African Caribbean and Pacific Group of States

Science and Technology Programme

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WORKSHOP REPORT

Production of non-food, bio-oil supply chains for renewable energy in Ghana: Needs, Challenges and Opportunities

2 – 4, April, 2013
Yiri Lodge, University of Ghana
Legon, Accra, GHANA

Prepared by: Adelina Mensah (PhD), Bennet Atsu, Amadi A. Sefah-Twerefour

Project Partners: The University of Greenwich, University of Ghana, Jatropha Africa, Turner and Townsend, Sam Nujoma Marine & Coastal Research centre (University of Namaibia) SANUMARC, The Marine Biological Association, Consortzto DT Ricerca Per Lo Sviluppo Di Sistemi Innovativi Agroambientali (CoRiSSIA)

BACKGROUND

Carbon dioxide emissions, and energy use and conservation are matters of global concern. Biofuels hold the capacity to meet energy demands with a low/zero carbon footprint. Biofuels are still the only renewable energy technology to remove CO_2 from the atmosphere via photosynthesis. In addition, liquid biofuels will drive CHP engines to deliver energy with high efficiency (38% electricity, 42% heat).

In Europe, a market for carbon has been created in the form of the EU Emissions Trading Scheme (ETS) to help meet the EU's greenhouse gas emissions targets under the Kyoto Protocol. The project ***Capacity building in South Africa, Namibia and Ghana to create sustainable, non-food bio-oil supply chains*** is aimed at EU and African partners jointly collaborating on a project to deliver sustainable non-food renewable biofuel supply chains, destined in the first instance for CHP electricity, and in the longer term, a renewable chemical feedstock linked to low/zero CO_2 emissions. The benefits will be income generation for rural African farming communities linked to the global demand for sustainable 2nd generation non-food biofuels.

Based on a guiding principle of consultation and partnership, the nine workshops being organized under the project are to be developed in consultation with the partners of the ACP Biofuel Capacity building project in South Africa, Namibia and Ghana, the UK and Italy, as well as relevant sectors in the participating countries.

The seventh workshop was held in Accra, Ghana from April 2-3, 2013. It was followed by a partners meeting on April 4th, 2013. The two-day programme on the *Production of non-food, bio-oil supply chains for renewable energy in Ghana: Needs, Challenges and Opportunities* was held at the Yiri Lodge at the University of Ghana campus. The programme consisted of a brief opening ceremony, an overview presentation, ten technical presentations and a practical session for innovations in the biofuel supply chain (*see Annex 1*).

The workshop brought together 31 participants (*See Annex 2*) from various sectors within Ghana, including representatives of the ACP project. The participants from Ghana consisted of:

- Members of Universities and the Academic Community
- The media
- Governmental agencies
- Non-governmental organizations
- Professionals in the energy sector
- Industries in the biofuel and energy production sector

The post workshop report is intended to provide an overview of the issues that were presented and discussed, and how the event contributed towards the national agenda of providing renewable energy in Ghana.

OPENING

The welcome address by the Ghanaian partner, Dr. George Wiafe, centered on the theme for the workshop, with background information on the key participants of the ACP group, and on renewable energy resources. Reference was made to the current energy production challenges in Ghana (known colloquially as 'dum-so') and the ACP Biofuel project. Dr. Wiafe explained that the challenges, needs, current trends, opportunities as well as gaps that were identified from the previous ACP Workshop held in 2010, would also be addressed in the current workshop. The Vice-Dean of the Faculty of Science at the University of Ghana, Professor Oduro Owusu, in his Chairman's address, expressed the Faculty's interest in workshop. He emphasized the importance of the practical nature of the workshop theme and how it contributes to science courses.

The programme comprised of presentations from various sectors that addressed various aspects along the biofuel supply chain, i.e., the producers, the researchers, the investors and the users.

Table 1: Presentations at the Biofuel Workshop in Ghana

PRESENTER	**TOPIC**
Professor Patricia Harvey	*ACP Biofuel Capacity Building in Africa*
Dr. Lawrence Darkwah, KNUST	*Assessment of Biomass Residue Availability and Sustainable Energy Yields in Ghana*
George Kwadwo Appiah, Energy Centre, KNUST	*Biofuel In Ghana: Dead or Alive*
John Afari Idan (BTAL)	*Ghana's Experience on Biogas Production: Needs, Challenges, Capacity*
Mr. Sulemana Issah	*Investment Potentials*
Dr. Joe Asamoah	*Biofuel Production versus Food Security*
Dr. Gabriel Ameka	*Algae as a Potential Source of Biodiesel in Ghana*
Mr. Noble Wadzah	*Unmasking the Realities of Investment in Agrofuels*
Dr. Michael Addae-Kagyah	*Placing ACP Correctly in the Bio-Oil Supply Chain (As contributors of Technology and Innovation, not just as Feedstock Producers)*
Mr. Ogundare Oluwaseun and Mr. Olufemi O. Fatunade	*Accra Polytechnic Bio-Fuel Project – The Integrated bio-fuel plant*
Dr. Adelina Mensah	Biofuel as Renewable energy in Ghana - Innovations

PRESENTATIONS

ACP Biofuel Capacity Building in Africa (by Professor Patricia Harvey of the University of Greenwich, UK)

The presentation by Professor Patricia Harvey focused on where to start, where we are (the energy problem) and where to go. With respect to where we are, she described the continued emission of CO_2 in the UK despite existing policies. There is the need for research and innovation in sustainable non-food bioenergy with options for energy sources such as coal, solar energy and CO_2 capture sequestration methods. The history of biofuel was described from the 1890's through to 2009 to the present. The current energy problem was presented, with a focus on fossil fuel dominance in energy usage and research communities devising means of efficient energy use. She also presented different forms of generation feed stocks of biofuel, the second generation feed stock – non-food source as the basis of the ACP Project, and the exploration of the extraction of glycerol from biodiesel. The biofuel supply chain and economic challenges as well as how to optimize them was also addressed. The presentation was concluded with the challenges of finding cheaper means of producing glycerol so that the EU emits less CO_2

Assessment of Biomass Residue Availability and Sustainable Energy Yields in Ghana *(by Dr. Lawrence Darkwah, The Energy Centre, KNUST)*

This presentation described a number of research projects on renewable energy resource from non-food sources being carried out at the Kwame Nkrumah University of Science and Technology (KNUST) in Kumasi, Ghana. This included *Assessments of Biomass Residue Availability and Sustainable Energy Yields*, and *Waste Vegetable Oil Transesterification using Unsupported Potassium Carbonate Catalyst*. There was a brief introduction on the main fuel, petroleum, being used in Ghana and a provision in Ghana's law, Ghana's Renewable Energy Law, which states that by the year 2020 10% of Ghana's total energy must come from renewable energy.

The objective of the first project research was to enhance efficiency and provide alternative energy supply in Ghana. The presentation focused on four main sections – non-edible biodiesel feed stocks, biomass/biomass gasification project, biogas, and waste-to-energy research. Dr. Darkwah gave examples of non-diesel feed stocks such as Jathropha, castor oil, *Allan blackia*, and waste vegetable oil that are being assessed, as well as challenges such as the controversy between energy use and food consumption and higher product cost. The second research project explained that biogas potential of waste vegetable oil is equivalent to 28% of the thermal energy in woodfuel consumed in 2010.

The numbers of available digestors, feasibility studies on institutional biogas, in addition to evaluations of the Guinness Biogas plant. The Ghana-UNIDO-Korean project, which supports green industrial development in Ghana, biogas technology and business for sustainable growth, was also presented. With respect to waste-to-energy research, the use of plantain and banana stalk for biodiesel production, palm kernel shell and palm fibre (syngas

analysis), corn cobs – pyrolysis (for syngas and biochar, and trigeneration), corn stovers (pyrolysis for biochar) were also descrbed. Finally, emphasis was put on the ability of strong local and international collaboration to help attain the goal of using clean non-food sources to energy in Ghana.

Discussions

Following the presentations, the following issues were discussed:

- The relatively lower yield of biogas from faecal matter versus biodiesel from faecal matter.
- The advantages of the use of biochar from corn stover, an abundant natural resource, in neutralizing the acidity in soils. This could be a better option to artificial fertilizers.
- The use of the trough concentration method to concentrate the solar energy areas like the Ashanti Region of Ghana where solar energy levels are not high
- A simultaneous energy production and sanitizing system such as the pond system in Namibia. The pond has an anaerobic digestor buried 10m underground with a gas capture system in between and algae grown on the pond surface to capture waste phosphorus and absorb emitted CO_2.
- The potentials for generating energy from the enormous waste materials available in the environment in Ghana, instead of focusing on non-food sources.
- The difficulties with lignin in cassava peels for generating biofuel.
- The need for feed-in-tariffs and internal subsidies rather than external subsidies for biofuel projects.

Biofuel in Ghana: Dead or Alive (by, George Kwadwo Appiah, Energy Centre, KNUST)

The presentation provided the results of a survey carried out to assess the status and productivity of companies in the biofuel supply chain and biodiesel in Ghana and influential factors that may impact production. The survey was carried out a number of bioenergy companies in Ghana, located in from Tamale, Accra, Cape Coast and Kumasi. Biofuel companies included Biofuel Africa, Scanfuel (now ScanFarms), Tragrimacs and Kimminic, and biogas companies Beta Construction, and IIR-Ankaful. According to the presenter, most of the biodiesel companies had stopped operating, with the exception of Tragrimacs, which uses sunflower. The survey showed that factors such as bad publicity for the companies from environmentalists, acquired lands not in use and inadequate information on Jatropha and its impacts on the soil, had contributed the failure of the biodiesel companies.

Discussions

Following the presentation, a number of issues were discussed including:

- Criteria for the selection of the case studies, which included a pre-selection of two categories of the production of companies, namely biodiesel and biogas
- The bad press coverage as a result of the need of sensational news by the public, or politics

- The need for proper communication between scientists and the media and proper education of the masses on environmental issues.
- The factors affecting the performance of the companies, namely, lower yields of Jatropha than expected, and the fact that there was insufficient research on domesticating or bioengineering the wild plant. Although some research has been carried out, these had unsuccessful outcomes.

Ghana's Experience on Biogas Production: Needs, Challenges, Capacity *(by John Afari Idan, Biogas Technologies Africa Ltd.)*

The needs, challenges and capacity of biogas production in Ghana were the central theme of this presentation. Pictures of biogas plants that have been set up by Biogas Technologies Africa Ltd were shown as examples of biogas production in Ghana. The presenter described the various needs for production, including policies, financial support, advocacy, and research and technology adaptation of available raw material. He emphasized that challenges involved financial outlay and advocacy, whereas capacity included private sector, polytechnics and science based tertiary institutions, and artisanship capacity. In biogas technology, there is recycling of energy and abundant raw material sources, thus a win-win situation. Biodegradable waste should be seen as a sustainable potential source for development of a renewable energy source. Biogas plants that had been installed by his company have been adapted to suit the needs of individual institutions and the environment in which they were located. These institution categories included educational institutions, hospitality institutions such as hotels, institutions such as the nation's seat of governance - the Flagstaff House, and community based applications such as bio-latrines and domestic applications.

Investment Potentials (by Mr. Sulemana Issah, TRAGRIMACS)

Mr. Sulemana Issah, a businessman involved in the production of biodiesel, introduced the investment potential in biodiesel production. He described the immense investment potential in biodiesel production in competing with energy production from fossil fuel. He also discussed areas of concern in biodiesel production such as the lack of capital and legislation. According to the presenter, 50 million US dollars is used to generate power weekly from crude oil in Ghana, which could be scaled down to 90 US dollars per barrel a week if biodiesel was being used. As a bonus, the Volta River Authority could gain carbon credit. Mr. Issah's told the participants that his company had submitted a proposal to the Ministry of Energy to meet 30% of the energy needs in Ghana using biodiesel by the year 2016, but there had been little progress, due to various factors.

Discussions

The reaction of participants to the two presentations is summarized below:

- The success of BTAL in biogas production and its role in the current energy crisis. There is the need for public education.
- The sustainability of biofuel production from the private sector, which requires time to build up to full scale production

- The need to educate scientists for suitable advertisement and public exposure of the potentials of biofuel
- The need for public awareness for encouraging social acceptance of sewage as biofuel

Biofuel Production versus Food Security *(by Dr. Joe Asamoah)*

The presentation described the various classes of biofuel sources and its use in Africa, with a review of the potential of cellulosic biofuels and the opportunities presented by fourth generation biofuels. Due to enforcement of the Kyoto Protocol, the presenter explained that there has been an increase in biofuel production. However, there were threats due to food security, food versus fuel debate, land ownership and livelihood, and existing statistics on biofuel plantations in Africa. Enzymes for lingo-cellulose degradation, bioethanol from maize, sugarbeats were also introduced in the presentation. The different generations or classes of biofuel sources were explained: First generation sources are the food crops, the second generation sources are the non-food crops, the third and fourth generation sources are the genetically modified carbon neutral crops and genetically modified carbon negative crops, respectively. The presentation concluded on the following statements: Biofuels are a threat in Africa, cellulosic biofuels have potential; there is a plethora of biofuels generation to address; and fourth generation sources have, for now, overcome several challenges.

Algae as a Potential Source of Biodiesel in Ghana (by Dr. Gabriel Ameka, Professor and Head of the Department of Botany, University of Ghana)

The presenter gave an overview of on-going research on the extraction of biodiesel from marine algae and freshwater microalgae, which are being carried out at the Department of Botany of the University of Ghana since 2012. According to the presenter, the continual use of fossil fuel to supply energy needs in Ghana is not sustainable. Biofuel from algae is a promising source of alternative non-food source of biofuel. This is supported by the ongoing research at the department, which has shown that *Ulva flexuosa* provides the highest oil content. The extractive methodologies need to be refined and improved for biodiesel extraction, and for the collection of micro-algae from the wild and growing in the lab for extraction of oil and biofuel production, as well as finding collaborators in the research. The long-term goal of the research is to be able to grow microalgae and produce biodiesel on a large scale.

Discussions

After the presentations, the participants discussed the following issues:

- Prediction of microalgae production on a per hectare basis for large scale production is still in experimental stages
- Involvement of various communities for growing freshwater microalgae
- The potential of marine macroalgae for biofuel
- Experimental studies on oil extraction from a specific *Ulva* species and the cultivation in Ghana of edible microalgae imported from Indonesia which was not successful due to land issues
- The impact of microalgae cultivation on fish production is minimal

- The potential negative effects of water hyacinth on the environment although it can also be used as a resource for biofuel.
- Preservation methods of macroalgae to minimize the transport of water, when it is harvested.

Unmasking the Realities of Investment in Agrofuels (*by: Noble Wadzah, FOE/OIL Watch –Ghana)*

The presentation by Mr. Noble Wadzah assessed the energy situation in Ghana and Africa as a whole, with respect to agrofuel production and the impacts it has on the livelihoods of farmers and local communities in general. He explained that as Africa was now one of the hotspots for producing the much needed alternative to fossil fuels, there has been a land rush by the agrofuel companies for production. The presenter however explained that certain factors must be understood to appreciate the energy concept, such as the conflict between agro-fuel and food security, and land availability which have led to the alienation of farmers from their land. This is because most of the peasant agriculture is the mainstay of food production. In his opinion, the land grabs have caused discontent and unrest with the climate argument and false solutions. In conclusion, Mr. Wadzah asserted that decisions on alternative energy systems must be informed by a thorough assessment of available options and should include the ordinary citizen. The agrofuel production must be community controlled, decentralised and easily accessed.

Discussions

The presentations resulted in an animated discussion between the participants on the following:

- Limitations in the amount of carbon that can be emitted or sequestered in the pond system
- The need to address land issues in solving the alternative energy issues
- Degree of interaction with the Lands Commission to create land use maps so that disputes can be reduced
- The need to involve chiefs, who are custodians of the land, and effectively communicate information about biofuel to involve them in the biofuel-energy discussions
- Lands that have been acquired by closed down biofuel companies have still restricted the access of locals to the land, causing social unrest.
- Effective inclusion of the local communities through effective communication and integrated approaches

Placing ACP Correctly in the Bio-Oil Supply Chain (as contributors of Technology and Innovation, not just as Feedstock Producers) (*by Dr. Michael Addae-Kagyah, Energy Research Group, Department of Physics, University of Ghana*)

The presenter provided an overview of a variety of renewable energy sources and systems, with a focus on biofuel from the fast pyrolysis process. The main advantages of the fast pyrolysis process include the elimination of the issue and problems connected to land, i.e.

fuel from waste materials with a wider scope of applications, and easy storage and transport. Bio-oil can be a viable renewable energy source and its sources include corn, sugarcane, forest residue, etc. Fast pyrolysis is a thermal process that rapidly heats biomass to a carefully controlled temperature and very quickly cools the volatile products formed in the reactor. The main processes are drying, comminution, fast pyrolysis, char separation, and liquid recovery. Electricity, as well as heat transport fuels, can all be acquired from this process. A SWOT analysis was carried out with the participant on the Strengths, Weaknesses, Opportunities, and Threats of the system, which included:

- Strengths
    - Abundance of raw materials
    - People with imagination and enthusiasm
    - Ready investors
    - Stable political setting
- Weakness – poor documentation
    - Lack of networking and collaboration
- Opportunities –
    - Good timing
    - Lot of information available
    - Job creation
    - Wealth creation
    - Platform to launch a technological renaissance
- Threats –
    - Oil find
    - Expensive power supply
    - Geo-politics

Accra Polytechnic Bio-Fuel Project – The Integrated bio-fuel plant (*by Ogundare Oluwaseun and Mr. Olufemi O. Fatunade, Accra Polytechnic*)

The two presenters described the technology and pyrolysis process for generating biofuel from discarded palm kernels following red palm oil extraction from the palm oil industry, as well as the challenges and possibilities in improving the efficiency of the system. A sketch of the system was shown that demonstrated the processes involved. The system included an oil extractor, a nut cracker, electrical energy is generated from the exhaust heat, and the palm kernel cake that is recycled. An electrical generator connected to a mill provided additional services such as corn milling. The construction of the system cost GHC 21, 300 (approximately US$10,650). The main challenge of the system was the recovery of whole tar. The project had been pre-financed by a number of students who had designed it. Currently, there was ongoing work on adding water to the gasifier, since it was observed that the engine operated much faster when water was added. According to the presenter, 1000kg of palm kernel shell costs GHC 35 (US$ 17.50) and 1 ton of Palm kernel cake GHC 100 (US$ 50).

Discussions

The discussions following the presentations are summarized below:

- Bio-refinery and biogas production as a substitute for burning natural resources in the pyrolysis process
- Better strategies to communicate the advantages of biofuel processes to policy makers, including the use of existing platforms.
- Possible increase in efficiency by using the steam in a combined cycle; possible use of the tar produced in Tema oil refinery for bitumen
- The work being carried out by the Energy Commission on renewable energy and biofuel, with support to individual organizations and for research. The Commission has also developed the Bioenergy Policy currently under Strategic Environmental Assessment, with a target of 10% renewable energy production and use by the year 2020. There is an existent standard for biodiesel and bioethanol.
- More training for researchers, and facilitate interactions of experts, researchers, policy makers and the public

Biofuel as Renewable energy in Ghana – Innovations (facilitated by Dr. Adelina Mensah, University of Ghana)

Dr. Mensah informed participants that there was a need for researchers to be innovative with diverse ideas. In general, people most identify with what they know and do not pay attention to what is different. Instead, instead of constructive discussions and dialogue, there are debates in defending a stand. It is possible to harness the creative potential inherent in each person to reach an innovative consensus. This creativity, which can be harnessed through play, was the focus of the practical session on innovation. Participants were to form four groups, and create a possible future with bioenergy. Participants discussed and agreed to take the following into consideration:

- scale (household, community, city)
- type of biofuel
- technology type
- cost
- environmental friendliness
- long term use and sustainability
- carbon mitigation
- combined effects (e.g. improves sanitation, etc)
- water management
- incentives for private sector / job creation
- communication/education/dissemination
- social satisfaction

Each of the four groups consisted of 4-6 members and was given 40 minutes to create their biofuel energy world or community using toys, play clay, paper, markers etc. (Fig. 1). This

process required pre-planning, discussions and a representation of the created world on paper. Afterwards, a representative of the group was to present to the other participants.

Fig. 1: Providing instructions to participants and selection of tools for the innovative session

Results from the Innovation Session

GROUP 1

Two communities within a geographical boundary - an urban and a rural one, were built by Group 1 (Fig. 2). Both communities had different biofuel plants based on population size and availability of raw materials. In the urban area, the biofuel plant ran of domestic water. In the rural area, an integrated farm system with an anaerobic digester that used animal manure and vegetable waste, provided electricity for the community as well as powered internet cafes and discotheques that would discourage the youth from migrating to the urban areas. The group also included a time dimension, which showed changes that would come with increasing population.

Fig. 2: Group One at work and final presentation to the other participants

GROUP 2

This group approached their activity from a problem solving perspective, where the cholera and malaria issues that was becoming prevalent in the community had to be addressed (Fig

3.). It was an urban population that required the management of its municipal waste using a plant that turned the municipal waste into energy. The recycling of other material, such as glass, was encouraged, as well as the rehabilitation of water bodies. Wind mills were also set up to use as back-up energy supply systems.

Fig. 3: Group Two discussing their future community and finally presenting to participants

GROUP 3

This group focused on a Palm-kernel producing community (Fig. 4). Their objective was to find a way to make use of every product from the palm kernel to produce energy for the community. The community was educated about the system, with technical training from experts. A kernel bio-system was set up, which in addition to producing the energy, recycled it as well. The bio-system also had a charging point for recharging electric cars. In response to participants' inquiry about dealing with rodents, the group explained that a waste collection system would prevent their proliferation.

Fig. 4: Group Three creating their future community and discussions with participants

GROUP 4

The final group looked at a University campus as an autonomous, recycling system with water bodies for algae, farms for animals and biomass to the CHP and biogas generator. Sewage from a private residential area and student hostels would provide the sewage needed

to run the biodigester. An educational centre as well as a commission would sensitize the general puplic as well as oversee and manage the energy supply system.

Fig. 5. Group Four putting in representative pieces of their community and presenting

Following the interesting presentations, participants returned to the plenary to discuss lessons learnt from the process and the best way forward. Overall, despite initial hesitation about having to play with the toys, all the participants found the exercise to be very stimulating as it provided a new way for discussing ideas. In terms of follow-ups to the workshop, participants discussed the following:

- A proposal for production of clean energy focusing on Ghana's communities rather than the entire country. There must be a needs assessment for specific communities such that bioenergy technology will be tailor-made to meet the community's unique needs.
- Biofuel production and usage must be a shared responsibility – community based.Involvement of student contributions also resulting in job creation.
- The need for scientists and researchers to acquire certain basic skills that would facilitate the creation of various systems. For example, engineers can learn the basic skills of welding.
- Scientists and all stakeholders must share information and learn from each other.

CONCLUSION

In closing the workshop, Dr. Wiafe thanked the participants for their important contributions. In order to keep the momentum of the workshop and the project in general, he informed participants that the ACP project has provided a unique opportunity for practitioners, researchers, students, and other stakeholders in the bio-energy industry to establish a network in Ghana. In pursuit of this course, he informed members that a database of all participants of this workshop and the previous one will be created to foster better collaboration.

He proposed a meeting by the end of April, 2013 where participants will discuss potential business proposals, possible communities to target and eventually a prototype bio-energy power plant ideal for a local community. Dr. Wiafe encouraged the creation of a multi-functional system that will also include students from different departments and backgrounds.

In her concluding remarks, Professor Harvey, the Leader of the ACP Project expressed her satisfaction with the outputs of the workshop. She was impressed by the enthusiasm of the group and their efforts for protecting the environment.

Overall, the workshop was successful in that it provided a platform for sharing research outputs and ideas by professionals with varying expertise. New collaborations were created and the discussions on personal challenges yielded suggestions that would make significant input to the renewable energy strategy agenda for Ghana.

ANNEX 1: ACP 2013 WORKSHOP PROGRAMME

	Time	Speaker	Organization	Topic
DAY ONE	08:^{30}-09:^{00}	**Registration**		
	09:^{30}-10:^{05}	**Opening Ceremony**		
	10:^{05}-11:^{00}	**Group Photograph & Cocoa Break; Media interview**		
	11:^{00}-11:^{40}	Dr. Lawrence Darkwah	Kwame Nkrumah University of Science and Technology, Ghana	Biofuels Production from Non-Edible Sources - Research Activities at KNUST
	11:^{40}-12:^{20}	Mr. John Afari Idan	Biogas	Ghana's Experience in Biogas Production: The issues (needs, challenges, and capacity)
	12:^{20}-1:^{00}	**OPEN DISCUSSIONS**		
	1:^{00}-2:^{00}	**Lunch**		
	2:^{00}-2:^{40}	Ms. Rosa Djangba	Kwame Nkrumah University of Science and Technology, Ghana	Biofuel Case Studies in Ghana - Dead or Alive
	2:^{40}-3:^{10}	Mr. Issah Sulemana	Tropical Agricultural Marketing & Consultancy Services	Investment potentials in the Biofuel Sector in Ghana: Areas of concern
	3:^{10}-3:^{40}	**Cocoa Break**		
	3:^{40}- 4:^{20}	Dr. Joe Asamoah	EnerWise Africa	Bio-fuel production vs. food security
	4:^{20}-5:^{00}	Mr. Ohene Akoto	Jatropha Africa	Jatropha oil as catalyst for rural electrification
	5:^{00}-5:^{40}	**OPEN DISCUSSIONS**		
DAY TWO	09:^{00}-09:^{40}	Prof. Gabriel Ameka	Department of Botany, University of Ghana	Microalgae as a potential source of bio-fuel in Ghana
	09:^{40}-10:^{20}	Dr. Festus Addo-Yobbo	Further and Higher Education	Ghana's research capacity for bio-oil development
	10:^{20}-11:^{00}	**OPEN DISCUSSIONS**		
	11:^{00}-11:^{30}	**Cocoa Break**		
	11:^{30}-12:^{10}	Dr. M.K.A. Addae-Kagyah	Department of Physics, University of Ghana	Placing ACP correctly in the bio-oil supply chain (as contributors of technology and innovation, not just as feedstock producers)
	12:^{10}-12:^{50}	**OPEN DISCUSSIONS**		
	12:^{50}-2:^{00}	**Lunch**		
	2:^{00}-2:^{40}	Mr. Noble Wadzah	FOE, Ghana	Importance of bio-fuels in the phase of recent environmental
	2:^{40}-3:^{20}	Dr. Adelina Mensah	Department of Marine and Fisheries Sciences	Climate change and the era of bio-fuels: Impacts and Implications
	3:^{20}-3:^{50}	**Cocoa Break**		
	3:^{50}- 5:^{00}	OPEN DISCUSSIONS, CONCLUSION AND CLOSING		
	5:^{00}-7:^{00}	**Cocktail**		

ANNEX 2: ACP 2013 WORKSHOP PARTICIPANTS

No.	Name	ORGANISATION	EMAIL
1.	Mr. Francis Kemausuor	The Energy Centre, Kwame Nkrumah University of Science and Technology, KNUST	kemausuor@gmail.com
2.	Prof. Gabriel Ameka	Department of Botany, University of Ghana	kgameka@ug.edu.gh
3.	Noble Wadzah	FOE/OIL-Watch Ghana	kowadzah9@yahoo.com
4.	John Afari Idan	Biogas Technologies Africa Ltd (BTAL)	info@biogasonline.com / info@btwl.com
5.	Broni Hornsby	CORRISIA (ACP Partner)	broni@corrisia.it
6.	Robert Kofi Yankey	National Nuclear Inst., Ghana Atomic Energy Commission	rkyankey@gmail.com
7.	Merita Wickens	Turner & Townsend (ACP Partner, South Africa)	mwickers@turntown.co.za
8.	George Kwadwo Appiah	The Energy Centre, Kwame Nkrumah University of Science and Technology, KNUST	jorgeappiah@gmail.com
9.	Dr. Beatrice Mensah	CSIR-IIR	byakrah@yahoo.com
10.	Dr. Lawrence Darkwah	The Energy Centre, Kwame Nkrumah University of Science and Technology, KNUST	ldarkwah.soe@knust.edu.gh
11.	Mr. Olufemi O. Fatunade	Accra Polytechnic	femodfat@yahoo.com
12.	Dr. Joe Asamoah	Department of Physics, University of Ghana	joasa2@yahoo.com, joe.smh@gmail.com
13.	Sulemana Issah	TRAGRIMACS	Sulemana.issah@gmail.com
14.	Stephen Adu	Ghana Standards Authority	sadu@gsa.gov.gh
15.	Benjamin Boakye	African Centre for Energy Policy	benboakye@acpghana.com
16.	Robert Kingsford-Adaboh	University of Ghana	kadabohs@ug.edu.gh
17.	George Wiafe	Department of Marine & Fisheries Sciences, University of Ghana	wiafeg@ug.edu.gh
18.	Dr. M. K. A. Addae-Kagyah	University of Ghana	mkaaddae-kagyah@ug.edu.gh
19.	Dr. F.K.E. Nunoo	Department of Marine & Fisheries Sciences, University of Ghana	fkenunoo@hotmail.com
20.	Dr. Adelina Mensah	Department of Marine & Fisheries Sciences, University of Ghana	ammensah@ug.edu.gh
21.	Prof. Patricia Harvey	University of Greenwich	p.j.harvey@gre.ac.uk
22.	Patrick Kpobi	TRAGRIMACS	p-kpobi@yahoo.com
23.	Amadi Afua Sefah-Twerefour	Department of Marine & Fisheries Sciences, University of Ghana	staamadi@gmail.com
24.	Eunice Nana Adjoa Brown	Department of Marine & Fisheries Sciences, University of Ghana	ubrown1990@gmail.com

No.	Name	ORGANISATION	EMAIL
25.	Rockson A. Armaah	Department of Marine & Fisheries Sciences, University of Ghana	armaahr@gmail.com
26.	Bennet Foli	Department of Marine & Fisheries Sciences, University of Ghana	bentsufo@yahoo.co.uk
26.	Daniel Sarfo Kantanka	Ghana Atomic Energy Commission	dskantanka@gmail.com
27.	Clement Adzei Boye	New Times Corporation, Takoradi	clementboye@yahoo.com, tracypasha65@gmail.com
28.	Emmanuel Oman	Accra Polytechnic	emmanueloman@hotmail.com
29.	Ogundare Oluwaseun	Accra Polytechnic	sj58k@yahoo.com (not sure 5j58k@yahoo.com)
30.	Julius Nyarko	Energy Commission	jnkansah_nyarko@energycom.gov.gh
31.	Kwame Adu Agyekum	Department of Marine & Fisheries Sciences, University of Ghana	kaagyekum@gmail.coM