

*PROCEEDINGS OF THE REGIONAL WORKSHOP  
OF  
GTZ- MICRO HYDRO POWER GROUP  
SUB-SAHARA AFRICA*

*From 11<sup>th</sup> to 14<sup>th</sup> May, 2010  
At Motel Garuso in Manica - Mozambique*

*This report is recorded in the sequence of presentations  
Reporting team - Hilario Saenz and Heinrich von Geymueller*

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*Tuesday 11<sup>th</sup> of May*

## **Introduction and opening**

### **Introduction speech**

*By Fernando Quelhas (representing Provincial Directorate of Mineral Resources and Energy in Manica, Mozambique)*

The lack of clean energy is still an important aspect in Mozambique where more than 80% of the people do not have access to electricity. This percentage is even higher in rural areas. The potential for hydropower in the country is estimated to 13000 to 14000 MW.

The Ministry of Energy is grateful that GTZ/EnDev helped installing 4 MHPP as a pilot project in the first phase, and is looking forward to see the results from the second phase, that aims to reach about 16000 new beneficiaries through participation of civil societies, private sector and Government sector. Challenges expressed by the government include: O&M for long term use; reduced vandalism and increased productive use for economic enhancement

### **Official opening**

The Workshop on micro hydro power was officially declared opened by Mr. Colaso, representative of District Government of Manica.

### **Opening remarks by the Coordinator of GTZ-AMES-Mozambique**

By Dirk van Eijk (GTZ-AMES-M Coordinator)

- Background of GTZ AMES
- Thanks to the organizers of the workshop
- Special thanks to the local participants from Ministry of Energy, Funae and AKSM
- Welcome of participants from different countries

### **Highlights of Participants' Expectations during introductions**

Some of the expectations and recommendations expressed by participants during self introductions:

- Exchange of experiences including from projects done with German support before EnDev like in Tanzania, Zambia
- To learn more from what is happening in projects in other countries
- Mixed group of engineers, lawyers, political scientists
- Encourage south to south dialogue and cooperation on MHP and draw from experiences in Latin America and Asia. Continue linkages to former actors like Klaus Hornberger now in Nicaragua.

- Increase gender balance in MHP projects and to participate at future workshops
- Encourage participation of local actors or counterparts in regional workshops
- Would like to tap concrete ideas in terms of local production of turbines

## **Workshop Rules**

- To be informal
- Strict time keeping (warning with yellow and red cards as in soccer)
- Sharing of chairing sessions
- Team work

## **Remarks by the Speaker of the Working Group**

*By Peter Schragl (GTZ Uganda)*

- Remarkable progress of MHP Working group considering that the first idea came up in May 2008 and the workgroup was officially launched under the Sector Network in November 2009
- The Focus of the workshop is to share experience so that people can learn from each other including experiences from bad examples – fearless learning, and good examples / best practices – to replicate and further advance

## **Market of opportunities**

*By Andreas Michel (Endev Germany)*

The idea of the market of opportunities is to gather information from each project, the skills and experiences they have in specific topics that they can share with others, and also requests for expertise and advices for specific topics. The idea is then to link those who request for advises to those who offer answers to those questions.

From last year's MHP meeting in Nairobi, a lot of topics were discussed, and some links have been established between projects, but little long term exchange has been maintained. A summary of the offers and requests are presented below (pictures of the pin boards):

Mozambique

Request

- ME - TARIFF DEFINITION
- ME - EQUIPMENT PURCHASE
- ME - BATTERIES RECYCLING
- ME - PRODUCTIVE USE

Experience Offer

- TECHNOLOGY DEVELOPMENT FOR TECH PERSON AND CRUI-FARM - LOCAL PRODUCTION ME
- COMMUNITY ORGANIZATION ME
- SCOUTING FOR TECH ME
- UPGRADING MATERIALS - BATTERY FIT INITIATION ME

Nicaragua

Experience Offer

- Experiences/Results after Installation of 310 MHP
- and List of Things to avoid
- Design of MHPs

Rwanda

- COST COMPARISON
- TECHNICAL PROMOTING TRAINING
- TASK ASSIGNMENT

- BUSINESS PLAN DEVELOPMENT
- FINANCIAL ANALYSIS
- TASK NEGOTIATION
- PLANNING AND CAUTIONS

Request

Benin

Experience Offer

Technical and economic feasibility study to implement the first village project in the area of the central and southern parts

Spatial planning analysis Tool

Site survey tools and business model

Load forecast model Tool

Renewable energy systems / equipment / materials / who gets involved in the job?

economic and technical survey tool (to find out supply)

Uganda

Calculation / determination of reasonable Tariff / TRC / TRCS

Organizational set-up of the community

Business Plan For ACP (in with all partners - all self funded self)

Cost-effective Design Real costs

- Input for structural design of a micro-high voltage power house

PICO GRID

- Operating Strategy of micro-high voltage - what is crucial in making Pico succeed!

What will watermill?

Ethiopia

Request Experience Offer

TOOLS FOR COMMUNITY DEVELOPMENT & COMMUNICATION

GENDER BASED STUDY RURAL ELECTRICITY

WORK IN RDP - COMMISSIONING

Madagascar

FEED-IN LAWS (ETHIOPIA)

"GOOD + BAD" OF MIT IN FRENCH

SCOUT MANUAL (ETHIOPIA)

REGIONAL PLANNING SOFTWARE "GEDSIM"

FUNDS STRUCTURE TO COMBINE SEVERAL DOORS' HEADS

BASIS OF CONSTRUCTION SUPERVISION

FUNDS STRUCTURE TO LINK SEVERAL DOORS' HEADS...

EXCEL-BASED TOOL TO ASSESS FINANCIAL VIABILITY OF PROJECT



## Project update on pico-hydro training held in Mozambique

By Crispen N.Z. Zana (GTZ-AMES-Mozambique)

### Content

- Strategy based on ownership and participatory approach
- Training on site-scouting
- Training on fabrication of pico Pelton turbines
- Training on fabrication of open pico cross-flow turbines
- Participation of gender, youth and government
- Participation of a micro financial institution



## **Battery Kit project**

*By Hilario Saenz (GTZ-AMES-Mozambique)*

### Content

- Introduction
  - Objectives and strategy of Battery Kit project
- Technical part : review of the material and installation
  - Battery kit presentation
  - Devices requirements
  - Before & After
  - Installation, use and maintenance
  - Life of materials, repair and recycling
  - customer information including at social events
- Commercial part : strategy
  - Procurement of the material
  - Price of the battery kit and payment procedures
  - Quantity of kits to sell per area
  - Warranty and Seller's responsibility

## **AKSM project description**

*By Domingos Neto (AKSM- local partner for AMES – Mozambique)*

### Content

AKSM is the local partner of GTZ AMES-M based in Manica province. Its manager; Domingos Neto, presented the results of the project in figures in terms of beneficiaries, income and loan repayments by the community.

### **Discussion**

“There are challenging problems in payment/repayment procedures which require systematic solutions like involving professional micro financing institutions?”

“Former projects have been based on donations, but strategy has now changed. People have to get used to it, and projects have to align their position.”

“We have to open more and more discussions on failures and weaknesses in order to have effective lessons.”

“Since energy is not food and without it, people will not die. We have to be able to stop and change a project if it fails”

“The problem is that many donors still like to be initiators and owners of projects. A better strategy would be to carefully analyse people’s initiatives and work along these initiatives. Encourage more private sector initiatives”

“We also have to deal with the mentalities and bring in sociologists and psychologists.”

“Keep projects small and simple to be in line with the capacities of the operators.”

## **Local pico hydro turbine manufacturing in Indonesia**

*By Gerhard Fisher (Indonesia)*

### Content

- Knowledge transfer : Capacity building is a long-term process
- Cross-Flow turbine: simple and affordable
- Evolution and range of models in Indonesia: T12-T14-T15
- New models developed: TP100 and TC60
- Installed capacity and future perspectives
- Pico propeller and pico Pelton
- Rehabilitation of Pelton PET01-500 in Salido
- Regional Hydro power competence centre <http://www.hycom.info/>
- Trainings and works abroad
- For better maintenance more work was done on standardization
- ENTEC licensing

## **Entec T15 licensing and manufacturing in Ethiopia**

*By Bart-Jan van Beuzekom and Belay Ragga GTZ-AMRS- Ethiopia*

### Content

- GTZ-AMES-Ethiopia implementation approach
- T3 series
- Training on T15 cross flow turbine
- Penstock elements (locally manufactured)
- Civil works

## Discussion

Cost of the locally produced turbine: 1000€/kW for the first turbine.

A main disadvantage of cross flow turbine is that you might lose part of the head, due to difficulties of using a draft tube to make use of the suction head (distance to tail water) below the turbine; especially in low head schemes -2 m out of 10m head is significantly more than 2 m in 50 m head.

Ethiopia works with 3 private companies and a university. There is need to analyse market before high investments into private sector.

## **TP200 presentation / Calculation costs and factors**

*By Gerhard Fisher (Indonesia)*

### Content

- Presentation of TP200
- Trainings : ball bearings, alignment, use of a micrometer
- How much does a turbine cost?
- Product types : Price makers, price takers, the difference is like elephants and rats
- Production costs in Indonesia
- Operation and maintenance costs
- Good design needs feedback

### Discussion

- MHP takes many years to yield remarkable results, therefore requires long term investments.
- Avoid monopoly and allow competition in production
- Engineering quality aspects need close supervision
- Standardization is highly recommended for an improved O+M system

## **Pumps as turbines** (from Hydro Power scout guide pp 89-93)

*By Valentin Schnitzer (Germany)*

### Content

- Good alternative to Cross-flow turbines
- Advantages and disadvantages
- Principles of work: like a Francis turbine, limited range of operation

- Cheap because these are mass produced items
- Can be installed in parallel

### Discussion

- It is better to order pumps as turbines from big manufacturers, who are present in most of the countries or in the regions.
- They need a minimum flow under which they will not operate at all. Measure the flow in dry season.

## Electrical equipment for Pico hydro and mini grids

### Wirings, loads, equipment and protection

*By Nigel Smith(UK)*

### Content

- Distribution design
- **Wiring:** ABC – preferable, but be careful in areas with lightning risk, ACSR – carefully tensioning, copper should be used only for final distribution
- **Poles:** timber is cheapest: use at least used motor oil to protect against termite attack
- **Domestic wiring:** can be very expensive, search for cheap local opportunities, cheap does not mean bad quality, if you are creative
- **Readymade wiring harness** is a cheap option, **use load limiters**
- **Load limiter:** cheap option is the Positive Temperature Coefficient (PTC), and the other is the Electronic Load Limiter
- **Earthing:** All metal parts have to be properly earthed, use a RCD that disconnects when leakage between phase and neutral detected
- **Lightning protection:** avoid direct strikes, use spark gap and varistors

### Discussion

“In Indonesia they have only the Power House earthed. If done wrongly, earthing in households can be more dangerous.”

## **Ethiopian case of practical micro grid design and implementation**

*By Fasikaw Dessie and Bart-Jan van Beuzekom (AMES Ethiopia)*

### Content

- Two MHP sites: Bensa (20kW) and Gobecho (10kW)
- Bensa MHP grid installation approach
- Gobecho: pico hydro power scheme grid
  - Grid design & installation approach
  - Service drop and house wiring
  - Street lights
  - System protections
  - Challenges
- Comparison of the two sites

### Discussion

“Price per kW is not a very good sole indicator because of pilot project and because it gives no indication of how many people were reached (HH connected)”

“Problem of how to convince local people to use new construction material”

## **500W grid to light up a village**

*By Ivan Karau and Peter Schragl – GTZ PREEEP-Uganda*

### Content

- 72 households
- One 5W bulb per household
- Line from Powerhouse to the village (700 m) is buried 1 m under ground and uses an aluminium armoured cable (Solidol 16 sqmm) which is used in Kampala to connect the houses to the grid: 1 Dollar/m (central single conductor used as live, armour used as neutral)
- Distribution stations with load limiters for various houses
- Community contributions differentiated by gender

### Discussion

- Project still looking for more sites
- Be aware of termites attack on transmission cables buried under earth
- Apply grid sizing tool to reduce grid costs and avoid wastage

## **Challenges in MHP sector - Barriers and strategies in Sub-Saharan Africa**

*By Mirco Gaul and Miriam Schroeder from Sinergy (Germany)*

### Content

- Guide Book to provide policy development
- Aim to compare challenges and barriers met in different countries of SSA
- Structure of the background paper
- Perceived gap for MHP sector development : Bottom-Up vs. Top-Down approach

### Discussion

Try to prepare a red line document of some recommendations and good practice as a starting point for any country willing to work in the policy development sector.

*Wednesday 12<sup>th</sup> of May*

## **Potentials of traditional Watermills**

*By Valentin Schnitzer (Germany)*

### Content

- Old technology of over 2000 years, mastered by the Ottomans 300 years ago
- Technology varies from one area to another according to traditions and available materials
- Advantages and Disadvantages
- Example of modernisation of old mills by a new mill built next to the old one

### Discussion

Advice: keep the traditional system running. Use electricity only for lighting to have enough energy for the mill

Mapping of existing water mills

What to do if no existing tradition? Is there a need of installing a watermill before electricity?

Answer: 25 years ago, main demand was for watermills, but now people want electricity.

Watermill is a good business, with high income. It is found mainly where there is/was mining and irrigation.

In areas with favourable conditions to run water mills, encourage operators to shift from diesel operated mills to water.

## **Community mobilization and participation work**

*By Bart-Jan van Beuzekom and Fasikaw Dessie AMES-Ethiopia*

### Content

- Awareness creation
- Identifying the Key issues by building a cooperative community
- Discussing about the key issues
- Trainings on cooperative organisation, administration, management, legal procedures, financial management and technical O&M
- Community participation

### Discussion

Challenges faced by AMES-E:

- “Community did not understand the rules of the game” (energy not free and not for everybody)
- Environmental impact assessment still to be done
- Problem to address women

Women bring the income for the household, while men spend their income from cattle for their own personal purposes.

Are the members of the management committee paid? Answer: Not yet, because MHP is not yet completely installed.

Is there a per diem given for the training? Answer: No, just meals and travel costs are paid.

It is better to have a minimum of women in the committee.

How is it possible to solve the problem of unpaid fees? Answer: the management of the fees has to be left to the community, but here are some examples of solutions:

- Pay fees upfront (at the beginning of the month)
- Cut off the power in the case of defaulters
- Pay fines for delayed payments
- Call the local authorities in case of strong reluctance to pay
- real problem is how to organize the cooperatives
- How to create a paying moral. Solutions: Prepaid or disconnect immediately (but in phases of different intensity, e.g. first switch off power / disconnect cable, only later remove the service line)

## **Mini and Micro Hydro development and prospects for electrification of remote locations in Tanzania**

*By Valentin Schnitzer (Germany)*

### Content

- Study on MHP potential in Tanzania
- The grid developed according to hydropower sites
- Hydropower plants were built either by cooperatives or missionaries
- Rehabilitation by Kfw of a system with complex couplings

### Discussion

Equipment was subsidised by the Federal state of Hessen - Germany.



Management is done locally and maintenance is responsibility of the community, e.g. in one case it is being done by a self motivated old man of over 80 years of age.

Rehabilitation study documents, tools and lessons learnt are available. These will be distributed through GTZ-EnDev.

## Productive uses of Micro/Pico Hydro

*By Nigel Smith (UK)*

### Content

- Mechanical energy vs. Electrical energy
- Example saw mill: starting the motor can cause problems: solution is a *PWM* which cuts the starting process in parts.
- Another option: direct use of mechanical energy
- Example of refrigeration with good experiences from Colombia
- Return on investment is much shorter when productive use included

### Discussion

Electrical Use	Mechanical Use
Lighting, Radios, TV and video	Milling
Battery charging	Dehulling
Cell phone charging	Sugar crushing
Computers, photocopying machines	Oil expelling
Ice making	Refrigeration
Welding	Workshop machinery
Saw milling	Saw milling
Peanut butter	Peanut butter
Juice making	Juice making
Water pumping	Water pumping
Crop drying	
Baking	
Cooking	
Hair dressing	
Sewing, knitting	

## **Productive use: technical preconditions, options and future approach**

*By Gerhard Fisher (Indonesia)*

### Content

- Hydropower: “once you have it, you should use it”
- How to develop productive use
- Advantages and disadvantages of mechanical drive
- Advantages and disadvantages of electrical drive
- Examples of direct drive and electric drive
- Small industrial area
- What should be considered
- Summary on most important points
- Technical requirements for electrical use
- Network design
- Starting current
- Load control
- Ownership : community vs. private

### Discussion

-it would be interesting to have a table with Power used corresponding to productive use (application)

## **Productive: Watermills – direct hydro power, without electricity**

*By Valentin Schnitzer (Germany)*

### Content

- Industry started using hydropower
- In remote areas milling is still the principal productive use
- Different types of mills
- Taste of flour depends very much on the milling process

### Discussion

There is need to analyse local hand operated tools that can be incooperated into productive use of MHP

University of Hohenheim in Germany did some research on problem of noise in hammer mills.

## Field Trip: Visit to Chua

The field trip included the following scenarios:

1. Visit a water mill of Cefasse Mucheca in original state built by owner
2. Walk through the village with the grid
3. Visit to Jimmy Pondo's system
  - Forebay tank build by owner in 1974 with own initiative, design and inputs
  - Penstock and milling machine done by owner
  - Project intervention – improved turbine done locally, new alternator imported from SA, electronic control box done locally.
4. Visit to Lino's system
  - Canal done by owner in the 1980's
  - Self fabricated maize mill
  - Project intervention – Improved turbine done through a local company
  - Electronic load controller done by a company from SA with air heating as ballast for dispersing energy and trials to used dispersed energy for a crop drying cubicle.
5. Comments by consultants:
  - The technology background in the community is very impressive i.e. turbines, mills, canals
  - The project is quite a good start, "curiosity is the best teacher"
  - Vibrations of machines to be controlled by fixing equipment firmly; alignment of flat and V belts to be improved
  - Concern on ballast as dryer ,use power for drying but have the ballast as your back-up (it is part of your controller), use Distributed Intelligent Load Controllers (DILG) to make most out of the generated power and therefore, ensure that minimum power is "wasted" on the ballast.
  - Maintenance requires statistical monitoring; introduce standardised machines for spare parts
  - Conservation of watershed needs attention since farmers are using the same areas for crop fields

*Thursday 13<sup>th</sup> of May*

## **Motors as Generators**

*By Nigel Smith (UK)*

### Content

- Advantages and disadvantages of asynchronous motor
- Construction
- Motor operation
- Slip
- Supply connected vs. stand alone generator
- Number of Poles

Number of poles	$N_s$ (synchronism speed)
2	3000
4	1500
6	1000

- Behaviour of a resistance, capacitor and inductor
- Operating voltage

### Discussion

With the 3 phase induction motor as generator (IMAG) setup using capacitors in the C-2C connection and a defined load there is only one line (phase) of 220 V leaving the installation..

To have a defined load you use a load controller called Induction Generator Controller (IGC). The voltage is controlled, the frequency can vary. On modern devices a change of 10% of the frequency has neglectable influence.

### Practical session

- Use of a Variable Speed Drive to simulate hydro potential and different rpm of the shaft.
- Use of multimeter and tachometer
- Starting the motor as generator with no load
- Calculation of capacitance needed
- Connection on C-C-C
- Connection on C-2C
- Use of Induction Generator Controller and Load controller

## Field Trip: Visit to Honde

Background information given: Funds for construction were sourced through GTZ in form of “Eigenmassnahmen”, originally planned for a bridge over the Luenha River. When it was realized that the budget for the bridge was too big for the available funds it was decided to use them on MHP scheme. That time GTZ PRODER was under the Ministry of Agriculture and Rural Development. During the planning stage the ministerial responsibilities were shifted from the Min of Agric to the Min of Energy. Then the Min of Energy formed coalition with Min of Public Construction and Water, Min of Environmental Coordination, District Government to construct the project. A tender bid was processed and the contract was won by Leo Construcoes Lda. a local construction company. Because of inexperience Leo Construcoes failed to continue when they had only dug half of the canal in wrong positions and after spending 40% of the budget for the canal. Then Africa Construcoes was invited to take over and they had to complete the canal on a limited budget.

Comments by the Consultants:

- Building on rock good idea
- Flood gates not opening due to wrong dimensioning of the spindle and lack of greasing
- Spillway overflowing and canal over flowing on some places showing lack of proper management of the system.
- Trash rack on canal entrance into forebay tank to have screen with parallel aligned bars (for easy cleaning with a rake) instead of a squared mesh
- Powerhouse built on higher level thereby losing head. Tail water shows head loss that would increase power 2 -3m lost on 10.5m is 20 to 30%
- Sizing of electrical mechanical machines – affected political interference. Should be redesigned
- Sizes of pulleys not professionally dimensioned. Redesign and replace the pulley
- Penstock would be better with a single large pipe say dia. 600mm instead of three dia 250mm. less friction losses. Refer to text books for proper calculations.
- Maintenance of canal not adequately done showing weaknesses in ownership – government owned and community managed
- Call for redesigning for rehabilitation
- A simple belt guard should be adopted in Chua (safety!)
- Voltage on each phase is low = 200V; Frequency:  $f = 44\text{Hz}$ ; Current is unbalanced:  $I_1=25\text{A}$ ,  $I_2=25\text{A}$ ,  $I_3=0,3\text{A}$  (Maybe also =0A, unclear documentation; showing that something not correct on the system)
- Bearings on generator need to be checked

Tariff and financial management:

- Household connection = 200Mt (about 6 USD)
- Shops, school, Health post, administration post = 600Mt (about 18 USD)
- Circuit breakers used as load limiters
- Only 60 consumers connected to date and this is still very low compared to planned power
- Cost of maintenance uses all the collected income leaving no cash for salaries.
- Account for the collections in the name of chef do posto vs. ownership

Engineers from FUNAE expressed interest that they would like to copy the design.

*Friday 14<sup>th</sup> of May*

## **Pelton Turbine Buckets**

*By Nigel Smith (UK)*

### Content

- Possibility of use is determined and limited by the available flow and head
- There is an instruction manual on fabrication and assembly of Pelton turbines as a product of the research done in the UK (based on studies in Nepal)
- The pelton buckets used are cast out of patterns (three different sizes) which were handed out to each participating country
- A mech. Eng. Student supported by GTZ Uganda manufactured successfully a turbine using the cast patterns and the available manual

## **Tool for the financial analysis of hydro power projects**

*By Sören David (Madagascar) and Julian Frede (Germany)*

### Content

- A small reminder: PERER Project Set-Up
- Development of the tool: Point of departure
- Development of the tool: Process & implementation
- Overview and outcome of the analysis
  - Project analysis – Basis of the analysis
  - Project analysis – Input sheet (subsidies)
  - Project analysis – Cash Flow
  - Outcome for the AMES-M projects

## **Challenges and barriers in SHP/ MHP Development in SSA : discussion of interview results**

*By Mirco and Miriam – (Sinergy - Germany)*

### Content

Project / Country	Special aspects of consideration
GTZ – AMES - Mozambique	Individual Private power producers, government considering

GTZ AMES - Ethiopia	<p>Demonstration for policy level to learn from practice  Government considering Feed In Tariff (TIF)  Work with civil societies, associations for solar and micro hydro power projects  Organised gatherings where dialogue on policy matters can be initiated</p>
GTZ - Rwanda	<p>Work with private sector who will push the government to change policies</p>
GTZ - Uganda	<p>Policies and regulations focus on big hydro power schemes. Present setup doesn't take hydro power &lt; 1 MW into account. GTZ and KfW Uganda is working with the regulator to revise the Feed in Tariffs and during this project small scale hydro power</p>
GTZ - Benin	<p>Good opportunity to work on policy matters  Introduction of standards</p>
EnDev - Germany	<p>Look for positive benefits of MHP as leverage of policy formulations e.g. electrification of schools  Synergy with bilateral projects that are involved in policy matters</p>

### **Open Sessions – group work**

- Group work was done in four sequences in 2-3 groups in parallel
- Results were either learning and better understanding of the topic or start for more work in the specific topic until the next meeting
- The topics of the sessions offered were:





The results/presentation of the individual groups is partially reflected by the following pictures and will be documented in the [endev.info wikiBattery kit](http://endev.info/wiki/Battery_kit):

⇒ NOT THE BEST SOLUTION

BUT SOMETIMES THE ONLY

⇒ GOOD BATTERIES WITH MAINTENANCE  
OR MAINTENANCE-FREE BUT LESS EFFICIENCY

- 3 LITTLE BATTERIES MORE HANDY THAN A BIG ONE
- AIM FOR 1 CHARGE A WEEK
- REDUCE CONSUMPTION → EG. LED LAMPS
- CHARGE CONTROLLER
- DEEP CYCLE BATTERY
- AVOID INVERTER

- The group will continue their work on battery charging systems (Hilario, Ethiopia, Rwanda)

Session Synchron vs Assynchron:

# AVA SYNC VS INDUCTION

STAND-ALONE

## Advantages of Synchronous.

- 1). More stable voltage & frequency.
- 2). Load controller not essential
- 3). Can start with load connected.
- 4). Easier to use (no capacitors/calculation) & precise.
- 5). ~~More~~ <sup>Fewer</sup> components. 6). Can start motor more easily (?)

## Advantages of induction.

- 1). Robustness (solid rotor, totally enclosed, designed for belt drive).
- 2). Can ~~be~~ extend shaft at far end without much difficulty.
- 3). Cheaper especially for smaller sizes
- 4). ~~is~~ Safe against overload.
- 5). Slower speed machines available
- 6). IF gear drives can be easily connected.

ADDITIONAL ISSUES  
AVAILABILITY OF CONTROLLERS /  
GENERATORS.  
PRICE OF GENERATORS + CONTROLLERS.

DECISION

BELOW 10KW (ESPEC SINGLE PHASE) USE  
ASYNCHRONOUS.

> 30KW SYNCHRONOUS.

Way forward:

- next technical WS of the group will take place in April/May 2011, most likely in Rwanda
- before or at the Sector Network Meeting in Cape Town the (old and new) Speakers will prepare the 2011 meeting
- the results of the MHP WS 2010 will be presented during the Sector Network meeting.

MHP WS Mozambique			11.5.2010 - 14.5.2010	
<b>DAY 0 ( 10th of May, 2010) - Arrival</b>				
180	13:00	16:00	Travel form Beira to Garuso Motel	All
120	19:00	21:00	Welcome Drink	
<b>DAY 1 ( 11th of May, 2010) - EnDev and MHP Technology</b>				
30	08:30	09:00	Registration	
10	09:00	09:10	Introduction and Opening	Welcome remarks and opening
20	09:10	09:30		AM/PS
10	09:30	09:40		td
5	09:40	09:45		OPENING SPEECH - Mozambique
10	09:45	09:55		Introduction of participants
30	09:55	10:25	Open Session: Discuss and Clarify WS Objective	AM
20	10:25	10:45	Setting Context: EnDev and MHP	PS
60	10:45	11:45	Market of Opportunities - review 2009	AM
45	11:45	12:30	>>Tea Break<<	AM/PS
60	12:30	13:30	>> Lunch Break <<	
30	13:30	14:00	Local Manufacture of Components (pico-turbines, motors as generators.)	Update on pico training held in Mozambique -1hours
30	14:00	14:30		Zana
20	14:30	14:50		Local Pico-hydro turbine manufacturing - Calculation factors and experience
30	14:50	15:20		GF / MM
45	15:20	16:05		
30	16:05	16:35		TP200 presentation of the new turbines - update from ID
30	16:35	17:05		Presentation on Entec T15 licensing and manufacturing in Ethiopia
15	17:05	17:20		pumps as turbine
30	17:20	17:50		VS
10	17:50	18:00		
30	16:05	16:35	Electrical equiment for Pico hydro and mini grids	Wiring, loads, safety and protection
30	16:35	17:05		Presentation on the Ethiopian case of practical micro grid design and implementation
15	17:05	17:20		500W grid to light up a village (distribution boxes and self made load limiter)
30	17:20	17:50		discussions
30	17:20	17:50	Challenges in MHP sector development – barriers and strategies in Sub-Saharan Africa 1	NS
10	17:50	18:00	Introduction to Excursion/Field Trip	BJvB
<b>DAY 2 ( 12th of May, 2010)</b>				
30	08:30	09:00	Hydro Power from Water Mills, Electrifying mills, up grading, components, experience	Potential of traditional Watermills for AMES-E - example Ethiopia - mill
30	09:00	09:30		Presentation on Ethiopian case of community cooperative organization and training (technical, financial, ...)
30	09:30	10:00		Rehabilitation of MHP - example of Study in Northern Tansania
30	10:00	10:30		VS
30	10:30	11:00		
15	11:00	11:15	Productive Uses of Hydro Power	productive use of Elec - eg battery charging, direct drive of cooling equipment
30	11:15	11:45		direct drive of machinery
75	11:45	13:00		Water Mills - direct hydro power, without Electricity
300	13:00	18:00		discussions
300	13:00	18:00	FIELD TRIP: to CHUA - Upgrading of Mills	all
<b>DAY 3 ( 13th of May, 2010)</b>				
20	08:30	08:50	Blitzlicht Feedback	
20	08:50	09:10	Presentation Friday program	
180	09:10	12:10	Motor as Generators	practical session
60	12:10	13:10		NS
300	13:10	18:10	FIELD TRIP: to HONDE - MHP plant and operational model	
<b>DAY 4 ( 14th of May, 2010)</b>				
30	08:30	09:00	Opening	Introduction Day 4 + Topic selection
15	09:00	09:15	Logistics payment transport etc	AM
30	09:15	09:45	EnDev / HQ update / Wiki update / Group discussion into Wiki + Task forces	Zana
15	09:45	10:00	Pelton Buckets	Tools + templates...
30	10:00	10:30	Market of Opportunities	AM PS
15	10:30	10:45	Market of Opportunities - linking up	NS PS
30	10:45	11:15	Tea Break	AM
10	11:15	11:25	Financial Study Mosambik + Financing calculation tool INTRO	AM
35	11:25	12:00	Groupwork	all
35	12:00	12:35	Groupwork	all
30	12:35	13:05	presentation of results	all
			Group picture	
60	13:05	14:05	Lunch	all
5	14:05	14:10	Feedback form	
60	14:10	15:10	MHP sector development	MG
15	15:10	15:25	Hydro Scout Presentation	VS
30	15:25	15:55	Tea Break with MHP G+B and HS order coordination	all
30	15:55	16:25	Groupwork	all
30	16:25	16:55	Groupwork	all
20	16:55	17:15	presentation of results	all
5	17:15	17:20	Group	all
20	17:20	17:40	Sector Network + way forward	PS AM
20	17:40	18:00	Closing	Zana Ministry and Funae
	19:00		WS Final Dinner	

Evaluation Questionnaire MHP- Workshop Mozambique 11th - 14th May 2010

	poor	average	good	very good	excellent	total no
accomodation	0	3	9	8	2	22
conference room	0	6	11	5	2	24
field trip 1	0	2	1	12	8	23
field trip 2	0	2	5	7	8	22
transport	1	7	7	7	0	22
assistance by organising committee	0	0	3	8	11	22
meals	0	3	7	6	7	23
entertainment	1	3	3	2	2	11