CASINDO

Capacity development and strengthening for energy policy formulation and implementation of sustainable energy projects in Indonesia

CASINDO WP4: Education and research mission

Topic: Biofuels and energy management
Venue: Universitas Diponegoro Semarang & Universitas Mataram Lombok

Date: 5 – 9 July 2010

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1. Introduction

As part of Work package 4 of the Casindo project, education and research missions are executed aiming to provide the specialists of the five Indonesian partner universities with material, discussions and advice on their topic of interest. In July 2010 two missions were organised by UNDIP in Semarang and UNRAM in Lombok. At each of the locations the specialists of the four partner universities gathered for two days (Medan could not come due to fully booked air planes). Topics of these missions were biofuels and energy management at both UNDIP and UNRAM.

During the second day in Semarang visits were made to a farmers collective jatropha biodiesel plant close to Purwodadi and also a short visit to the Waterland Jatropha biodiesel plant and Jatropha intercropping project in cooperation with the Ministry of Forests. During the first of the visit in Lombok also 2 small scale biogas digesters were visited. Some projects may be considered succesfull while others are not, as will be explained later.

Program of these two days is included in the annex and demonstrates the set-up of this mission. Each of the specialists of the Indonesian universities was invited to present their ideas on the development of their subject and/or research to be able to start the discussion on content and direction. Around 32 lecturers and students attended the meetings and site trip at UNDIP Semarang while the UNRAM meetings were attended by 12 lecturers.

Quite some enthousiasm and effort was observed by the two Dutch lecturers. The interaction between all participants was good (with slightly more discussions at UNRAM).

1.1 Background of mission

In the Casindo projects the five universities will develop education and research on sustainable energy to prepare students for future jobs related to SE and to, as a university, give backstopping for industry that want to make use or produce sustainable energy technologies. This mission is to discuss the possibilities and opportunities for research and education in the areas of biofuels and energy management.

1.2 Objectives of mission

- To assist the Indonesian universities in developing their knowledge on biofuels and energy management and advice them on which direction to head and which topics to include.
- To develop a draft outline of the subject on biofuels and energy management together with the Indonesian lecturers

- To make and discuss the ideas for master programmes at both universities visited and to discuss some of the biofuels draft research plans including short analysis of experimental set ups, materials needed etc.
- To discuss current local SE energy developments and projects with regard to technical aspects, successful implementation, business models, social aspects etc.

2. Presentation as introduction by Ir. A. Hoogendoorn

A presentation was given in both Semarang and Mataram. Major topics: Biogas full scale projects and biogas laboratory R&D, Gasification, Application and purification of animal for small scale electricity production.

a) 2.1 Main questions based on presentation and various discussions:
   - CO_2 trading schedules, how does it work?
   - Help with practical design of biogas + engine test set up (UNRAM)
   - Lots of questions on practical design of digesters (mixing, getting digestate out)
   - Using others substrates to increase gas output
   - Using waste from food industry for biogas
   - C/N ratios of substrates into the digester
   - how to use 2 different fuels in 1 engine
   - practical design of a new Demo biogas digester in Side Karya for 50 cows
   - request by M. Kismurtono of LIPI for possible support of new bioenergy projects by PT Aciditama Solo (biggest chemical company of Solo) where already biogas and ethanol from molasses is being produced
   - discussion on the use of enzymes and bacteria from or inside termites for quicker biogas production (current desktop R&D by TU/e and Ingenia)
   - see also above; the addition of 5-10% waste cooking oil from a krupuk factory to f.i. double the biogas output.

Photograph the presentation of ir. Hoogendoorn at UNRAM (photo by Geert Verbong)

3. Presentations as introduction by Dr. Ir. G. Verbong

Two presentations have been given, one on biofuels in Semarang and one on energy management in Mataram.

a) Semarang

In the presentation at UNDIP, the topic of the lecture has been adapted to fit the program of the day. The focus has been on the introduction of biofuels in Europe and in particular in Sweden and the Netherlands (Ulmanen, Verbong and Raven, *Renewable and sustainable energy review*, 2009). Sweden has been particularly successful in developing and introducing biofuels. The Swedish government has adopted a more pro-active approach towards biofuels, compared to the reactive and reluctant position of the Dutch government towards biofuels. Moreover, Swedish policy not only supported R&D and pilot projects, but also actively developed the market for biofuels by encouraging the production of Flexible Fuel Vehicles and bi-fuel vehicles, giving privileges to the users of clean cars etc. Dutch policy has focused mainly on supporting R&D and blending biofuels into regular diesel and gasoline. However, all efforts to develop biofuels have been only possible because of tax exemptions and other forms of (political, financial) protection.

The second part of the lecture has elaborated this notion of protection. A brief introduction on political sciences and governance has been given and used to analyse both Swedish and Dutch policy. Also, the food versus fuel issue has been discussed and the efforts to settle this issue by introducing certification schemes. Several questions have been answered and topics have been discussed, in particular on the differences between the European and the Indonesian situation and also on what such an analysis means for Indonesian practicioners to organise support for local biofuels projects.

On the second day a brief visit to the vice rector of UNDIP has taken place. In the context of ASEAN, UNDIP is organizing a meeting on innovations in the field of renewable energy. Also, Pak Joko has submitted a proposal (together with TU/e) for a three month stay at Eindhoven or developing a course on innovation and innovation management at UNDIP as part of the master program on Energy. Details of the program have been discussed and dr.ir. G. Verbong has agreed to act as an advisor in this field.

b) Mataram

At UNRAM, the topic has been Energy Management. The lecturer has in presented three different approaches to Energy Management. The first one was on Energy Management within companies or institutions. A general approach to Energy Management in practice, based on a method developed by EPA (USA) has been presented. This is perfectly comparable to the method presented by the representative of UNDIP. However, this method still has to be tested in practice. Therefore, several practical lessons and experiences with Energy Management in companies in the Netherlands have been put forward and discussed.

The second approach was about new business models in relation to social entrepreneurship. This specific topic has been selected because developing new markets for renewable energy is also about increasing social wealth. A conceptual model of business models has been presented and several key factors have been discussed, in

particular the role of the consumer, human resources, financial support, fit with the internal and external environment and legitimation. The role of thess key factors was amply demonstrated by several other presentations and the visit ot he biodiesel plat near Purwodadi (where human resources are one of the main problems). In other community oriented projects (Yogyakarta) one of the main aims has been the creation of new markets, creating local development and empowering women.
In the third part of the lecture, the focus was on the question why it is so difficult to develop and create markets for new technologies lik renewable energy technologies. For this purpose, the theory of Strategic Niche Management has been briefly introduced and the main concepts have been explained by giving examples. In this case the projects carried out (and presented the meeting) by Rosmaliati Muchar of UNRAM are particularly interesting. The projects of UNRAM focus on community development by providing energy (PV, biogas) to small local communities. The approach has been carefully designed in order to avoid the mistakes many development projects have suffered from (and still do). The monitoring and analyse of these projects can provide valuable lessons for other projects on Lombok. The theory of Strategic Niche Management offers a useful framework to carry out such an analysis. This also offers very good opportunities for closer co-operation with on going research by lecturers from the school of Innovation Sciences at TU/e (dr.ir. Raven, dr. H. Romijn and dr.ir. G. Verbong). This will be further explored in the next few months. The expectation is that dr. Muchar (or one of her colleagues will submit a paper for a worskhop on sustainability experiments in Asia that will be organised by TU/e, IHDP and APN next January. Another participant (Lilies Setiartiti) has already submitted a paper proposal for this workshop.

Photograph the presentation of dr.ir. Verbong at UNRAM (photo cortesy by Geert Verbong)

4. Presentations and discussions of lecturers and site visitsof the five partner universities

3.1 UNCEN

Presentation by Ms Libertina Ambari ST in Semarang on the application Sagu residues. The Sagu tree is of the order of Metroxylon Sp.. A lot of discussion took place on the actual process steps which are necessary to obtain the Sagu starch.

Presentation by Petrus Bahtiar in Lombok on Public transportation and traffic jams in the city of Jayapura.

3.2 UNRAM

Presentation by Mr. Yesung on pyrolysis of coconut flesh and biogas production by means of digestion and Fery Citarsa. The coconut pyrolyis oil had a very high LHV around 38 MJ/kg which suggests that is mainly the coconut oil inside the flesh which pyrolysed. The reason for the addition of methanol to the pyrolysis oil is not completely understood.

3.3 UMY

Presentation is given by Indira Prabasari on PUSPER and small scale digestion of cow manure. The biogas is used for cooking and can be used in up to 10 houses. The investment cost for such a digestor can be 6 million rupiah (15 million for a bigger type of digester).

Also some work was presented on the application and search for alternative (lignocellulosic) enzymes for the production of ethanol from waste biomass. A project proposal will be made in cooperation with FACT foundation. Enzymes from cassave fermentation were used and also some grinded termites (!).

Presentation is given by Ms. Lilies on biogas in a village near Yogyakarta.

3.4 UNDIP

Presentation is given by Mohamed Djaeni on Algae and other R&D at UNDIP

The presentation is given by Mr. Joko on the energy planning in Middle Java (Java Tengah), biofuels (especially jatropha) and the draft master education programme.

Figure showing main electricity lines and (renewable) power stations in Central Java taken from presentation by Pak Joko.

5. Site visit to biodiesel and jatropha in Purwodadi (Semarang) and biogas in desa Side Karya (Lombok)

5.1 Visit to farmers collective biodiesel plant KSU " DME Dian Groboban"

DME means “Desa Mandiri Energi” which is a governmental program where villages should be able to be energy self-sufficient for at least 60% of all energy applications including transportation fuels. A visit was made to a small biodiesel plant which was funded by the Indonesian government. Some current problems occurring at this project are:

- As the current cost of the biodiesel produced amounts to 25000 Rupiah/liter,
- a bigger scale biodiesel plant is installed but not functioning
- a (sound?) decision was made to switch from Jatropha to Nyamplung seeds
- no Nyamplung biodiesel is sold on the free market but is used in 750 kVA diesel gensets on site
- Nyamplung oil is black and contains more free fatty acids (FFA)

In total 11 billion Rupiah was invested (1 million Euro) in especially the big unused biodiesel plant and the project still needs operational support by the Indonesian government. The latin name for Nyamplung is "Callophyllum inophyllum" where 1 kg of Nyamplung fruit contains 250 gram of seeds. The seeds contain 60% of oil.

The switch from Jatropha to Nyamplung was not really explained but may have to do with the maintaining of the plants (Jatropha may need more maintenance?). The business case for a Middle Javanese worker to collect jatropha seeds on the fields of somebody else seems very bad: a worker can collect 20 kg of seeds/day and receives only 1200 Rupiah/kg and needs to give half of that to the land owner (a typical Javanese worker in the rural area needs 40.000 Rupiah /day to support his family).

Photographs of the visit to DME Dian Groboban (photos by Geert Verbong), photograph below shows the not operational bigger biodiesel plant (2 m^3 tanks each)

5.2 Visit Waterland biodiesel plant and Jatropha intercropping project

A short visit was made to the Waterland jatropha biodiesel project. The short meeting was with mr. Willem Vonk CFO of PT Waterland. Mr. Vonk presented the Waterland project and everything almost seemed to good to be true (already giving a means of living to 40.000 people in the Purwodadi, giving jatropha oil stoves (designed by Siemens), giving cell phones to the poor farmers, already paying for the planting to the farmers) but it must be said the business model of intercropping and the joint venture with the state owned forest company does need a lot more attention in the light of the Casindo project (!).

The authors including Pak Joko are especially interested in the Waterland business model as one very interesting aspect of the Waterland model is that the cost for the land must be really low or perhaps even zero. At the same time it is known that Waterland BV in the

Netherlands is a very smart and "for profit oriented" privaty equity high risk high return investor. Pak Joko thinks that the company does have a very good management, especially when compared to the other collective biodiesel project visited.

Photograph of Waterland Jatropha intercropping with corn on barren lands (photo by Pak Joko)

Photograph of Waterland Purwodadi Jatropha biodiesel reaction tanks (photo by Pak Joko)

5.3 Visit to 2 small scale cow dung digesters in desa Side Karya

During the first of the visit in Lombok also 2 small scale biogas digesters were visited. One digester for 10 houses was out of operation (too far away from the cows and perhaps also some opposition by house owners who were not connected to the biogas) while the other seemed to be working properly.

The project is also a result of the Governmental " 1 million cows in West Nusa Tengara in 2013" program where 3-5 cows are given to every poor rural family in Lombok and Sumbawa. After the cows gives birth to a calf, the calf has to given to the Government. The market price for a 2 year old cow amounts to 7-8 million Rupiah while the market price for a calf is only 2,5 million Rupiah.

The site of a possible new and bigger digester for cow manure from 50 cows was also visited. It was recommended to use concrete canals ("goot" in bahasa) to shove the cow dung automatically to the digester.

Photographs of operational biogas system for cooking in desa Side Karya (Lombok)

Photograph of potential site for new and bigger biogas project in desa Side Karya (Lombok)

6. Results related to objectives

The objectives as stated in paragraph 1, have been met. The staff members of the four universities agree that the two days meeting has considerably assisted them on developing their knowledge on in the fields of biofuels and energy management. The Indonesian universities now have a good idea of what the most interesting directions of research and teaching are in the field of biofuels and energy management.
More specifically:

- Draft outlines for research have been developed and discussed by Indonesian lecturers, in particular in the field of biogas research (experimental set up, resources)
- Several (parts of) master programmes have been discussed and suggestions for improvement have been articulated
- Local experiments and projects have been extensively discussed with regard to technical aspects, successful implementation, business models, social and cultural aspects etc.

7. Conclusions and recommendations

The general conclusion is that the visit has been successful. The discussions at the meetings have demonstrated that there are still gaps in knowledge at the Indonesian universities in the field of biofuels. Therefore, the exchange and dissemination of knowledge in this field is very useful in order to set up and improve research and teaching.

The field of energy management (and innovation) is not well developed yet, but (some of) the universities involved recognise the importance of this field. One specific point is that the projects and rsearch are carried by members of engineering departments. With the exception of a few economists, there have been no innovation specialists or social scientists involved in the project. For the development of teaching and research in this field, this point should be taken into account. Several opportunities for further cooperation with the School of Innovation Sciences in the field of research have been identified and will be further explored in the Academic year 2010-2011.