



**Asia-Pacific  
Economic Cooperation**

**Training Course on Biogas Technology  
FINAL REPORT**

**APEC Agricultural Technical Cooperation Working Group**

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Training Course on Biogas Technology

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## 1. Basic data

### 1.1 Relevance

The world economy has been developing in a sustainable, renewable and recyclable direction. Renewable energy is the development tendency in all APEC economies. How to find the alternative energy has been of great significance to handle the problems and keep on with sustainable agricultural development. Biogas technology stands out, which is an important green energy effective in waste treatment for mitigation of GHG emission which relates directly to climate change. Secondly, the application of digestate, the product after biogas digestion will help to establish green farming substituting chemical fertilizer. Besides, the problem of hygiene and health that bothers the population in rural area needs to be controlled by developing biogas technology which could interdict the transmission of parasitic ova and pathogen bacteria by anaerobic fermentation. In addition, the adoption of the technology in rural area might replace the consumption of conventional fuels such as fire wood and coal in farmer households as a way to protect forestry.

At the first APEC Ministerial Meeting on Food Security in Niigata in 2010, the Ministers acknowledged in the Niigata Declaration on APEC Food Security that global food security is “at a crossroads” as the population continues to grow, and agricultural production continues to be constrained due to several factors including the adverse effects of climate change. The Declaration further points out that agriculture depends heavily on natural resources such as land and water, and generates both positive and negative environmental externalities in terms of land, soil, water, landscape and biodiversity.

Under this background, the training course is initiated to provide a platform for sharing information and technological expertise on the issues related to application of biogas technology among APEC economies and for the whole APEC region. The application of biogas technology will be highlighted in the training.

The features of biogas technology benefit not only the poor in developing APEC economies but also the rich in developed APEC economies. In this regard, it is urgent to develop and utilize biomass by means of multi-lateral technical training on biogas technology.

## 1.2 Objectives

- Discuss the economic and social benefit of biogas technology for the energy recovery waste treatment as a solution to climate change and food security to publicise the significance, applicability and adaptability of biogas technology in APEC economies.
- Identify the needs and areas of collaborative research and development on biogas technology in the APEC region to make aware of the applicability and adaptability of the technology.
- Come up with recommendations on effective governance frameworks for wider dissemination and adoption of adaptation strategies with mitigation potential at the national and local levels in APEC economies by introducing the existing logistic forces and regulations that systemize the development of biogas technology in China and other technical-advanced countries so as to lead a clear way to the APEC economies to make planning for the technical development.
- Enhance cooperation and communication of biogas technical development and build interest in technical exchange and transfer among APEC economies by establishing database and knowledge bank that is to be managed by the project organizer and shared by all APEC economies in regards to demand and supply of certain technologies and equipments as well as outstanding experts in this field who could provide technical consultancy.

### 1.3 Activity location

Chengdu, P.R.China

### 1.4 Project plan and actual implementation

<b>Schedule</b>	<b>Actual implementation</b>	<b>Activities and outputs</b>	<b>Role of Project Beneficiaries and APEC Member Economies</b>
August 2012 to September 2012	October 2012 to November 2012	<p>Participants enrollment</p> <p>Delivery of enrolment information</p> <p>Selecting candidates</p> <p>Distribution of invitation to expected participants</p>	<p>Participating economies to provide timely confirmation of their participation</p>
September 2012	November 2012	<p>Curriculum establishment</p> <p>Survey to participating economies on the training demand in the regards of participants' education background and working experience, local conditions such as climate, geographical conditions, livestock and poultry raising style, energy demand and utilization of digestate.</p> <p>Discussion among teaching faculty of the training about key points and difficult points that should be presented by proper teaching methods</p>	<p>Participating economies to complete the survey on training demand.</p> <p>Member Economies to give suggestions on topics and teaching methodologies.</p>
September 2012	November 2012	<p>Preparation for venue, accommodation, transportation arrangements &amp; other logistical support</p>	<p>Participating economies to confirm logistical needs and other</p>

Schedule	Actual implementation	Activities and outputs	Role of Project Beneficiaries and APEC Member Economies
			necessary information
October 2012	November 2012 to December 2012	Training course organization	<p>Participating economies to provide necessary coordinative support to the organizer.</p> <p>Member Economies to monitor the quality of the training.</p>

## 1.5 Agenda of Activities

Date	Day	Time	Activity	Presenter	Institution of Presenter	Venue
Nov. 26	Mon.	8:30-9:10	Orientation/Opening			Chengdu
		9:30-11:30	Lecture 1: Biogas development in China	Prof. Dr. Deng Yu (Deputy Director)	Research Center for New Material of Rural Energy Development, Chinese Academy of Agricultural Sciences	Chengdu
		14:30-17:30	Lecture 2: Design and Construction of domestic digester	Prof. SHI Guozhong (Deputy Director)	BIOMA	Chengdu
Nov. 27	Tue.	8:30-11:30	Visit 1: Hongqi company of fiber plastic digester			Huayang Prefecture, Chengdu
		14:30-17:30	Visit 2: Ancient Huanglongxi Village			Huanglongxi Village, Chengdu
Nov. 28	Wed.	8:30-11:30	Lecture 3: Large and medium size biogas plant in China	Prof. Dr. DENG Liangwei (Chief Engineer)	BIOMA (Environmental engineering)	Chengdu
		14:30-17:30	Lecture 4: Operation and management of large biogas plant	Prof. MEI Zili (Director)	BIOMA (Biogas Engineering)	Chengdu
Nov. 29	Thu.	8:30-11:30	Lecture 5: Bioenergy Evaluation and the Practice	Dr. Tang Xiaoyu	Research Center for New Material of Rural Energy Development, Chinese Academy of Agricultural Sciences	Chengdu
		14:30-17:30	Experiment: Separation and cultivation of anaerobic microorganism	Dr. Ma Shichun	Sichuan Biogas Engineering Research Center (Expression of functional genes)	BIOMA lab



Date	Day	Time	Activity	Presenter	Institution of Presenter	Venue
					in Thermophilic anaerobe; genome evolution; high-throughput genome sequencing and analysis; microbial genetics; cellulolytic bacteria)	
<b>Nov. 30</b>	Fri.	8:30-11:30	On-site study 1: Biogas plant for power generation on Jinli swine farm	Associate Prof. Lei Yunhui	Sichuan Biogas Engineering Research Center	Qionglai City, Sichuan
		14:30-17:30	On-site study 2: Straw-fed biogas plant	Associate Prof. Han Zhiyong	Sichuan Biogas Engineering Research Center	Xinjin County, Chengdu
<b>Dec. 1</b>	Sat.	8:30-11:30	Lecture 6: Advanced technology for biogas energy production	Prof. Dr. Bernhard Raninger	GIZ China Task Manager for the disposal Industry	Chengdu
		14:30-17:30	Lecture 7: Technical and Economical Optimization of Biogas Plants	Prof. Dr. Rolf KLOSS	Zhejiang University,	Chengdu
<b>Dec. 2</b>	Sun.	8:30-15:00	Visit 3: Dujiangyan Irrigation System			Dujiangyan City
		17:00-18:00	Closing			Chengdu

## 1.6 Participant economies

No.	Economy	Name	Gender	Institution, Position and Contact
1.	China	<b>Wei Xiuli</b>	Female	Chongqing Academy of Agricultural Sciences Assistant Research Fellow, <a href="mailto:weixiuli.cau@126.com">weixiuli.cau@126.com</a>
2.	China	<b>Zhao Lijie</b>	Female	Yunnan Niuneng Environmental Protection Engineering Co. Ltd. Deputy Chief of Design Division, <a href="mailto:Zhaolijie2007@126.com">Zhaolijie2007@126.com</a>
3.	Chile	<b>Max Cooper Larrain</b>	Male	Agriculture trade, studies and politics office. ODEPA, Ministry of Agriculture Advisor, <a href="mailto:mcooper@odepa.gob.cl">mcooper@odepa.gob.cl</a>
4.	Chile	<b>Macario Achondo Larrain</b>	Male	Institute of Agriculture Development, INDAP, Ministry of Agriculture Advisor, <a href="mailto:machondo@indap.cl">machondo@indap.cl</a>
5.	Indonesia	<b>Yuniawan</b>	Male	National Animal Health Training Center Cinagara Trainer, <a href="mailto:bbpkhcinagara@gmail.com">bbpkhcinagara@gmail.com</a>
6.	Indonesia	<b>Muryanto</b>	Male	Central Java Assessment Institute for Agricultural Technology Researcher, <a href="mailto:mur_antok@yahoo.com">mur_antok@yahoo.com</a>
7.	Philippines	<b>Alan Anida</b>	Male	Soil Research Division Bureau of Soils and Water Management Agriculturist, <a href="mailto:alananida@yahoo.com">alananida@yahoo.com</a>
8.	Philippines	<b>Reymer Martinez</b>	Male	Research Division Bureau of Animal Industry Engineer, <a href="mailto:reymer71@yahoo.com">reymer71@yahoo.com</a>
9.	Malaysia	<b>Mohd Hafdzuan Adzmi</b>	Male	Ministry of Energy, Green Technology and Water Assistant Secretary, <a href="mailto:hafdzuan@kettha.gov.my">hafdzuan@kettha.gov.my</a>
10.	Thailand	<b>Phisit Seesuriyachan</b>	Male	Chiang Mai University Engineer, <a href="mailto:pasinee23@gmail.com">pasinee23@gmail.com</a>
11.	Thailand	<b>Kris Likit-anurak</b>	Male	Chiang Mai University Engineer, <a href="mailto:l.kritini@gmail.com">l.kritini@gmail.com</a>
12.	Viet Nam	<b>Tran QuangChieu</b>	Male	Department of Crop Production MARD Official, <a href="mailto:quangchieu07@yahoo.com.vn">quangchieu07@yahoo.com.vn</a>
13.	Viet Nam	<b>Bui Hai Nguyen</b>	Male	Department of Livestock Production MARD Official, <a href="mailto:buinguyen2604@gmail.com">buinguyen2604@gmail.com</a>



Opening Ceremony



Presentation given by Dr. Raninger





Field trip to rural households



Visit to manufacturer of reinforced fiber plastic digester



Experiment in laboratory

## 1.7 Expert details

No.	Economy	Name	Gender	Institution, Position and Contact
1.	Germany	<b>Bernhard Raninger</b>	Male	Prof.Dr. Phil Project Director GIZ China Task Manager for the disposal Industry T: +86 (0) 10 65087080 Ext. 200 F: +86 (0) 10 65087689 M China: +86 138 1151 4020 <a href="mailto:Bernhard.Raninger@giz.de">Bernhard.Raninger@giz.de</a>
2.	Germany	<b>Rolf Kloss</b>	Male	Prof.Dr.Ing. Director Zhejiang University Institute of Biomechatronic Engineering Director of the CBEB Sino-German Centre of Bio-Energy and Biomass +86-13067731456 (Mobile) <a href="mailto:drkloss@zju.edu.cn">drkloss@zju.edu.cn</a> <a href="mailto:kcsheng@zju.edu.cn">kcsheng@zju.edu.cn</a>
3.	China	<b>Prof.Dr. Deng Yu</b>	Male	Deputy Director General Research Center for New Material of Rural Energy Development, Chinese Academy of Agricultural Sciences Research field: anaerobic microorganisms, efficient biotransformation technology  +86-13348899057 <a href="mailto:dengkaiyu@yahoo.com.cn">dengkaiyu@yahoo.com.cn</a>
4.	China	<b>Dr. Tang Xiaoyu</b>	Female	Assistant professor Research Center for New Material of Rural Energy Development, Chinese Academy of Agricultural Sciences Research field: Biomass conversion, Ethanol fermentation, Membrane separation and membrane process  +86-13880691223 <a href="mailto:11034766@qq.com">11034766@qq.com</a>
5.	China	<b>Ma Shichun</b>	Female	Assistant professor Sichuan Biogas Engineering Research Center Research field: Expression of functional genes in Thermophilic anaerobe; genome evolution; high-throughput genome sequencing and analysis; microbial genetics; cellulolytic bacteria Chengdu, China +86-13881873141 <a href="mailto:377640617@qq.com">377640617@qq.com</a>
6.	China	<b>Lei Yunhui</b>	Male	Associate Professor Sichuan Biogas Engineering Research Center Research field: wastewater



				treatment, straw biogas fermentation +86-15008419867 <a href="mailto:652143763@qq.com">652143763@qq.com</a>
7.	China	<b>Dr. Zhiyong Han</b>	Male	Assistant professor Sichuan Biogas Engineering Research Center Research field: Municipal Solid Waste Treatment and Disposal, Waste Management.  Chengdu, China +86-13438198403 <a href="mailto:361915410@qq.com">361915410@qq.com</a>

## 1.8 Summary of management arrangements

### 1.8.1 Project overseer and assistants

- Project overseer

Mr. FANG Xiang, MS. of agricultural sciences, Deputy Director General of Biogas Institute of Ministry of Agriculture, experienced in international program management.

- Project overseer is assisted by Mr. Ren Xiaobin

Mr. Ren Xiaobin, Director of Training and Information Research Center, Biogas Institute of Ministry of Agriculture, having rich experience in managing training programs.

- Project overseer is assisted by Ms. Zhao Yuexin

Ms. Zhao Yuexin, Professor, Deputy Director of Training and Information Research Center, Biogas Institute of Ministry of Agriculture, experienced in biogas research and development, as well as international project management.

- Project overseer is assisted by Ms. Long Yan

Ms. Long Yan, Associate Professor, program official of Training and Information Research Center, Biogas Institute of Ministry of Agriculture, experienced in managing training programs and international projects.

### 1.8.2 Gender

The project overseer will take care to implement the project in a manner sensitive to gender considerations, and to ensure that it benefits equally men and women. During the planning stages, the overseer will actively seek to achieve gender balance in the selection of workshop speakers. During the nomination phase, APEC

member economies will be encouraged to nominate qualified women participants, where appropriate. Care will be taken to ensure that the workshop and all related administrative arrangements are executed in a gender-neutral manner, and in particular in a manner that does not disadvantage women. And the assessment questionnaire will include gender criteria. Women are encouraged to participate in the preparation and implementation of the project.

This project will be conducive to improve capacity of all APEC economies on in related field so as to ensure food security for all the APEC economies. The participation of women and the spread of outcomes make female researchers, administrators and farmers broaden their eyes, encourage their interests in the related issues, and improve their expertise. With the enhancement of the capacity, the women who are involved in this sector will directly benefit from this project. The competitiveness of these women in APEC member economies will thus be enhanced.

What's more important, the project aims at the solution to energy shortage and waste treatment. By disseminating biogas technology, the relevant problems may be solved in the APEC economies in that the women could be liberated from heavy work of firewood cutting and collection from forest instead of using the green biogas as domestic fuel. The treatment to the agricultural and animal waste may also be efficient in improving the farmers' living environment, thus women may benefit from a better sanitation conditions.

#### 1.8.3 Cost efficiency:

To ensure the cost efficiency, the training will last just for 14 days with a tight agenda. The existing relevant projects outcomes, research findings and published documents will be fully utilised to avoid the cost of duplicating work. Consultations will also help maximize the value derived from project funding. Moreover, the APEC rules and procedures will be followed strictly, and most direct and economical travel should be ensured to minimize the travel costs. Besides, qualified experts, presentations and discussions as well as the project report should also be ensured.

#### 1.8.4 Risk management

- Duplication
  - The proposed project is not duplicated with all of the APEC projects and activities. Possible risk management strategies: close consultation and cooperation with relevant economies.
- Economies may not respond to the invitation on time.
  - Communications may be carried out among economies to popularize the project target.



- The invitation may not be distributed to the right participants.
  - Economies may be informed of the criteria of recommending participants.
- The curriculum may not be practical and suitable to participating economies or participants' demand.
  - Surveys will be distributed and collected to adjust to participants' demand. Economies' conditions for disseminating biogas technicality will be the basis to determine curriculum content.

Lack of interest in the seminar-workshop. Lower expected number of participants.
- The logistical arrangements may not satisfy every participant.
  - Full communication with participants will be made before logistics arranged.
- The training may encounter unexpected loopholes and accidents.
  - Rules will be established as manuals for participants and organizing committee to follow.
  - An emergency management team will be established to tackle accidents.
- Project report may not conclude every aspect of the project.
  - Conclusion may be made on the base of daily record and participants' feedback.
- Internet database may not work efficiently.
  - Information of technical progress, demand and supply may be updated on internet database.

## 2. Key outputs

The project is a response to the capacity-building needs of APEC developing economies in the area of biogas technology, a potential developing tendency to cope with the environmental pollution and energy shortage which directly impact secure food production, a key priority for APEC.

The objective of this project was to initiate and sustain information exchange among resource speakers and participating APEC economies. It identified adaptation strategies in energy recovery from agricultural waste treatment.

A major project activity was training activities made up of lectures, on-site practice and study tours for discussion and elicitation about how to apply the advanced technologies for effective governance strategies towards the widespread adoption in APEC economies. Policy makers and implementers, academics and practitioners from APEC economies have been invited to participate in the event.

The key output of the project is a proceeding of the shared presentations on different topics of biogas technology, and after this main part of the project was completed, the original project was extended to build on the trace survey of knowledge transfer effectiveness among participants. The outcome of the extension is a website developed as a platform for information sharing.

An website was established to share presentations as follows:

[http://www.biogas.cn/CN/R\\_Files.aspx](http://www.biogas.cn/CN/R_Files.aspx)

username APEC, password APEC

### 3. Summary Report

#### 3.1 Steps taken to meet objectives

To finish the task successfully, we did following work:

**Phase 1** (October to November 2013):

- (a) Develop concept paper and inquiry notes for the project, including pertinent project background, purpose, risks and outputs;
- (b) Curriculum establishment based on the analysis on objectives, market orientation and status of the technical development;
- (c) Draft training methodology, including lectures, on-site practice and study tours for knowledge transfer;
- (d) Identify trainers, technical resource personals and logistic personnel for the training plan and sessions; potential participants, speakers and program were tentatively sketched;
- (e) Discuss methodology with project overseer;
- (f) Develop project timeline to assure timely outcomes;

**Phase 2** November 2012 to February 2013)

- (a) Administer survey;
  - Training questionnaire on demand and assessment.
  - Training organization. A wide range of knowledge was covered by lectures, discussions, hands-on experiments and study tours.
  - Knowledge transfer. A readily available information and easier transaction between economies were developed. Further communication among APEC economies were achieved by the web page established at PO's website to initiate regular discussions of regional issues.
- (b) Organize results and analyze findings;
- (c) Review preliminary report with project overseer, prepare report and submit to project overseer;
- (d) Edit and submit Completion Report to project overseer by Feb, 2013

## 3.2 Conclusions

The economic and social benefit of biogas technology were discussed for the energy recovery from waste treatment as a solution to climate change and food security to publicise the significance, applicability and adaptability of biogas technology in APEC economies.

The needs and areas of collaborative research and development on biogas technology in the APEC region were identified to make aware of the applicability and adaptability of the technology.

Effective governance frameworks were recommended for wider dissemination and adoption of adaptation strategies with mitigation potential at the national and local levels in APEC economies by introducing the existing logistic forces and regulations that systemize the development of biogas technology in China and other technical-advanced countries so as to lead a clear way to the APEC economies to make planning for the technical development.

Cooperation and communication were enhanced for biogas technical development and interest in technical exchange and transfer among APEC economies was built by establishing database and knowledge bank at the project organizer's website sharable by all APEC economies in regards to demand and supply of certain technologies and equipments as well as outstanding experts in this field who could provide technical consultancy.

## 4. Overall impact and lessons learned

### 4.1 Beneficiaries

Beneficiaries of the project include government agencies, private sector particularly those from the energy development enterprises and livestock and poultry farm practitioners who have the intention for energy recovery from waste treatment. Government agencies of APEC member economies will be gaining the most from this training being the competent implementing bodies in the aspects of technical boosting, policy making and standardization establishment for healthy development of the technology.

### 4.2 Dissemination

The training and its publications will feature project report and other documents that will be produced from the activity will include economy presentation from the delegates summarizing their farm practices, handouts and reference materials from the speakers, experiences and vital information that may contribute to the improvement of the project output. Confidentiality of the documents will depend upon the discretion of participants or speakers base on the sensitivity of the issues included within.

About 30 hard copies will be prepared and 30 CDs will be provided, the copyrights of work belong to APEC. The report will comply with the APEC publications guidelines. Publication plan includes (1) Draft report will be given to all participants of the project; (2) Revised draft (upon compliance to the APEC publication guidelines, consultants and speakers inputs; (3) Download to APEC website; (5) Distribution of project outputs to APEC economies and with APEC Agricultural Technical Working Group members.

Project overseer will see to the quality of the project outputs, such as subjecting this to professional editing, before publication and distribution. The outputs should be reported to ATCWG and accessed through the APIP.

### 4.3 Lessons learned

The late issue of passports of some participants. As a measure of backup, letters stating the invitation to the participants were emailed to the corresponding embassies for the request of urgent treatment of visa. Anyhow, all participants

managed to arrive on time according to the updated schedule and gave no impact on the event.

The second unexpected matter was that one of the participants nominated cancelled his attendance and caused a last-minute nomination. In this case, information of more nominees might be stored for the sake of absence in the participation.

Generally, understanding of the APEC project guidebook and communication with the project secretary were very helpful and should be done earlier to avoid unnecessary mistakes.

## 5. Conclusions and future work

### 5.1 Conclusions

The project falls under Rank 2 of the APEC 2012 funding criteria as it directly supports the Leaders' Growth Strategy by advancing the implementation of the Niigata APEC Action Plan on Food Security. It addresses the capacity-building needs of APEC developing economies in the area of biogas technology, a potential developing tendency to cope with the environmental pollution and energy shortage which directly impact secure food production, a key priority for APEC.

This project intended to initiate and sustain information exchange among resource speakers and participating APEC economies. It identified adaptation strategies in energy recovery from agricultural waste treatment. Participants discussed and elicited recommendations on effective governance strategies towards the widespread adoption in APEC economies. Policy makers and implementers, academics and practitioners from APEC economies have been invited to participate in the training course.

By means of lectures, on-site practice and study tours, the training was held from Oct. 16 to 22, 2012 (7 days) in Chengdu, China. The number of participants is 13 from 7 economies. With joint effort from project organizer, speakers, APEC secretary and participants, the project was completed with every success.

### 5.2 Future work

Based on the achievements of this project, more activities will be continued in the promotion of biogas technology within APEC framework with following creative:

1. To connect biogas industry in APEC economies for the knowledge sharing and market information.
2. To bridge the developed economies with the developing economies to shorten the gap in the development of technical know-how.
3. To hold Exhibitions of industries products and improve the cooperation via free and open trade and investment.
4. To establish biogas promotion centres with the support from governments in APEC economies, providing technical assistance based on the local conditions and demand.