volume and significance and need more cooperation among scattered responsibilities in order to avoid overlapping of actions and fractionizing is a prudent measure. Among established Government bodies this is a challenging task which requires time and determination and still is the right thing to do in view of a more responsive and efficient governance.

Continued strengthening of the NEMC therefore is paramount task and assigning national RE supervision to this office will have favorable bearings.

3.4 Capacity Development

The Myanmar development goals rely on a rapid expansion of power production and power access. RE has been acknowledged as a veritable contribution to achieving these goals:

Power production can be enhanced in a cost-effective way by distributed grid connection of utility-size RE plants.

Power access in an expansive country with low electrification rate can rapidly be enhanced by off-grid RE installations.

In order to take advantage of RE technology, it will be a major task of the new RE office to develop the necessary capacity to competently and efficiently apply those technologies. As RE is an entirely new field and the existing technological background is low, the expanse of the country and the time pressure in development make this a task of challenging size.

A business-as-usual approach neglecting the enormous capacity need would inevitably lead to wasted investments and a generally poor reception of the new technologies.

Just as the stakeholders in RE technology vary from Government offices to private enterprise to village communities, their specific capacity demand varies considerably in level, content, purpose and language.

An inappropriate capacity development program which is not based on the existing abilities and specific requirements of the different stakeholders would fail in cost and dissemination.

This report section presents a targeted capacity development program, adapted to target groups, responsibilities and scale-up requirements.

3.4.1 Demand

National Energy Management Committee

To be able to fulfill its new responsibilities the NEMC will have to assume completely new functions, also in the set-up and guidance of the Renewable Energy Office. The RE policy will have to be fine-tuned and promulgated. Laws and regulations have to be prepared. The REO will need a work-plan, priorities, location and personnel. Providing meaningful visions and career opportunities would also help.

Overall, an enabling framework for the RE sector in Myanmar will have to be created. The first task will be to build the capacity to perform these functions in a timely and effective manner.

Renewable Energy Office

The REO as the national lead office for Renewable Energy will have to demonstrate expertise in all subjects of RE application, of planning, design and operation, it will also have to coordinate the capacity building measures of the sector. This is best done in a training office which coordinates with suitable training institutions. It will include the design of trainings for various levels of RE practitioners, the certification of advisers and system planners and the up-dating of specialists who have already undergone training. The

capacity to develop a suitable training plan will be another priority task requiring administrative capacity background.

State Energy Offices

State offices assume the mandate of energy supply in a new and expanded way. The capacity of performing this planning and implementation task varies among States, but generally will need up-dating and expansion of capacity in the entire field. Regional RE advisers can be of assistance in preliminary project design and pre-feasibility study, so villages who cannot afford professional consultants have assistance in the crucial initial steps of power development

Private Enterprise, NGO

National regulations will require that private companies including NGOs involving in power generation have the necessary competence and certification. This will show their proficiency and knowledge of standards and regulations and will secure RE investments for long operation times. In rural electrification, better knowledge of developing and operating private mini-grids will be an asset. Knowledge of standards and impacts also here will be of benefit. Private developers also will have to train village committees after installation and commissioning in operation and maintenance.

Communities

The approach of community based development holds many advantages in improving power access and service quality. Village councils assuming these new tasks of power operators however, have to be trained and coached in this new task. Considering the large number of village concerned and their remote location, these capacity building initiatives will require substantial resources, not at least in trained personnel.

3.4.2 Status

Myanmar does not yet offer formal training on RE technologies. There are occasional courses sponsored by NGOs, development partners or companies. Government officers went to specialized training abroad. Other acquired god knowledge on the job with often internationally sponsored projects. The overall volume of RE capacity available in the government sector is however limited.

A comprehensive training structure still needs to be developed. In the anticipated large scale national roll-out there is a substantial demand of capacity building in various levels and subjects.

In the commercial sector, the limited demand for RE installations is one reason that practical or vocational training is very limited and practitioners widely have to rely on self-education. The capacity demand depends on the different levels of responsibility and is ranging from overall planning and managing to installation and service.

Formal education

The development and commercial recognition of RE Technologies is a reason why internationally, RET are entering the syllabus of higher education. This will also be the case in Myanmar. The rapid development however is a reason that formal education cannot yet offer the required capacity volume. For some time, Myanmar will have to rely on international courses. And it will have to create their own training network.

3.4.3 Methodology

The necessary extent of required training and the need for training in the local language strongly suggests to develop a training of trainers structure. Trainers will need to have a suitable professional background and knowledge in English terminology. They will attend the courses of their specification and assist in designing the training material in local language. Upon successfully completing their subject courses they can apply for a trainer's position and will receive an additional background in didactics and methodics. A trainer´s position will receive an appropriate remuneration and a contract opportunity for several years.

In fields with a good national experience base such as hydro power, it is important to include experienced trainers so as to maintain the valuable existing knowledge und build on for future development.

The vision of a permanent job in a new and developing field justifies that courses are charging appropriate fees. Only the introductory courses can be free in order to lessen the barriers to a widespread general knowledge on the technologies.

A nationwide capacity building initiative on RE will involve a significant investment in time, cost and personnel and is likely to meet several challenges:

- The quantity of the capacity building measures particularly in the village- and regional level is enormous. Advanced technical training in 20 States and Regions and in different languages is a first task, enhanced by the need for a basic training on operation and maintenance in about 20,000 remote villages all over the Union. A central training facility will impossibly cope with this volume.

- The language on RE technology and training materials in general is English which in Myanmar at this time is not widely known and not often used in reporting and data bases. While technical personnel in Government and commerce are slowly adopting the terminology, regions and villages will for some time to come have to rely on local language.

- The cost of capacity building for a whole new field of technology must not be underestimated. While capacity building in the long run will always pay for itself in achieving self- reliance, quality and sustainability of service, the cost of qualified training initially will be a substantial barrier.

- The personnel for large scale training interventions is at present not available. While international development partners and commercial affiliates can be expected to provide important initial inputs, a national training force has to be built up rapidly.

The appropriate answer to these challenges is the design of a nationwide training-of-trainers program:

As RE technology in the country is developing and expanding, so is experience and knowledge. It is important to regularly update and refresh knowledge on all levels. The training facility therefore will not be a limited endeavor but rather a permanent and developing institution.

An advantage for learning in Myanmar today is the rapid expansion of communication and internet access. This opens valuable opportunities for e-learning, for on-line assistance and remote monitoring. The major benefit will be in reduced cost and standardized training content. It will not entirely omit however, the need for personal attention.

The RE training program whether nationally or regionally will need a home base. For reasons of accessibility and resources a base in Yangon will be most accepted. Possible institutions existing are the Renewable Energy Association of Myanmar REAM and the Myanmar Engineer´s Society MES, which is already availing of suitable premises.

3.4.4 Structure

A capacity building structure adapted to various levels and subjects will follow a Vertical and Horizontal Capacity Development model:

Vertically, the levels of expertise and responsibility show from low up to top. This corresponds also to the extent of training: RE introduction on the basic level will have to be shared with all RE actors throughout the country, an estimated 30.000 people. Policy will concern those responsible with policy development and implementation, less than 1oo specialists.

Horizontally, the four main subjects will receive the same training in level and purpose, from technical basics to design and operation. Trainings will however be specifics for subjects. Depending on the subject the extent of capacity development will vary from about 500 for solar to 25 for wind.

Fig.8: Renewable energy Capacity Development model

These capacity components can be organized according to target groups. Table 2 shows a matrix with a basic set-up of curses and the target groups. The courses will be distinct from duration, applicability of fees, language and issuance of a certificate.

Tab.2 RE Capacity Development Matrix

Target Group → / Subject ↓		Duration	Cost	Language	Certificat	Ministry MoEP DRD	NEMC	REO	State	Developer	Installer	Monitor	Village
Introduction RE		3	-	M	A	X	X	X	X	X	X	X	X
Maintenance		2	-	M	X			X	X	X	X	X	X
Design Hydro		5	X	E	X	X	X	X	X	X	X		
Design Solar		5	X	E	X	X	X	X	X	X	X		
Design Biomass		5	X	E	X	X	X	X	X	X	X		
Design Wind		5	X	E	X	X	X	X	X	X	X		
Installation		5	X	E	X			X	X	X	X	X	X
Operation		5	-	M	A			X	X	X	X	X	X
Project Development		5	X	M	A	X	X	X	X	X	X	X	
Project Management		5	X	M	A	X		X	X	X	X		X
Policy, Regulations		3	-	E	A	X	X	X	X	X			

The courses are designed to attend to officers and private personnel who will need them to perform their duties within a national RE advisory network. It is understood that this workforce has to be created before courses can be held effectively. Training of staff who are not formally assigned to RE work and are not committed to the tasks ahead would be futile.

The content of the courses addresses actually applied RE technologies. It is therefore required to have a nationwide implementation strategy in place and operational. Training on subjects with no actual projects to follow would be futile.

Courses are applied to grid-connected and off-grid applications. They may develop into more specific orientation as the need arises.

The tables below give an overview of the content for the various training modules.

Course	**Introduction to Renewable Energy**
Target Group	All RE stakeholders
	3 days, free, Myanma
Structure	Test on subject questions, confirmation of participation
Indicator	Presentation with multimedia based on handbook
Methodology	
Agenda	RE Potential, intensity, strength, weakness
	Wind conversion
	Hydro power
	Biogas and Gasification
	RE policy Myanmar, support mechanisms

Course	**Maintenance**
Target Group	All regional and field practitioners
	2 days, free, Myanma
Structure	Minutes, confirmation of participation
Indicator	Presentation, group work, practical exercise
Methodology	
Agenda	Service, maintenance, repair - comparison
	Maintenance structure and organization
	Cost, price and fee of maintenance
	Maintenance tasks, exercise
	Reporting, plausibility, archiving

Course	**Design Hydro Power**
Target Group	All practitioners hydropower
	5 days, paid, English
Structure	Test on subject theoretical, practical. Certificate
Indicator	Presentation with multimedia, handbook, practical exercise
Methodology	

Agenda	Hydro Potential, flow rate, strength, weakness Hydro power technical options and applications, hybrid use Design models, exercise Cost calculation, optimization, economic comparison RE policy Myanmar, support mechanisms

Course	**Design Solar Power**
Target Group **Structure** **Indicator** **Methodology**	All practitioners solar power grid and off-grid 5 days, paid, English Test on subject theoretical, practical. Certificate Presentation with multimedia, handbook, practical exercise
Agenda	Solar Potential, tilt and tracking, strength, weakness Solar power technical options and applications: Thermal, grid connected, off-grid, hybrid use Design models, exercises Cost calculation, optimization, economic comparison RE policy Myanmar, support mechanisms

Course	**Design Bio Energy**
Target Group **Structure** **Indicator** **Methodology**	All practitioners biomass power generation, grid and off-grid 5 days, paid, English Test on subject theoretical, practical. Certificate Presentation with multimedia, handbook, practical exercise
Agenda	Bio Energy Potential, logistics, strength, weakness Technical options and applications with biogas, gasification grid connected, off-grid, hybrid use Design models, exercises Cost calculation, optimization, economic comparison RE policy Myanmar, support mechanisms

Course	**Design Wind Energy**
Target Group **Structure** **Indicator** **Methodology**	All practitioners wind energy conversion 5 days, paid, English Test on subject theoretical, practical. Certificate Presentation with multimedia, handbook, practical exercise
Agenda	Wind Potential, speed, height, strength, weakness Technical options and applications: Grid connected, hybrid use Design models, exercises Cost calculation, optimization, economic comparison RE policy Myanmar, support mechanisms

Course	**Installation Hydro / Solar / Bio / Wind**
Target Group	All practitioners RE conversion devices
	5 days, paid, English
Structure	Test on subject theoretical, practical. Certificate
Indicator	Presentation with multimedia, handbook, practical exercise
Methodology	
Agenda	Specific RE challenges, technical development
	Technical standards, rules, regulations
	practical exercise, tools, measurements
	Installation organization, logistics, cost
	Quality control, commissioning, certification

Course	**Operation Hydro / Solar / Bio / Wind**
Target Group	All practitioners RE conversion devices
	5 days, free, Myanma
Structure	Minutes, confirmation of participation
Indicator	Presentation with multimedia, group work, practical exercise
Methodology	
Agenda	Operational challenges of RE technologies
	Demand side management: Consumption, supply, power balancing
	Operations organization, time and data management
	Operations cost calculation, fees, meters and billing
	Conflict management and sanctions

Course	**Project Development**
Target Group	Ministry, REO, State, developers
	5 days, paid, English
Structure	Minutes, confirmation of participation
Indicator	Presentation, group work
Methodology	
Agenda	RE policy Myanmar, legal framework, support mechanisms
	RE Options, economics, development
	Calculation of project cost, IRR, fees
	Assessment of feasibility, viability, sensitivity, risks
	Financial models and financing options
	User demand assessment, prognosis
	Project organization, legal requirements
	Design models, exercises
	Cost calculation, optimization, economic comparison

Course	Project Management
Target Group	Ministry, REO, State, developers
	5 days, paid, English
Structure	Minutes, confirmation of participation
Indicator	Presentation, group work
Methodology	
Agenda	RE policy Myanmar, legal framework, support mechanisms
	Organization of project tasks and responsibilities
	Project objectives, strategy
	Planning and records, reports
	Motivation and remuneration
	Cost of quality
	Conflict management and sanctions

Course	Policy and Regulations
Target Group	Ministry, REO, State, Trainers
	3 days, free, English
Structure	Minutes, confirmation of participation
Indicator	Presentation, group work
Methodology	
Agenda	RE Potential, strengths, weakness
	National Energy Policy
	Policy Goals
	Priority action
	Implementation strategy

3.4.5 Road Map

The first training modules will have to apply to the formulation of the guiding rules and regulations, standards and quality assurance measures.

Following will be subject modules for the trainers to be trained. In Myanmar at this time it may be a challenge to identify personnel suitable for trainers. An appropriate remuneration and career opportunity will be helpful.

Next stage will be to develop course modules in local language and for e-learning. This might require specialized external assistance and the corresponding funding for training materials and practical exercises. Development partners could be of assistance in such a demanding endeavor.