CARL VON OSSIETZKY universität OLDENBURG

Postgraduate Programme Renewable Energy

PPRE

NEWSLETTER

2010 | Vol. 29

Published by:
Carl von Ossietzky University of Oldenburg,
Faculty of Physics, Department of Energy and Semiconductor Research,
Postgraduate Programme Renewable Energy—PPRE, D - 26111 Oldenburg
phone: +49-441-798.3544, fax: +49-441-798.3990,
e-mail: edu@uni-oldenburg.de, web: http://www.ppre.de

Editor: Edu Knagge
Typesetting & Layout: Hauke Beck
Printer: Druckzentrum, CvO University Oldenburg - 800 copies

Content

Dear Reader,
earlier this year another group of international students successfully finished the Postgraduate Programmes Renewable Energy (MSc) available at University of Oldenburg, so that we now surpassed the number of 400 graduates (338 for PPRE and 65 for the European RE Master Programme) from 83 countries. Along with the increasing number of participants we face a drastically increase of inquiries and actual applications (nearly 300 for PPRE 2010/12) sent to our office.
The RE markets are obviously still booming worldwide and specially Germany is highly attractive to foreign students interested to work in this field. This was also noticed at the 'Job and Education fair for renewable energies and energy efficiency', which took place for the first time in March 2010 in Oldenburg. With 74 companies and institutions from the north-west region of Germany and more than 4000 visitors this fair was quite a success and will be continued next year.
Starting with this summer semester there will be an additional research group in Wind Energy, head by Prof. Dr. Martin Kühn. He will also be engaged in lecturing in PPRE and build-up a specialisation within the Engineering Bachelor and Master Programme. This will definitely strengthen the wind research and teaching at Oldenburg University.
6 years after its 1st accreditation PPRE passed the re-accreditation-process in 2010 successfully. The assessment committee positively commended the variety of training methods available, like lectures, lab-work, seminars, case-studies and excursions. Along with the accreditation we improved the transparency of the study programme itself by uploading the revised syllabus and module-handbook onto our homepage. You may have a look yourself at: www.ppre.de
We hope you enjoy this news, which contain contributions from about 100 alumni in form of notes, updates and reports.
Keep the line open!

Edu Knagge

THE PPRE-TEAM

(fr. left): M. Golba, R. Frels, E. Brudler, H. Holtorf, E. Knagge, U. Kulschewski, K. Blum

DAAD SUMMER SCHOOL AND PPRE EXCURSION

A multicultural excursion which combined didactic and leisure activities

by Andreea Costache, Maria Gabriela Gomez and Theodoros Kotsonis

REPORT'S CHARACTER

The PPRE excursion in June 2010 had not only didactic character. Students had the opportunity to meet DAAD Alumni as well as to visit magnificent historic cities and places of exceptional natural beauty. This excursion proved to everybody that Germany is not only a strong financial power with developed cities and immense factories but also a country with rich history surrounded by a unique natural environment. The present report will focus on the experiences received by the students during the PPRE Excursion in June 2010.

PARTICIPANTS / ORGANIZERS

The excursion was organized within the frames of the DAAD Alumni Summer School "Applied Solar Energy". The participants consisted of two categories: the PPRE, EUREC and EEM (Energy and Environmental Management, University of Flensburg) students and the PPRE, EEM and ZEF (Zentrum fuer Entwicklungsforschung, Uni Bonn) alumni. Due to the number of participants, two coaches were necessary for the whole transportation procedure. The three organizers of the excursion and the summer school were: Hans Holtorf, Andreas Guenthner and Yi Zheng.

SUMMER SCHOOL AND EXCURSION'S CHRONICLE

The adventure of summer school accompanied by the excursion began on Sunday 30th May 2010 in Energielabor. The PPRE students undertook the reception ceremony of the visiting students and alumni by offering a dinner with flavors from many different countries. Each PPRE student had the duty to prepare a representative plate of his or her country. This meeting brought the excursion participants closer and was the ideal start for a memorable two weeks experience.

On Monday 31st May and Tuesday 1st June, the participants attended the first two days of the Summer School's presentations in TGO buildings in Oldenburg. The subjects were covering a wide variety of issues such as renewable energies, energy conservation, rural electrification, lessons learned, etc.

The excursion began on Wednesday 2nd June 2010. The meeting point was Energielabor. The departure time was 6 in the morning. It was then when everybody realized the strict German schedule imposed by the organizers (6 o' clock sharp!).

As expected, the majority of participants fell asleep after the first travel minutes. After 4 hours of sleeping, the convoy reached the first destination. It was Hoppecke Batteries installations close to Brilon. Hoppecke Batteries was situated in this area in 1927 to provide financial breath to the whole region and reverse the emigration atmosphere towards the big cities. From a visitor's point of view, a very impressive fact was the respect of the industry for the environment and the very good working conditions given the

fact that battery manufacturing requires the processing of chemicals that can have adverse consequences for people and environment. Having attended two lectures, a guided tour of the company's facilities and being "equipped" with the business cards of the human resources staff, we departed with considerable knowledge improvement about batteries and their manufacturing at 15:00 to Erfurt.

The trip to Erfurt was much shorter but very beautiful as we crossed a spectacular forest. The entrance to Erfurt brought us to a different reality. Erfurt is a city influenced by the culture of former East Germany, so the buildings are much different than the buildings of Bremen and Oldenburg. Furthermore, there are plenty of parks and squares that give the sense that Erfurt is a city dedicated to the people, respecting people. Despite the fact that the organizers suggested students to sleep and save energy for the next difficult and tiring days, many of us decided to have a walk around the city. The place that drew the attention of most of us was the square of Mariendom and its spectacular illumination at night. But due to the limited free time, we returned early at the hostel and tried to rest.

Thursday 3rd June began with a quick breakfast and after that the visit to Bosch Solar took place. Bosch Solar is situated a few kilometers outside Erfurt and follows a very strict visitors policy as it was asked from the students to sign a kind of contract in which everybody accepts some terms concerning the factory visit. Nevertheless, Stelio Correia, a former EUREC student and his colleague gave a very interesting and informative lecture about the technologies of the PV they produce and in sequence they showed us the company's facilities. The fully automated thin film PV production was a unique spectacle that proves that robots and engines can effectively replace workers especially in procedures that require extreme precision. Having acquired plenty of knowledge in solar PV, we returned to the bus in order to start our journey towards Würzburg.

Würzburg is a city at the region of Frankonia and according to the majority of participants was the key point that made the excursion unique. Würzburg combines hills with rivers as well as cathedrals and castles with modern city infrastructure. Some secret stories and legends of the city in medieval times were revealed by a Night Watcher who guided us around the city. His spicy humor in combination with his naivety made all of us laugh and on the meanwhile learn new things about the city. But as always the timetable was really strict, so everybody should go and sleep early. The reason: Friday's Workshop.

After two days of consecutive factory visits and plenty of time spent in the coach, the time for brain-storming arrived. The whole Friday 4th of June was booked for workshop regarding Rural Electrification. Seven teams were chosen and each team had a time period of four hours to prepare a presentation over a selected topic. The cooperation between the alumni and the students proved to be very fruitful as the first were coordinating the groups and the second were providing the ideas. In the afternoon, the presentations took place and after that a two hours discussion over the lectures covered the majority of existing questions. In the meanwhile, several members of the alumni presented their posters concerning some topics they currently work on. Another object of the workshop was to vote the

three best posters. The voted posters would be exposed in the Intersolar exhibition of Munich, one different poster each day of the exhibition. The end of the Workshop day was welcomed with relief from the participants, the majority of which had plans to explore the nightlife of the city.

Saturday 5th of June was a day off. Despite the fact that everybody could spend the day independently, Tobias and Stephan, two apprentices from the Uni Oldenburg's Electronic Workshop, provided a special tour to the castle and the city. The tour began with a visit at the Fortress Marienberg, the symbol of Würzburg, home of prince – bishops for nearly five centuries. The fort situated on a small hill, dominates the whole Würzburg region and is today a museum and a park. The multicolor gardens in combination with the spectacular view and the old baroque buildings make fortress Marienberg an ideal place for visiting and making photos. The next visited sight was the old main bridge, an impressive construction that stands out due to its delicacy. In sequence, heading towards the inner of the city, we visited the Dom. The Dom is Würzburg's cathedral, a representative example of Romanesque basilica. The magnitude of the building is outstanding and fills the visitor with awe. The final visited sight was Würzburg's Residenz. It is a palace of baroque architecture. The architecture style is exceptional and the gardens with the different species of flowers and trees shaped in different forms from gardeners give a sense of incredible exotic beauty to the place. Finally, it is worthy to mention that during our stay in Würzburg, a wine festival was taking place. As a result, flea markets selling traditional products and of course wine from the region were situated in the city squares, so everybody had the opportunity to taste the local wine and admire its flavor.

The night of Saturday was a real surprise. Taking advantage of the international mosaic of participants, an intercultural fest was organized. Within the frames of this fest, some of the students and the alumni played music of their country; other presented national dances and even theatrical plays. Music from Brazil, Taiwan, Costa Rica and Chile, dances from Kenya, Eritrea as well as Latin America and finally a memorable Goethe's theater play composed the multicultural event. It was a memorable experience that brought everyone closer and vanished for a moment all country boundaries.

On Sunday 6th of June, the trip to Ottobeuren took place. Another surprise was waiting for the participants as our arrival coincided with an annual local festival. The best part of the festival was the citizens' parade. People were dressed with traditional clothes and performing traditional Bavarian dances. After that, we visited the Ottobeuren Abbey, a majestic Benedictine abbey which is a sample of the Bavarian baroque architecture. In the afternoon, many excursionists played football, volleyball and table tennis with pupils of a school staying in the same hostel. What an experience for these kids meeting so many people from so many different countries! In the evening, people were completely exhausted by the dense excursion's program and that is why everybody decided to watch a movie and then fall asleep.

The new week started with two company visits in Memmingen. Firstly, the visit to Steca Electronics took place. We visited the main factory which is the oldest of Steca's facilities guided by Mrs. Aust. In this place the integration of the circuit's components

of their products take place. It was very impressive to observe the creation of the surface-mounted electronic circuitry, which is a high technology process carefully controlled by Steca's personnel.

The second company visited was Phaesun. They act as a link between Solar Industry's investors and manufacturers and we had the opportunity to walk through boxes, PV panels and solar lights in their warehouse.

After these two visits, Mrs. Aust offered us lunch at a very nice Chinese restaurant and afterwards we continued our journey towards Augsburg where we spent the night. A small night-walk in the city revealed us the beauty of its streets, fountains and buildings.

On Tuesday 8th of June, the program previewed a visit to Phoenix Solar installations in Sulzemoos. Phoenix Solar develops big solar PV plants and provided us the opportunity to visit two of them. The immense areas covered by PV caught the attention of everyone but the most important part was the lectures provided by Thomas Schwarz, former PPRE and his colleague. Again traditional Bavarian food and beer accompanied the visit. The end of the day found us in Munich where the alumni and the students were split up. The Alumni joined a three day DAAD program at Intersolar while the students prepared themselves for a mountain hike. The report focuses on the mountain hike.

So Tuesday evening everybody had free time to explore the city of Munich. The next day was expected to be one of the most difficult days in terms of fatigue, so the necessity for relaxation and refreshment was vital. Wednesday 9th of June was a very important day for many of the excursion participants as the group briefly visited Intersolar exhibition in Munich. A very big number of companies covering different aspects of the solar industry were exhibiting their products. This gave the opportunity to many students to negotiate a thesis with the company they are interested in; so many interviews and many exploratory discussions took place. According to the strict program, everything should be over before 2 p.m, in order to start the second and most difficult part of the day: Trekking to a mountain hut close to Mittenwald.

On a sunny Wednesday afternoon a large group consisting of 25 persons started the ascent to the first stop at 1500 m. From the very beginning, the common idea was that it is not the mountain that we conquer but our fears, our doubts, our limits, ourselves. For some it has been tiring, for other it was been thrilling but for everybody has another way to escape from his/her everyday's life. After 1 hour of steady trekking we reached a recently constructed bridge across Sulzleklamm, by the disposition of Deutscher Alpenverein. And what a bridge…at the end it was able to sustain more than 24 happy bouncing persons.

After the bridge endurance was tested, the group went on the quest until the Brunnensteinhutte with no more stops. On the terrace of the hut everything started to make sense. Experiencing an incredible view with all the mountains around and the sun within the clouds, accompanied with a cold beer, there couldn't have been more things that you would have expected from life at that moment. As a result the rest of the day was spent singing and being happy.

One of the surprising things of this mountain hut was the number of people it could host. In the first night, the 74 years old hut hosted more than 34 persons, both inside and outside. The next day early in the morning we had breakfast. Around 9 o'clock the trekking to the next mountain peak began and again, the very happy and loud group made its way through pebbles, slippery rocks and tree roots during a 2 and a half hours ascent. By this time the path was trickier and it required the full attention and concentration of everyone. It was not about endurance, who arrives first at the top, but about the will to help the one next to you who may be insecure about where to put the foot or just afraid of slipping. The collaboration and care from one to each other was remarkable and impressive, and proved the strong bounds among the members of our group.

After some time everybody reached the top: the Brunnsteinspitze. This place, the view and the interior peace that it offered made all the effort priceless. According to Arno's GPS, we reached 2132.6 m high.

In the evening the group had the chance to talk for a couple of hours with the hut's owner, who explained in very simple words how renewable energies gave him the opportunity to offer a comfortable place to stay at 1500 m, without affecting the environment. The most touching part was the way Mr. Gallenberger perceived the importance of the forest and the surroundings, how a low ecological footprint can make the difference. Once again, the next day very early in the morning we descended the mountain and departed to Munich.

The last night of the excursion was spent in rainy Munich. The group was scattered among street labyrinths of this beautiful city to finally gather in the huge Augustiner Keller Biergarten to watch a football game and say goodbye to the DAAD Alumni.

Saturday 12th of June was the return day. After a long 12 hours-trip back to Oldenburg, everybody returned home with the best experiences and the ideal impetus to continue and finish the program of studies. There is no doubt this experience will never be forgotten by any of us.

PPRE - alumni & students at a PV Farm of Phoenix Solar

BIOGAS WORKSHOP 2010, UNIVERSITY OF OLDENBURG

by Evelyn Brudler PPRE 2004/06

PPRE students, EUREC students, and international participants met in Oldenburg for the 5th time for a 4 days workshop on biodigester performance and successful large scale programme set-up.

Financial subsidises by DAAD enabled the programme to invite students from other postgraduate programmes with relevance to developing countries to extend and deepen their knowledge in biodigester biochemistry, construction and operation on the practical side. During 3 days the focus was on domestic biodigesters while the 4th day was reserved for large systems technology, financing and modern CHP for biogas. As every year the lectures focussed in successful planning and large scale domestic biogas dissemination on national level: Conditions and programme set-up with long term experience by our presenters Jan Lam and Felix ter Heegde from SNV (NL) gave the opportunity to discuss real life obstacles with experts with 20 years experience in this field.

New in the programme was an extensive half day lecture on the biochemistry of bio digester held by Dr Henri Spanjers of Lettinga Associates Foundation (LeAF, NL), which was, though demanding, highly appreciated by the participants.

Newly included to the time table were as well practical parts which dealt in the first session with performance testing of biogas stoves and gas lamps and in the second session with flow and mixing patterns of manure in a biodigester model.

PPRE is planning the next Biogas Workshop for February 2011. For more information on the past workshop, please visit our homepage.

Participants of the International Biogas Workshop 2010 at TGO-building, Oldenburg

EXCURSION TO SCIENCE BOX

by Hans Holtorf, PPRE 1988-89, PPRE-lecturer

In November 2009 the PPRE & EUREC-Students visited the Science Box at Schlossplatz in Oldenburg. Dr. Schneider from EWE Research Centre, who had developed the exhibition, gave us a comprehensive guided tour to all the displayed objects. It started with the "Bullensee Thesen" and it's main proclamation e3:

- energy conservation,
- energy Efficiency, and
- renewable energy,

which are the three main pillars of our future energy supply system.

We learned about the fuel cell cogeneration units which are installed by EWE within a pilot project in private houses supplying some kW of electricity. The by product heat in the range of 10kW are used to supply heat for the building. Hence the gas consumed in the cogeneration units is used at a high efficiency.

Entrance of Science Box at OL

An exhibit showed the activities at the offshore Windpark Alpha Ventus. The actual wind speed, the estimated power output from the wind park under these conditions were displayed. During our tour the expected power output was in the range of 150MW.

The problem of sizing and matching several different power plants to supply the load of a community as Oldenburg was demonstrated in the next step. Students could check how large different power plants (Conventional, PV, Wind, Cogeneration Units) would need to be to supply 150MW of Oldenburg.

In this context another hands on experiment demonstrated how difficult it is to keep the grid frequency constant under varying loads such as a typical weekday load profile. At a handle one could rotate a crank shaft and try to adjust the rotational speed in such a way that the frequency indexer would not exceed certain limits from the given 50 Hertz.

Finally a possible architecture in terms of information technology in a futuresque homestead was displayed. A building giving information about all the consumers in operation (coffee machine or cook stove but also open windows) can be checked on a display in future buildings. This information system will also supply music or general information when requested.

Last but not least Mrs. Schneider gave us figures about the overall energy consumption of Oldenburg in terms of electricity and natural gas, the beginning of electrification of Oldenburg in the 1930ies and the pipeline bound gas supply in 1959 of Oldenburg. Oldenburg therefore was the first town in Germany which was supplied with gas for heating.

The students thanked Mrs. Schneider for the very interesting 1,5 hours by a package of "Merci" carrying all the signatures and countries of origin.

FIRST JOB AND EDUCATION FAIR FOR RENEWABLE ENERGIES AND ENERGY EFFICIENCY IN OLDENBURG

The „zukunftsenergien nordwest“, opened its gates for the first time on the 5th and 6th of March 2010.

With 74 exhibitors involved in renewable energies and energy efficiency the EWE ARENA in Oldenburg was fully booked. The more than 4000 visitors of the fair from all over Germany met attractive employers with open job opportunities, traineeships, informed themselves on prospects for further education, and received insight into the branch by taking part in technical workshops. This program was complemented by excursions to well-known companies and regional facilities.

The job and education fair was sponsored by aleo solar Deutschland Gmbh, ENERCON GmbH, EWE AG, EnviTec Biogas AG and organized by the University of Oldenburg and ForWind – Center for Wind Energy Research of the Universities Oldenburg, Hannover and Bremen.

The next Job and education fair „zukunftsenergien nordwest“ will be held on 11th and 12th of March 2011, in Bremen.

zukunftsenergien nordwest JOB- & BILDUNGSMESSE
www.zukunftsenergien-nordwest.de

1st Job-Fair with respect to Renewable Energy at EWE-Arena in Oldenburg

PERSONAL COMMENTS ABOUT FIRST JOB AND EDUCATION FAIR FOR RENEWABLE ENERGIES...

"The Job-Fair in Oldenburg mainly addressed students, but also freelancers and other people of the renewable energy sector. From the very beginning we were welcomed with a warm smile and a catalogue with all the companies present.

By far the highest numbers of jobs were offered by wind companies. Being interested in this field I had the opportunity in talking with most of the people involved in the promotion of their companies. Most of them provided me with valuable information like how to apply for a certain position in their company or how to present the subject of the thesis I would like to do. For a future job seeker the main idea is never to give up, and if one has an idea for a thesis project, he/she should submit it. At first I didn't enter the building with high hopes, knowing from previous experiences that job fairs usually don't have too many positions available for students, but somehow this fair changed my opinion. It was really nice to see the amount of projects proposed both in wind and solar, where a lot of changes will take place in coming years. A number of universities were present at the fair including Oldenburg, Kassel, Hamburg, and Bremen University . And a number of research institutes were also present to allure us into the world of science with very interesting research programs.

What this fair had in common with all the other fairs I've participated so far, was the fact that most of the jobs were offered by companies with more than 1.000 employees, and that the smaller companies had openings only for people with professional experience. The good part was that the companies that promised master thesis really had a broad range of topics available.

To conclude, there was something for everybody in the end if you really searched, and also checked the board with all the jobs available at the fair. There were plenty of jobs, plenty of opportunities if one had the knowledge, determination and will to work."

by Ms. Andreea Costache,
Romania (EUREC 2009/10)

"With respect to my opinion, I found the job fair very good to have a first approach with human resource managers in good companies, if you are looking for an internship or a job position. There were around 70 companies related with wind, solar and bioenergy, but also universities offering M.Sc. and Ph.D. positions. The companies which attracted most of the attention of visitors were GE, GL (with GH), Enercon, Siemens, Fraunhofer IWES, Bosch, REpower and Vestas, who offered interviews to students and recent graduates from different parts of Germany. Some PPRE students managed to make a good impression among the representatives of the companies, who showed interest in the search for certain profiles in particular, students with a background either in engineering or renewable energy. For me this was a good opportunity to talk with people, who are directly involved with human resource processes within those companies. According to my experience, it is much better when you go to talk with an idea of the opening positions, which are usually posted on the websites and on the boards in the event, for instance, you can discuss real opportunities to be hired. In summary, this event was focused to people looking for a job or educational opportunities, in order to succeed the first step."

by Miguel Angel Pérez,
Venzuela (EUREC 2008/09)

COMPANY PRESENTATIONS AT PPRE, OLDENBURG

by Edu Knagge, PPRE 1990/91, PPRE-Coordinator

PPRE is inviting regional RE-companies to the Energielaborbuilding at Oldenburg University in the beginning of each programme. This Seminar was organised for the first time in 2007 and started on small scale with 4 companies only. In November 2009 more than 10 companies were interested to give a presentation and 9 were accepted and joined in the end(see list below):

All institutions were asked to provide an overview about the company and its various fields of activities. Emphasis should be given on typical activities for graduates of an international MSc-programme in the field of Renewable Energy.

Since all PPRE- students are looking for 2 months practical training places and for 6 months MSc-thesis-project placements in the year to come, the presenters were asked to include any possible offers or perspectives in this direction as well. At the end of each presentation time for questions and discussion was allowed.

Resuming the Company – Presentations over the last 3 years it is quite obvious that they provide a kind of win-win forum for everybody participating; on the one hand side the companies are able to recruit MSc-Students for internships and MSc-projects, and on the other hand students benefit at an early stage of their studies, because they get 'hands-on' and focused presentations about different fields of specialisations and possible future job profiles. Additionally they offered various internships and project places.

Institution:	Contact:
• energy & meteo systems GmbH	• Marie-Curie-Str. 1, 26129 Oldenburg www.energymeteo.de
• EWE AG – Geothermal Technology	• Tirpitzstraße 39, 26122 Oldenburg www.ewe.de
• Garrad Hassan Deutschland GmbH	• Marie-Curie-Straße 1, 26129 Oldenburg www.garradhassan.com
• GE Wind Energy GmbH	• Holsterfeld 16, 48499 Salzbergen www.gewindenergy.com
• Overspeed GmbH	• Marie-Curie-Str. 1, 26129 Oldenburg www.overspeed.de
• Solar Power Group GmbH	• Hohenzollernstr 24, 45130 Essen www.solarpowergroup.com
• Aleo Solar Deutschland GmbH	• Osterstraße 15, 26122 Oldenburg www.aleo-solar.de
• Biogas Weser Ems GmbH & Co.KG	• Zeppelinring 12 -16, 26169 Friesoythe www.biogas-weser-ems.de

EXTERNAL / GUEST LECTURES IN PPRE 2009/10

In this chapter all seminars presented by external lecturers to PPRE/EUREC students during the last academic year are listed. These seminars took place besides the regular classes, seminars and labs offered in the Postgraduate Programme Renewable Energy (PPRE).

Winter term 2009/10:

Building Physics and Heat Demand of Buildings
Seminar by Ms. Herena Torio, who graduated from PPRE in 2007 and is doing her PhD studies at Fraunhofer Institute for Building Physics in Kassel (www.ibp.fraunhofer.de) in cooperation with TU Munich

Energy Policy and Case Study Energy Policy Indonesia
Compact courses presented by Prof. Dr. August Schläpfer, Murdoch University, Perth, Australia

Wind Turbine Technology and Design
Seminar by George Pehlivanoglou, who graduated from PPRE in 2007 and is doing his PhD at TU Berlin – cancelled on short term notice.

The Modern Portfolio Theory applied to Wind Farms Financing
Seminar by Patricia Chaves from Brasil (PPRE 2005/07), who is doing her PhD at the German Wind Energy Institute in Wilhelmshaven, Germany (www.dewi.de)

Wind Energy Technology
Rainer Klosse, German Wind Energy Institute, Wilhelmshaven, Germany

International Energy Policy (Actors and Institutions)
Prof. Siebenhüner, Institute of Economics, University of Oldenburg

Biogas Compact Course
By Jan Lam, the Netherlands (PPRE 98/99) and Felix ter Heegde both from SNV, Netherlands / Dr. Henri Spanjers (HS) of LeAF are well-known international Biogas experts with many years of experience.

Summer term 2010:

Large Solar Thermal Systems & Solar Cooling & Heat Demand in Buildings and Exergy in Heating Systems
Seminars presented by Ms. Herena Torio, Spain (PPRE 2005/07) – see winter term

Solar Power to the People: A Chilean Experience
by Martín Jacques Coper from Chile, guest scientist at Forwind Institute, Oldenburg – see also article in the back.

Concentrating solar power: focus on linear Fresnel reflector technology
Seminar by Francois Veynandt, who graduated from Eurec in 2008. Francois started his PhD with respect to concentrating Solar Power in Alby (near Toulose, France)

Concentrating Solar Power Applications
Seminar by Dr. J. Göttsche (Head of energy efficiency department at Solar Energy Institute in Jülich, University of Applied Sciences, Aachen), who was working at PPRE up to some 12 years ago, and
M. Rojas, who is PPRE 2007 graduate and is now working with CSP at Solar Power Group GmbH in Essen.

Batteries, Controllers, DC Appliances
Prof. Adelmann from University College Ulm informed about his experience with small PV powered DC systems

EXPERIENCE WITH LAHMEYER INT., GERMANY

by Alex Loosen, US (EUREC 2008/09)

I started my Master's Thesis with Lahmeyer International GmbH in late June of 2009. Lahmeyer Int. is an independent engineering consultancy firm that is located just outside of Frankfurt, Germany. My thesis is currently on writing a software tool to analyze the performance of CSP power plants.

I had always viewed consultancy firms as full of older engineers; people who quit industry after many years of work and decide to settle down in a consultancy position to finish their engineering career. What I noticed soon after starting was that I couldn't have been more wrong. The renewable energy department that I have been working in has fewer than 20 employees and has over 5 students. In addition, many of the full time employees are under 30 years old and have diverse backgrounds with a large number coming from Latin America and some from Asia.

One thing that drew me to consulting was the constant exposure to new projects and ideas. When you work for a company that has no tangible product or manufacturing base, all of the projects have to come from the outside. Coworkers have travelled to South Korea, Abu Dhabi and Mozambique to work on different projects (to name a few). One of my fellow students even got to go to Spain for a week to work on a project.

Another surprise is the work atmosphere. Although most employees work together on projects, organizing your own time is mostly up to you. You do not have someone breathing down your back, or checking on you constantly, they just expect results. Some employees choose to start the day later and simply go home a little later. That was more freedom than I expected going into the job, but made for a much more relaxed atmosphere.

My thesis has been going really well. I've been able to achieve all my goals in my software tool and will be presenting my thesis in December. I really believe that the flexibility and mature nature of the working environment at Lahmeyer allowed me to better apply my own ideas and in the end make a much more interesting and effective result.

At the time of this writing I am undecided on my path after graduation, but I know that if I stay in the consultancy industry I will be exposed to new and interesting projects constantly. The learning curve can be very steep at times, but the payoff from such work can also be high.

PRACTICAL TRAINING EXPERIENCE IN INDONESIA

by Celia Moreno Chiunti (Mexico) and Elisa Rodriguez Sanchez (Mexico) PPRE 09/11

An important part of the PPRE program is the 2 months practical training during February and March, where all the 21 students were spread around the world applying what we had learned so far and learning even more. For Elisa and me this experience was even more special than what we had thought it to be.

We had the opportunity to do our internship in a wonderful country, Indonesia. It was by mid January that we were informed that we had the opportunity to work in a project with Mr Chayun Budiono (PPRE alumni and GMN director), in cooperation with ITS Uni-

veristy (Institut Sepuluh Nopenber).
The first thing we had to do was to apply for the Visa, we were in a hurry because of the short notice and also because of the exams in that week, but finally against the odds we got it and we were ready to go. We asked around and did some research about the country, its culture, traditions, food, religion, etc. and realized that we were about to start a great trip.

It was our frist time in Asia, but in some way we felt like home, maybe the hot weather or the wonderful people we met there who always had a smile for you, or maybe because they also have chili and similar food as in Mexico. Of course there are always cultural differences but this was never a problem. Well, maybe the fact that they drive on the other side of the road (for us) was a bit dangerous, because we always looked to the wrong side!

Our internship project consisted on analyzing the performance of three micro hydro power plants in Seloliman area (east Java) as well as their impact on the communities beneficed with the electricity service and also an economic analysis of the plants.

The team (Pak Chayun, Celia, Elisa, Bambang, Unggul and Firman) and behind Seloliman MHP.

The first days were difficult, getting to know the place and getting used to the "no internet" situation or almost any other way to communicate with our families, the war against mosquitoes, or the fact that sometimes we had to take a shower with cold water and a bucket! But on the other hand, we enjoy the wonderful nature, no other sounds but the birds and bugs and the beautiful landscapes made you feel completely relaxed.

Rise fields in Seloliman

We worked with 2 students of ITS Unggul and Firman, who helped us not only with the work but also communicating with the local people as most of them did not speak English at all.

Elisa, Celia, Unggul and Firman

At the end we concluded that the three evaluated plants have an enormous beneficial impact on society, most of the consum-

ers are grateful for the service, which has improved their life conditions in different ways (more jobs, better education, entertainment, etc.), and for this reason it is important to keep the plants working as good as new. And we also gave some advice onhow to improve and take care of the plants, so they will last for a long time.

Sendi MHP (10kW)

Elisa and I trying to do pottery

We have to confess that not all of the time was spent working, we took one week off for traveling around some islands and we visited Bali, Lombok, Gili, Flores and Rinca.

Beautiful places where we learned how to make pottery and fabrics, how to wear the sarung, some of the cultural customs, as in Bali the Nyepi (Balinese new year "Day of the Silence") and to see unique animals like the Komodo Dragons.

Komodo Dragons in Rinca Island

It is difficult to summarize such a great experience in a few words, what we can tell you is that we will never forget the time we lived there and the things we learned. Finally, we will like to thank the persons who made this possible, Pak Chayun Budiono and his family, PPRE team, ITS university, PKM cooperative in Seloliman, to the staff in PPLH, to all of you Terima Kasih!

EXPERIENCES GAINED AT SOLAR POWER GROUP IN ESSEN, GERMANY

by Juan Pablo Martin Gomez, Mexico (PPRE 2009/11)

Solar Power Group started in 1998 in Belgium with the name "Solarmundo" with the idea of developing and building Linear Fresnel Solar Collectors as the Belgian government incentives were strong at that time. Later due to better business conditions in Germany the company changed its name to Solar Power Group (www.solarpowergroup.com) and moved to Germany. This emerging company caught the attention of the Ferrostaal Group which in 2007 bought around 40% of the company. Nowadays the two companies work together for developing new projects; Ferrostaal group takes care of the structural engineering and power generating turbines while SPG (Solar

Power Group) takes care of the collector design, engineering, fabrication and construction.

Since 1998, three generations of Linear Fresnel collectors have been developed and then improved. The Type 2 solar collector was successfully tested as a demo Project in Almería, Spain at the "Plataforma Solar de Almería" for almost 2 years. This technology and design was also tested by the DLR (German Aerospace Agency) and received very positive feedback as they supported the argument that Linear Fresnel technology has a huge potential and is likely to compete intensely with Solar Parabolic Trough technology. Although Linear Fresnel Collector efficiency is lower, the manufacturing costs are about half as compared to that of Parabolic Trough Technology. SPG´s new "Type 3" collector is finished and now several potential projects are being developed of at least 10 MW power rating, both for demonstration and commercial applications. It may supply hot steam or electricity for industrial, commercial or residential applications.

The main reason why I got the opportunity to do the practical training at SPG was because they were looking for someone to help them plan with the production process (that was what I did back in Mexico before coming here) which was great because it would also help me to write my thesis in this company. Practical training is a great way to get to know a company involved in renewable energy, the people who work in it, the working atmosphere, and the projects. I am especially grateful to Mauricio Rojas (former PPRE student) who gave me the chance to work with SPG.

SPG´s "Fresdemo" (Type 2) at Almería, Spain

HALF A MILLION EFFICIENT FIREWOOD STOVES FOR KENYA - The Paradigm Project

by Juan Pablo Montoya, Venezuela (PPRE 2009/11)

Kenya is an example of one of the many cases of critical deforestation in East Africa. In this country the average household consumes around 23 trees per year and for every 28 trees that are cut, only one is replanted. In general, in the developing world, the firewood consumption represents a very important source of energy. Over 65% of the total energy consumption is from wood or another kind of biomass. The main usage of firewood is cooking as is shown in this picture of a "mama" cooking with three stones and an open fire.

Typical 3-stone fire used for cooking in Kenya

One of these women would have to walk around 6 kilometers or more to find wood and then carry back home an enormous weight of up to 40 kg or more on their backs. In some households the people spend 35% or more of their income buying firewood. Cooking with an open fire means a huge wood consumption and generates a lot of smoke due to incomplete combustion. This smoke kills thousands of people in rural areas due to respiratory diseases; one day of open fire could be like smoking 40 cigarettes.

The Paradigm Project, an American low profit organization, has taken up one of the most ambitious projects in East Africa to stop deforestation and improve the living quality of rural women. Around half million rocket stoves will be manufactured over the next ten years , with the goal of financing the first years with carbon credits revenues – they have a CDM project successfully in course and plan to achieve a market based system to produce and distribute the stoves in a sustainable way.

A very simple design that Peter Scott, a visionary trying to save Africa from deforestation, wants to spread and implement with local manufacturing is being used now to produce a rocket stove, which will not cost more than US $ 16, to be affordable enough to the rural communities. Paradigm is working hard in the scaling up of the process, training tinsmiths and welders, acquiring some machines and recruiting local man-

The kenyan "jiko" against imported versions

agers as well for a project that will be totally delivered to local hands in 4 or 5 years, when it will be feasible for all the market chains.

Soon a lot of families in Kenya and hopefully in Tanzania, Uganda and other neighboring countries will be getting the so called "Jiko" or rocket stove. A happy mama with one of this jikos is nowadays consuming half of the wood and the toxic smoke has been reduced to more than 70%, not mentioning the hundreds of hours and money spent collecting and buying firewood.

Please visit the reference of all this numbers and projects: www.theparadigmproject.org

MY EXTERNAL PRACTICAL TRAINING EXPERIENCE AT TATEDO – TANZANIA

by Daniel Ngoma, Tanzania (PPRE: 2009 – 2011)

During my practical training at TaTEDO, I worked at one of its energy research centre called Sustainable Energy Development Centre (SEDC), which deals with research, training and development of sustainable energy technologies. I worked in several projects at the centre and some of them include:

Training: I got an opportunity to participate as an instructor in one of the training course on solar home systems at the centre. The training course was of 10 days and was aimed to give participants with an interdisciplinary learning situation within which solar energy system and related enterprise development skills can be adapted and used by participants and other end users.

Research: I did some research on biogas technologies and tried to look how much gas can be produced in each biodigester technology after feeding continuously twice a day for 3 days. And my finding was that the fixed dome (Carmatec) biodigester plant produces the highest gas output which lasted for more than 5 hours at maximum gas pressure.

Fixed dome bio-gas system

The second in gas output was the adapted Vaccvina (Vietnamese) biodigester which looks like the toilet pit and sometimes uses toilet waste. Gas output recorded was lasted for less than 2 hours with relatively low gas pressure.

Vaccvina bio-gas system

The least bio gas plant was the floating tank biodigester which uses kitchen waste and the gas lasted for less than 1 hour.

RE Technologies: In other renewable energy technologies, I also worked on solar multi charger project, solar mini home system project, solar dryer project, improved cook stoves project, bio diesel and Jatropha project etc.

Solar multi charger, Solar mini home system and Solar dryer

So, my external practical training was very successful because I was eager to learn and as a result I gained a lot of practical skills and experience on RE technologies, some of which I have not seen before and I was also able to apply most of the knowledge that I acquired at the Energielabor in winter semester.

Internet source: www.tatedo.org

MY EXPERIENCE GAINED AT WOODS HOLE OCEANOGRAPHIC INSTITUTION, USA

by Tyler Goepfert, US (PPRE 2008/10)

Working for 4 months at the Woods Hole Oceanographic Institution (WHOI) on Cape Cod, MA, USA, I have been exposed to a broad variety of sub-themes within microalgal biofuels.

In April 2009, I was invited to work between the labs of Dr. Chris Reddy and Dr. Mak Saito. Reddy and Saito are a perfect pair for my interest in biofuels; while Dr. Reddy's lab allows detailed inspection of the chemical composition of biocrude and equipment for transmethylation and cracking processes, Dr. Saito's lab provides a culture collection and platform for biomass generation in addition to cutting-edge „omics" (proteomics, genomics, and metabolomics).Although my time at WHOI was brief (Sept 2009 -Feb 2010) I was able to hit the ground running on account of previous experience working in the WHOI Chemistry department (2004-2008). During my thesis project I successfully aggrandized microalgal biomass production and have investigated some key physiological and biogeochemically relevant aspects of two important phytoplankton groups (Haptophyta and Diatoms). I will complete my thesis in early 2010 and look forward to returning to Oldenburg and rejoining the PPRE family for several months as I consider PhD prospects related to biogeochemistry with an emphasis on biofuels sourced from microalgae. Open questions range from practical production to economic feasibility, and overall sustainability. Indeed emphasis on local and sustainable biomass energy resources coupled with greatly improved efficiency and gradual shifts in lifestyle pose an excellent path into our collective future.

Anyone interested in biomass energy, specifically microalgal biofuels should be encouraged to discuss this with me or my thesis advisor, Dr. Konrad Blum. There are very real practical limitations in this specialization, but regardless it will be part of our energy future in some form and is consequently an open and exciting area of research and development.

Images and captions for your consideration, see next pages:

In experimental tanks at WHOI, guest student Tyler Goepfert grows different species of marine algae to test which might be best suited for harvesting and converting into biofuels. Goepfert is working with WHOI marine chemists Chris Reddy and Mak Saito, and Scott Lindell of the Marine Biological Laboratory on a project to provide insights that could sustain and optimize large-scale

biofuel production. Theoretically, algae could yield 20 times more biofuel per acre than those made of vegetables such as soybeans—in part because they grow extremely fast. (Photo by Tom Kleindinst, Woods Hole Oceanographic Institution)

„Example algae oil extraction (a literally „green-fuel") in laboratory being prepared for conversion to component fatty acid methyl esters (FAMEs) by transmethylation. This work is part of a project by WHOI, guest student Tyler Goepfert who is growing different species of marine algae to test which might be best suited for harvesting and converting into biofuels. Goepfert is working with WHOI marine chemists Chris Reddy and Mak Saito, and Scott Lindell of the Marine Biological Laboratory on a project to provide insights that could sustain and optimize large-scale biofuel production. Theoretically, algae could yield 20 times more biofuel per acre than those made of vegetables such as soybeans—in part because they grow extremely fast. (Photo by Tyler Goepfert)

WIND TURBINE WORKSHOP

by Paola Cudan, Italy and Andreas Castede, Rumania(both EUREC 2009/10)

Course Objectives:
Building a wind turbine to the following specifications:

- Blade diameter: 1.2m
- Rated Power (at 12m/s): 150W
- Stator Voltage: 48V

Presentation: Friday
Introduction to V3 Power, the Hugh Piggott wind turbine

Saturday
Background Theory: Blade design and alternator design

Sunday
Installation; Tower design, electrical systems and maintenance

Handmade alternator

Handmade rotorblades

Someone said "Wind turbines don't make good neighbors" but at least now we know that they can make a weekend of workshop an excellent experience. The aim of this course was to gain a practical knowledge about how to build a small, low cost, easy to manufacture wind turbine, following the design of Hugh Piggott.

The course was mostly practical, although we had simple and clear presentations covering theory and background information to the turbine such as: Blade geometry, tower design, DC coupling and 3 phase rectifier The group was split into three teams, which rotated around 3 bases: woodwork, metalwork and electrical systems. There we learned how exhaustive and exciting it can be to build a WEC, carving the blades from wood, welding, grinding, drill, manufacturing the permanent magnet alternator, winding coils and assembling demonstration electrical system.

What better way to put the theory studied in these months into practice?

EUREC students 2009/10, University of Kassel

MSC-THESIS PROJECTS IN 2009/10

The following thesis projects were successfully completed in 2010

Name	First Name	Nation	Institution Master Thesis	Title of Thesis
Agarwal	Ankur	India	GE Global Research, Munich	Assessment and characterization of cloud shading situations in large scale PV systems and their effect on energy yield.
Alcazar	Freddy	Venezuela	Overspeed GmbH & Co. KG, Oldenburg	Mast measurements and long term data correlations for different countries
Binda Pereira	Mariana	Brazil	GE Wind Energy GmbH, Salzbergen	Development of an algorithm for a configuration tool for SCADA and grid connection of Wind Farms systems
Butler	Blake Allan	USA	Center for Energy Research, N. Mandela Metropolitan University, South Africa	Investigation of low concentration photovoltaic modules and systems
Chakanga	Kambulakwao	Zambia	Next Energy/ Univ. Oldenburg	Texturing of ZnO films on glass for use as a light-scattering layer in micromorphous silicon thin film solar cells
Cendrawati	Dian	Indonesia	AG Twist, Univ. Oldenburg	"The Design of Constant Temperature Anemometry Circuit
Farmani Marzankalateh	Issa	Iran	aleo solar Deutschland GmbH , Oldenburg	A Design Guide for Stand-alone Solar Systems
Goepfert	Tyler	USA	Woods Hole Oceanographic Institution, USA	Microalgae based solar energy conversion: modular large-scale production, processing technology, energy balance, and genomic/ proteomic assessments
Md. Motaher Hossain	Md. Motaher	Bangladesh	AG TWIST+ ForWind Oldenburg, Univ. Oldenburg	Direct Numerical Simulation of the Blade (FX77-W-500) Based on Spectral/hp Methods
Javed	Ahsan	Pakistan	ForWind / Uni Oldenburg	Performance assessment of a small Wind Power plant
Mahmud	Abdul Muhaimin	Malaysia	Public Works Department of Malaysia	Evaluation of the solar hybrid system for rural schools in Sabah, Malaysia
Njoka	Francis Namu	Kenya	PLANET Planungsgruppe Energie und Technik GbR, Oldenburg	Analysis of Multi-flow and Coupled Energy Conversion Processes
Paradine	Martin D.	Canada/ UK	Building Research Establishment (BRE), Watford, USA	Refurbishment strategies for domestic buildings: Case studies in the UK
Pereira Santos	Rafael	Brazil	Fraunhofer-ISE, Freiburg	Study of the Degradation Parameters on Valve-Regulated Lead-Acid Batteries for Solar Home Systems (provisory)

Name	First Name	Nation	Institution Master Thesis	Title of Thesis
Semere Tesfase-lasie	Russom	Eritrea	Phaesun GmbH, Mem-mingen	Rural electrification using renewable energy for a typical Eritrean village Adi-Gulti and a Semi-Urban town Areza.
Shah	Adnan	Bangla-desh	Garrad Hassan Germany, Oldenburg	Creation and Optimization of Symmetries in Wind Farms
Tchiemogo	Hamadou	Niger	Next Energy/ Univ. Old-enburg	Design , Construction and Optimization of Single Vanadium Redox Flow battery Cell.
Tempon-eras	Dionysios	Greece	ETA-Florence Renewable Energies, Italy	Status and potentialities of biomass co-firing in Europe
Thakuri	Sujit	Nepal	Lahmeyer International GmbH, Bad Vibel	Technical Acceptance Test for Large Scale Grid Connected PV System
Ullrich	Cédric	France/ Germany	TÜV Süd Industrie Service GmbH, Munich	Tools and Mechanisms for reducing green house gas emissions Interaction between Kyoto Protocol Mechanisms and tools de-signed on a local or interregional level
Wannapin	Sirinya	Thailand	Phoenix Solar AG, Sulze-moss	Potential of off-grid PV/hybrid systems

EUREC 2008/09 – The following projects were successfully completed and defended in Brussels in December 2009 already.

Family name	First name	Country	Institution	Title of Thesis
Emmerich	Roy	South Africa	ISET/IWES, Kassel, Ger-many	Design and implemention of a flexible distributed energy management system
Chatzi-panagi	Anatoli	Greece	ISPRA,Italy	Module measurements (Energy rating) indoor outdoor comparison
Gammoh	Omar	Jordan	3E, Brussels, Belgium	Model Development for Stochastic Short-term Forecasting of Photovoltaic Systems
Loosen	Alex	Germany	Lahmeyer, Bad Vibel, Germany	Development of a Solar Field Simulation Tool based on Tower Technologies
Adams	Brian	USA	NTUA Athens, Greece	Evolutionary Techniques in Blade Design
Arapo-gianni	Athanasia	Greece	EWEA, Belgium	Tool for comparing the kWh costs of gener-ating electricity from new coal, gas, nuclear power stations and wind energy (onshore and offshore)
Gkinis	Ioannis	Greece	CRES, Athens, Greece	Design of a wind farm in complex terrain
Hernan-dez R.	Juan Esteban	Columbia	wpd, Bremen, Germany	Wind energy project development in Colom-bia: Applying remote site
Kwapis	Elke	Germany	WindMW , Bremerhaven, Germany	HSE Management (Health, Safety and Envi-ronment) for an Offshore Windpark in the North Seafor Environmental Investigations
Perez	Miguel	Venezuela	DEWI, Wilhelmshaven, Germany	Evaluation of operating Wind Farms (Pro-duction, Losses, Cost Assumptions)

Name	First Name	Nation	Institution Master Thesis	Title of Thesis
Rojas	Sergio	Costa Rica	Cube Engineering, Hamburg, Germany	Market Overview of current Turbine Manufacturers for Projects in Emerging Countries
Teixeirinha	Patricia Alexandra	Portugal	Germanischer Lloyd, Hamburg, Germany	Development of a Procedure for Health, Safety & Environmental Consultancy Services in Offshore Wind Farms – UK and Germany Market
Thomas	Jaimie	Costa Rica	Cube Engineering, Hamburg, Germany	Wind Energy Project Barriers in Emerging Markets – Chile Overview

BIOMASS/BIO-ENERGY

Al-Mas Sendegeya, Uganda (PPRE 1999/2000)

who is lecturing and researching at the Department of Electrical Engineering, Faculty of Technology, Makerere University, Uganda informed us, that end of 2009 they received funds to do research in electric generation by running an engine on gasification. The raw material for the gasifier is rice husks abundantly available in Eastern Uganda.

The system will provide both thermal and electric energy to be used at a rural medical centre.

Edwin Sithole Mwakatage, Tanzania (PPRE 2006/08)

Early 2010 Edwin was working in Mpanda South West Tanzania (by Lake Tanganyika) with PROKON Renewable Energy Systems and Solutions Ltd., where they aim at producing pure Jatropha oil for diesel engine consumptions.

One of their targets is to electrify rural areas using PJO-Pure Jatropha Oil. He is looking forward to get more information on the technology for special gensets that work quite good with SVO's (Straight Vegetable Oil).

Sunil Prasad Lohani, Nepal (PPRE 2006/08)

rejoined Kathmandu University as lecturer in December 2009. Actually his research group is concentrating on bio-based energy research within the university and recently they won a NORAD grant assistance of about 5 million Rupees (56,000 €) for the development of a Biomass Gasifier to run small sized engines. Recently they also established a biogas laboratory with a facility of purification, compression and bottling system. Additionally some solar PV and water heater systems are also available.

César Roberto DEL CID LEMUS, Guatemala (EUREC2007/08)

He returned to Guatemala right after his EUREC-studies in April last year, and started to search for a job. Fortunately he found a job very fast. First he was working as a consultant in an American NGO but since August 2009 he is working in a sugar company called Pantaleon (www.pantelon.com). This is a big company, the core business is sugar but in the past 3 years it has been involved in energy projects; now it has a bioethanol plant and a biomass combustion plant. Rob is in charge of coordinating the energy crops division where he must supply enough biomass to the combustion plant

and at the same time he takes care of the sustainable management of the forest plantations (the main fuel used by the plant is eucalypt wood chips from their forest plantations).

SOLAR THERMAL / CSP

Julio René Sánchez Contreras, Colombia (PPRE 2003/04)

joined the Concentrating Solar Power Department at Vattenfall Europe PowerConsult GmbH in Berlin, Germany recently.

He is in charge of the CSP activities at Vattenfall Europe PowerConsult GmbH. As the engineering branch of Vattenfall Group the company has extensive firsthand experience with conventional thermal power generation which makes it easy to step into the Concentrating Solar Power generation market. The company advices investors, developers, financiers and constructors acting as lender or owner's engineer at all stages of project development, implementation and operation.

Rosiel Millan, México (PPRE (2007/09)

was employed at Solar Power Group in Essen, Germany (www.solarpowergroup.com) after she finished her research at ISE, Freiburg, where she did her Masterthesis project.

Francois Veynandt, France (EUREC 2006/07)

wrote: „My PhD-thesis work is about the numerical modelling of a concentrating solar thermal power plant. I simulate the Linear Fresnel Reflector based concentrator. The application seeked is among others cogeneration for buildings. So I have a simulation tool for the optics and a second tool for the thermal and thermodynamic simulation. I am working in parallel on the design, construction and testing of a prototype. It is a 9 square meters large prototype. This small scale system will enable us to test some design parameters. It is a good opportunity to validate our simulation tools as well. In this frame I host a master thesis. Mr. Can Serkan Ibrahimoglu from Turkey (EUREC 2009/10) will start working with us in July 2010."

PHOTOVOLTAICS

Thomas Schwarz, Germany (PPRE 1989/90)

wrote in May 2010: "I have changed to a new department at Phoenix Solar. There I will be in charge of all technical support, planning and eventually hopefully realisation of PV systems in so called „emerging markets", i.e. all countries beyond those with established on-grid PV markets. This will also include larger off-grid resp. hybrid PV-Diesel systems in rural areas. Currently we are in negotiations for projects in the Middle East mainly, but also South America and Asia.

We would also be glad to offer our services for (large scale) PV projects that our alumni know in their region, in which experienced foreign companies/experts are welcome (or needed) for implementation - www.phoenix-solar.com."

Ramon Gomez Vilar, Spain (PPRE 1997/98)

informed us that he has been working for Schüco – company for more than 6 years already, as the solar technical director for Spain and Portugal in Madrid. And in August 2010 he is moving to Berlin to start a new project by the company Inventux (PV Thin-film) as project manager.

Mathieu Sarran, France (PPRE 2003/04)

is working as technical director for a solar company in the South of France called REWATT (www.rewatt.com). It is a small solar company specialized in developing PV projects in French Guyana. Actually they are planning the construction of 4-5 „open space PV farms“ in Guyana this year and 5-6 more next year.

Stelio Correia, Portugal (EUREC 2004/05)

is now working at the R&D department of Bosch Solar Thin Film (www.bosch-solarenergy.de) in Erfurt, Germany. Formerly the company's name was 'Ersol', but Bosch took over last year.

Antonio Antonopoulos, Canada (EUREC 2005/06)

who is working as regional manager for CarbonFree Technology in Canada, participated in May 2010 on behalf of Canada in a kick-off meeting for a new Task of the International Energy Agency, Photovoltaic Power Systems Programme (IEA PVPS), Task 13: „Performance and Reliability of Photovoltaic Systems“.

Actually the person in charge of Task 13, who is the senior scientist at TÜV-Rheinland for renewables and is also organizing the Köln meeting, was **Ms. Ulrike Jahn, Germany (PPRE 1989/90)**.

Other participants of the workshop from PPRE were: **Luis Vera Tudela, Peru and Mauricio Rojas, Colombia both from PPRE 2005/07**.

Yann Tanguy, France (EUREC 2007/08)

is working for an energy consultancy company called 'Transénergie' in France, which organized an international workshop on the life cycle analysis of PV systems (network connected, crystalline and amorphous PV technologies) within the French project "ESPACE". The Workshop took place end of October 2009 at Ecully near the city of Lyon at the Transénergie PV pedagogical platform Qualiphoton, and the ESPACE team presented the results from the LCA of photovoltaic systems realized during the project.

Christopher Baldus-Jeursen, Canada (EUREC 2007/08)

wrote: "I've started a Ph.D. (in Sept. 2009) at the University of Waterloo Centre for Advanced Photovoltaic Devices and Systems. My work is on improving the quality and reducing the cost of silicon wafers by investigating alternative fabrication techniques to the industry standard equipment which is the multi-wire-slurry-saw.

I am in a research group with 9 other Ph.D. students – most of my work is on my project, but I also take several courses. Recently there is a new feed-in-tariff system put in place in the province of Ontario. It is very generous to photovoltaics providing a fixed return of 80.2 cents/kWh for photovoltaic electricity sent back to the grid. The tariff support should stimulate PV growth in this province significantly.

Sunny greetings from Waterloo!"

Anatoli Chatzipanagi, Greece (EUREC 2008/09)

wrote: "I did my traineeship for the third semester of the master, extended my contract and I am still working at the European Solar Test Installation (ESTI) at the Joint Research

Centre (JRC) in Ispra (Varese, Italy). The ESTI is part of the Institute for Energy (IE) which is one of the 7 scientific institutes of the JRC of the European Commission. The IE promotes Renewable Energies and ESTI focuses in Photovoltaics.

I am working on thin film PV modules and more specifically on the pre-conditioning of them in order to investigate their performance and stability.

My work involves pre-conditioning of the modules in a light soaking chamber and performing measurements on a pulsed solar simulator to analyze their behavior. In addition, performing outdoor measurements (under natural sunlight) and comparing indoor-outdoor measurements after the necessary corrections are applied are part of my work."

Giorgos Sandris, Greece (PPRE (2007/2009)

wrote: "So, since November I am working in Phoenix Solar in Ulm as planning engineer for big PV power plants!! It's quite interesting and I am learning a lot of things!!

I also met a PPRE alumni, **Thomas Schwarz (from PPRE ,1989/90**). He is working in the headquartes of Phoenix Solar in Sulzemoos close to Munich!! Also another collegue of mine, (EUREC alumni) knew about PPRE and he also took part to the Biogas workshop last year in Oldenburg!!! It's seems that the PPRE network and in general the RE network is everywhere!! :)"

Cédric Ullrich, Germany/France (PPRE 2008/10)

started to work for RENERCO - Renewable Energy Concepts AG in Munich right after his PPRE-studies. As Project Engineer he is in charge for the development of solar parks (open space) in France.

Hamadou Tchiemogo, Niger (PPRE 2008/10)

is currently in Mali working with FRES, a Dutch company (www.fres.nl). He is doing performance evaluation of batteries and charge regulators used by FRES companies based in Mali and South Africa. Hamadou will also visit the site in South Africa.

Sujit Thakuri, Nepal (PPRE 2008/10)

stayed at Lahmeyer International GmbH in Bad Bibel, Germany to work for the Energy Division in the PV-field. He also did his practical training and thesis-project during his PPRE-Studies before at Lahmeyer. Actually he is working as a Project Engineer at GE5-Renewable Energy Department.Some of his key responsibilities includes Solar PV Project development and management including detailed Technical Due Diligence Study, System Performance Analysis, Conducting/supervising Technical Acceptance Test of PV Plants and frequent site visits to PV plants.

WIND ENERGY

Mazharul Islam, Bangladesh (PPRE 2000/01)

In 2009 he finished his PhD-study at University of Windsor, Canada, in the field of Straight-bladed Vertical Axis Wind Turbine. His research topic was „Analysis of Fixed-Pitch Straight-Bladed VAWT with Asymmetric Airfoils". In 2009 he joined the Department of Mechanical Engineering at Taibah University, Al Madina Al Munawara, Saudi Arabia (see careers).

Alfredo Pena Diaz, Colombia (PPRE 2004/06)

In May 2009, Alfredo defended his PhD at the University of Copenhagen from the research carried out at the Wind Energy Division at Risø DTU, Denmark. His thesis „Sensing the wind profile" aimed to analyze, measure, describe, and model the wind profile in and beyond the atmospheric surface layer, by combining traditional techniques for wind speed measurements, such as the cup and sonic anemometers, with observations from commercial lidar instruments (a link to his thesis is found at: http://www.risoe.dk/Knowledge_base/publications/Reports/risphd-45.aspx?sc_lang=en).

In April 2009 he continued his worked in wind energy at Risø DTU as a PostDoc and from September 2009 he has been working as a Scientist at the Wind Energy Division of Risø DTU on the fields of wind power meteorology, atmospheric turbulence and remote sensing."

Giovanni A. Pabón Restrepo, Columbia (PPRE 2007/09)

After finishing his MSc-project with Innovative Wind Power Co. in Bremerhaven he joined VESTAS Co. in Denmark. He is attached to the tools and equipment department for the production of blades. Actually from their headquarters in Lem, Denmark they are giving support for the production of blades in all the VESTAS factories worldwide.

Jorifa Khatun, Bangladesh (PPRE-2006/2008)

wrote: "I am working in Bangladesh Power Development Board (BPDB) since 2000 and involved in Planning Department. BPDB is a government organization which generates power from conventional and non-conventional sources, at a time purchasing power from power companies as a single buyer and distributes power to consumers.

We have gas, coal & oil based power plants. The majority of power plants are gas based. Due to shortage of gas we are planning to generate power from renewables in near future. In this connection, we have planned to setup a 100MW wind based grid connected (off shore) Power Plant in the South Belt of Bangladesh. This plant will be in private sector "On a Build Own Operate" (BOO) basis, according to Private Power Generation Policy - BPDB will purchase power from Private Companies.

Patricia Teixeirinha, Portugal (EUREC 2008/09)

joined Airwerk GmbH, Essen, Germany right after her graduation at University of Oldenbrurg.

Airwerk is a consultancy company that has a main branch in the north of Germany, where they sell wind towers. They just opened a new branch in Essen and Ankara (Turkey) for consultancy. Actually Patricia is involved in the construction phase of a project in Azerbaijan and the project development of a Wind Park in Albania (with the Government of Italy). The company market is Albania, Turkey, South of Italy, Azerbaijan and Russia.

Patrick Roycroft, Ireland/Germany (EUREC 2006/7)

is still working at TÜV NORD in Hamburg, which is a competitor of GL/GH in the field of certification of wind turbines. Basically they check the design calculations of various wind turbine parts (electrical, mechanical and structural) and they also sometimes

go to the turbines or the manufacturing sites to make sure that they are installed and manufactured correctly.

The important aspect of his work is to be helpful to his clients (who they are supposed to check but who also pay them!) but at the same time to be neutral and follow the technical standards and regulations!

Erik Patschke, Germany (PPRE 2006/07)

joined the Service Proposal Coordinator Offshore Department at Siemens Wind Power GmbH in Bremen, Germany earlier this year.

George Pechlivanoglou, Greece (PPRE 2005/07)

is still in Berlin, working for the small research company „Smart Blade GmbH" (www.smart-blade.com) and at the same time going on with his PhD at TU Berlin.

He works in the field of wind turbine blade design, aerodynamics and flow control. They have a lot of work and the projects are very cool and challenging. Therefore it is really an interesting place to be. The general focus of the company is the creation of innovative blade designs and the integration of passive and active flow control means in order to achieve new concepts of Wind Turbine Power Regulation, Load Control and Efficiency Increase.

George is currently involved in all the projects of the company both in the experimental as well as the numerical field.

Juan Troncoso Lago, Spain (EUREC 2006/07)

is continuing with Airtricity, but changed place and task in late 2009. He is now „grid manager" for Italy stationed in Milan. He wrote: „It is challenging as I have learnt another language and the portfolio is huge and all is new and different in here, but at least weather is incomparable with Dublin!"

Petros Paterakis, Greece (EUREC 2007/08)

recently wrote: „ I quit from Vestas in July 09 in order to join the Greek army and after a short time I started looking for a job. Luckily I got one since March 10, 2010 and I moved back to Athens.

It is a small developer company called „Aioliki Metritiki" (meaning wind metering - www.aioliki-metritiki.com). For the moment my task is to do site surveys and wind resource assessment. But since it is a new company the plan is to get involved in all stages of wind farm development.

Leila Garcia da Fonseca, Brasil (PPRE 07/09)

is still with Vestas Company, but now moved from Brazil – office directly to Vestas headquarters in Aarhus, Denmark, where she is attached to Spare Parts – Logistics Department -

In July 2010 Leila joined the sales department of Vestas in Mexiko

www.vestas.com

Mariana Binda Pereira, Brasil (PPRE 2008/10)

joined the Edison Engineering Development Program (EEDP) at GE Wind company in Salzbergen, Germany, on 1st of April 2010. She will be working as Trainee-Engineer at GE in different departments for 2 years.

Freddy Alcazar, Venezuela (PPRE 2008/10)

joined the International Micrositing Department of the German Wind Energy Institute in Wilhelmshaven, Germany (www.dewi.de) right after his PPRE - studies at University of Oldenburg.

Just recently Freddy also joined the Edison Engineering at GE Wind Energy as Trainee Engineer for 2 years.

Miguel Perez, Venezuela (EUREC 2008/09)

After completing his master thesis at DEWI (Deutsches Windenergie Institut), he applied for a position as a project engineer in the department of micrositing and due diligence. Once past the selection process of DEWI, they decided to hire him to be part of the team. Since 1st of April 2010, he is working for DEWI and continuing his learning process in the wind energy sector.

Rafael Pereira Santos, Brazil (2008/10)

was employed at INOVA Energy, an independent consultancy company in the wind engineering area, located in Fortaleza, Brazil in May 2010 right after finishing his PPRE-studies (www.inovaenergy.com.br). He is working as Wind Energy Analyst for micrositing studies, including energy output calculations, estimate technical losses and conduct uncertainty assessment.

Adnan Shah, Bangladesh (PPRE 2008/10)

was employed by Garrad Hassan & Partners, Germany right after his studies with PPRE. He also did his MSc-thesis project with them before.

In June 2010 he wrote:

"Getting into PPRE was one of the best decisions I made in my life. It all started with my curiosity towards solar energy, when I found a university in a small city called Oldenburg offering a program in Renewable Energy. Everything started to fit in place when I began the program, greeted by a bunch of minds passionate about saving the environment. During the passing months my mind was opened to a wider world of knowledge beyond the understanding of our everyday lives. PPRE having a broad selection of subjects gave me the opportunity to have a taste of all the areas that the field of renewable energy has to offer before I could filter onto that which interests me the most. After spending some decisive times I ended up with my focus on wind energy which was totally different than what I had in mind when I first started the program. I was lucky enough to get a chance to do my master's thesis at Garrad Hassan where they were offering a topic which exactly suited my interest. Finally I was recruited by them into their energy assessment department where I am required to go on site visits, optimize turbine layouts, make energy predictions, and many more exciting works.

PPRE made it all possible for me to reach this far where I relish doing what I do, in a place where I want to be. May the wheel of PPRE keep running!"

RE RELATED SUBJECT

Anil Misra, India (PPRE 1989-90)

who is employed as Technical Specialist in the Natural Resource Management Programme at GTZ, India, informed us that TUEWAS Sector Network Workshop (Working Group on Rural Energy) was organising an Asia Regional workshop from 28-31 October 2009 in New Delhi, India, to discuss

A new 'Energielabor' at UTA-campus, Arica, Chile

the issues related to Rural Electrification (Policy framework, Productive use of Electricity, Quality & Standards, Capacity Development etc.).

Besides participants from Afghanistan, Pakistan, Nepal, Thailand, Indonesia, Tibet, Ethiopia, Bangladesh and Germany also some following PPRE alumni participated. (see below)

PPRE-alumni gathering at GTZ workshop in India (fr. left): A. Misra, A. Michel and A. Shukla

Enrique Fuentes, Chile (PPRE 1995/96)

who is lecturing at Universidad de Tarapacá, Arica, Chile (www.uta.cl), informed us that they built a new Energy Lab building on the university campus in Arica. Actually the structure of the building was completed already end of last year, but all the equipment has to be installed, like solar panels, wind turbine, solar cooker, dryer, instrumentation, etc.

Anand Shukla, India (PPRE 2001/02)

who also joined as Sr. Technical Expert for the Natural Resource Management Programme at GTZ, India, wrote:

"I feel happy to share that PPRE network spreads knowledge and share experience at every international forum. In continuation to Anil Misra's email on sector network (TUEWAS) workshop of GTZ, let me convey that **Anil, Andreas Michel, Germany (PPRE 2003/04), Samson Tolessa, Ethiopia (PPRE 1993/94)** and myself enjoyed a lot meeting each other. The workshop was a successful event of 4 days, where people from various countries participated and shared experiences. The real outcome of the workshop was the commitment to cooperate and support participants from/to other countries in a mutually agreed timeframe."

Satish Gautam, Nepal (PPRE 1994/95)

returned from his development job in Kabul, Afghanistan to Nepal, where he is still working on his Ph.D. from School of Public Policy, Georgia Institute of Technology, Atlanta, USA on Environmental Policy. He is using Elinor Ostrom's (Nobel Prize in Economics 2009) Institutional Analysis and Development Framework to look at the performance of community managed micro hydropower plants in Nepal. Earlier in 2010 he was trying to collect information from 50 plants supported by Rural Energy Development Program (REDP), where he used to work.

Juan Roberto Paredes, Colombia, (PPRE 1999/2000)

is still working as Renewable Energy Specialist for the Infrastructure and Environment Sector of Inter-American Development Bank (www.iadb.org) in Washington, US.

They are working with the governments in the region for fostering RE and capacity building. Actually they have supported the creation of a Renewable Energy Center in Chile and now they are looking for MSc students for developing their thesis work at the centre in Santiago. The recently opened center is hiring now staff and students could probably begin early next year for periods between 6 and 12 months.

Ram P Dhital, Nepal (PPRE 2001/02)

wrote in March 2010: „ Just wanted to inform you that I left Afghanistan and have started my new assignment as Rural Energy Technical Advisor with AusAID supported Access Power Investment Program in Vanuatu. The program works towards the goal of expanding access of modern energy services in the rural islands of Vanuatu. I will be focussing more on preparation of technical guidelines and specifications for RE technologies. I also need to train government engineers on feasibility study and design of energy systems. I am currently involved in designing an investment program known as the Vanuatu Energy for Rural Development (VERD) program which aims to expand access to power to rural areas of Vanuatu through various means of renewable energy technologies

Vanuatu is a small country of many islands in the south pacific. The capital, Port Vila is quiet and clean. People are friendly and hospital but the weather outside is very hot and humid."

Manoj Khadka, Nepal (PPRE 2002/03)

In March 2010 he started to work in the Ministry of Rural Rehabilitation and Development in Afghanistan Kabul as an energy expert. They have a component in UNDP supported programme National Area Based Development Programme (NABDP).

He wrote: "I am trying to learn what have been doing in the past and what I can do from my side to improve the access to the electricity in the rural sector. It was my previous professional experience working in a similar program in Nepal that I am here to support them. The working situation is challenging, and there are many things which need to be done and the capacity of the people working in the sector in the country needs to be strengthened."

George Chakravarthy Bandlamudi, India (PPRE 2003/04)

who is working at 'Zentrum für BrennstoffzellenTechnik ZBT GmbH' in Duisburg, Germany (www.zbt-duisburg.de) was selected as the 2nd Place Winner for the 2009 Dr. Bernard S. Baker Student Award for Fuel Cell Research, presented by the Bernard S. Baker Fuel Cell Scholarship Fund and the Fuel Cell Seminar.

He was presented with this award during the plenary session of the 2009 Fuel Cell Seminar at the Palm Springs Convention Center, Palm Springs, CA, on Tuesday, November 17, 2009. - www.fuelcellseminar.com

Naveed Akhtar, Pakistan (PPRE 2004/06)

After completing his PhD on Solid Oxide Fuel Cells from University in Birmingham, UK, he moved to Eindhoven, The Netherlands, end of 2009, where he is continuing to work on Fuel Cells projects funded by Energy Center Netherland (ECN). He is employed at the Department of Chemical Engineering, Technical University, Eindhoven working on PEM fuel cells.

Shahriar Ahmed Chowdhury, Bangladesh (PPRE 2004/06)

Shahriar joined the Electrical and Electrical Engineering department of United Interna-

tional University as an assistant professor after completing PPRE in 2006. Since then he is working towards establishing RE in the academic arena and also in the industry. He has introduced RE as an undergraduate course in the EEE department in his University, which is the first RE course in Bangladesh in undergraduate level in Bangladesh. He designed the course through expertise gained in Oldenburg and in Stuttgart (during his thesis research in ZSW). Shahriar is regularly communicating PPRE for his course upgrade and progress. He aims to start a full fledged RE masters course in his university. For that he is now working on starting an M.Sc. course in his university in energy, majoring in RE. He has also started establishing a state of art RE research lab in his university. In 2009 Shahriar completed the technical audit of the SHS project in Bangladesh, where he was the project team leader. The project objectives were surveying the field performance of solar home system components, sampling the performance of the SHS components from the manufacturers production line, investigating the causes of malfunction of the components and their technical shortcomings through laboratory testing and recommending for proper specifications of the SHS components in Bangladesh. He is now offering professional courses on RE short courses for those engineers and professionals who are already working in the RE sector but lacking proper knowledge. Shahriar is working as a committee member of Bangladesh Renewable Energy Society (BRES) and the head of the Solar Energy promotion (BRES is the professional organization for the RE disseminating organizations in Bangladesh). Early this year he has visited Loughborough University and Staffordshire University, UK as an academic visitor.

Recently Shahriar is working in a team as a local expert to install a 100 kWp solar PV mini grid system to provide power to the off grid rural areas in Bangladesh. The project will be funded by Japan and technical support comes from Fuji Electric.

He is continuously providing technical support to the RE disseminating organizations in Bangladesh. Among his other works, designing of low cost microcontroller based solar charge controllers and LED based lamps for SHS are worth mentioning.

Tek Boon Jin, Malaysia (PPRE 2004/06)

joined Juwi Solar GmbH in Germany as a project manager for the off-grid energy solutions department in August 2010 (www.juwi.de - more details to come).

Bertrand Guillot, France (EUREC 2005/06)

Informed us earlier in 2010 that he is volunteering at Energy Assistance France, which is a non-profit association carrying out worldwide humanitarian projects in the energy sector. Its members are volunteers from the energy branch of the GDF Suez group. At the moment they are starting a project in Peru in the San Martin Region. 20 villages are involved in a carbon mitigation project to compensate for the direct emissions coming from one of the main office of GDF SUEZ in Paris. To go further with this partnership, Energy Assistance France will work with the villagers to improve their quality of life through access to clean energy. One particular village is acting as a pilot for the project with the aim of expanding the solutions to the other villages. As they are able to follow a project during several years they intend to start with basic needs (first step: lightning) and see if they can improve the local economy to sustain other projects.

They are not directly financing any projects but they are able to provide easier access to some materials and help with local financ-

ing. As an example they are working with the principal fair trade company in France (Alter Eco), which is deeply involved in the area and they are in contact with an international bank which may help later by providing funds for microfinance projects.

Their first observatory mission was scheduled on the 26th of June. Thanks to a partnership with Schneider Electric they will also be able to equip this village with 200 solar lightning systems.

Mark Craig, Canada (EUREC 2006/07)

Earlier this year Mark was working as interim energy modelling lead for the Team Canada - 2011 Solar Decathlon team. They are designing and building a solar home for the United States' Department of Energy solar decathlon competition. During the competition, the engineering, architectural and economic aspects of the house will be judged. Additionally, the performance of the house will be tested by various competitions designed to test its operation. The team is primarily composed of students from the University of Calgary, but many graduates are also helping on the project (like himself). Check: www.sd-live.de

Jorifa Khatun, Bangladesh (PPRE 2006/2008)

recently wrote: "I have been upgraded as Sub- divisional Engineer from Assistant Engineer in Bangladesh Power Development Board (BPDB) last year. Now I am directly involved to establish renewable energy/ non renewable related project in my organization. The objectives of the Organization are electricity generation from conventional (natural gas, furnace oil, diesel etc) & non-conventional (hydro, Solar, Biomass) sources, transmission & distribution of generated electricity to supply throughout the country. BPDB has ongoing 1 MW, 2 MW, 3 MW, 5MW mini grid based solar projects and is planning a 100MW (offshore) wind based national grid connected project for rural community development. All projects should be implemented by 2015 latest.

Jorifa (right) checking battery performance

BPDB has also implemented a 20.16KWp grid based solar project in Prime Minister Office and I am involved in this project as well. I am nominated to test the project before commissioning. The photo below shows that the specific gravity is tested to check the battery performance. 48nos battery and two battery banks are used in this project."

Ian Phillips, US (EUREC 2007/08)

informed us recently: „I spent the last few months gaining certification as a Building Analyst (home performance and energy efficiency) and Ground-Source Heat Pump installer. Both are US certification programs, with the Building Analyst provided by BPI (Building Performance Institute) and the Ground Source Heat Pump installer provided by NATE and IGSHPA (National Association of Technical Excellence, International Ground Source Heat Pump Association). In a nutshell, my goal is to enter the residential energy market, focusing on improving and reducing heating and cooling costs, upgrading the heating and cooling system with a ground-source heat pump (which

as I understand it is currently the most efficient method of heating and cooling), and finally supplementing the electrical energy demand with renewable sources. With the background in renewable energy from Oldenburg, I hope to develop a comprehensive, highly technical approach to raising the bar in the residential energy market by retrofitting and designing custom home energy systems at the moment, I am in the process of developing a business model, and exploring exactly what services the potential company would be able to provide."

Blake Butler, US (PPRE 2008/10)

took a job with an Energy Efficiency Engineering company based out of California last year. He is working with Demand Side Management for commercial buildings. Blake wrote: "It's a slight step away from renewable energy BUT once things get moving here in Utah I may be well positioned to play a valuable role. It's a problem here because a kWh of electricity costs less than $0.04! Can you believe it? Renewables have no chance here yet."

Sergio Rojas, Costa Rica (EUREC 2008/09)

returned to Costa Rica to join Edificadora Beta S.A. as Civil Engineer, where he is involved mostly in hydroelectric jobs, some wind, and very little biomass.

CAREERS

Kelleh G. Mansaray, Sierra Leone (PPRE 1991/92)

in 2009 he finally returned back home to Sierra Leone after studying and working in Canada the last fourteen years. He joined Fourah Bay College, University of Sierra Leone as a Lecturer and Coordinator of Energy Studies. They are now in the process of introducing a Masters Programme in Energy Studies within the Faculty of Engineering.

Bernard Osawa, Kenya (PPRE 1996/97)

informed us that on March 1, 2010 he left his job of Environment, Resources Recovery Manager within the Lafarge group to join the Kenyan Government as the Director of Renewable Energy at the Energy Regulatory Commission. He seems to be excited as this brings him back into mainstream Renewables and will allow him to be more active within the PPRE network.(Please see also article in the back)

Wesly Urena Vargas, Costa Rica (PPRE 1998/99)

Right now he is working as a Consultant on Climate Technology & Innovation as part of the Sustainable Energy & Climate Change Unit in the Inter-American Development Bank in Washington DC, USA. He is dealing mainly with mainstreaming Renewable Energy technologies within IDB operations, identifying barriers and mechanisms to overcome them. Lately he is working a lot with the private sector to identify opportunities for Biogas programs throughout the Region.

Also he is busy to establish several technology-defined networks to enhance the information at this regard among all projects stakeholders, particular emphasis on dissemination and technology development. IDB supported a Network of Bio-digesters for Latin America and the Caribbean, and is about to launch a Network of Experts in Geothermal Energy for Latin America and the Caribbean. Additionally he is trying to integrate more players in the renewable game in LAC.

Moreover the unit he works for is supporting the Multilateral Development Banks (MDB) Committees regarding the Climate Investment Funds. Wesly is supporting that team in a program: „Scaling up Renewable Energy in low-income countries".

Mazharul Islam, Bangladesh (PPRE 2000/01)

After about 8 years of silence he informed us that he finished his doctoral studies in Mechanical Engineering at University of Windsor, Canada in April 2008 and moved to Saudi Arabia last year to take the position of Assistant Professor in Department of Mechanical Engineering at Taibah University, Al Madina Al Munawara. He is involved in the Thermo-fluid related courses and the strategic unit Energy Committee. Additionally he is supervising 4th year students in their Capstone Design Project on „Solar Car". Actually he will be teaching a Final Year course on "Renewable Energy System" in the coming term for the very first time.

Butchaiah Gadde, India (PPRE 2001/02)

After finishing his PhD at King Mongkut's University of Technology Thonburi, Bangkok, Thailand last year, he started to work with UNDP in Bankok as consultant supporting their GEF projects.

Ernest Mazimpaka, Rwanda (PPRE 2001/02)

submitted his PhD-thesis in Energy and Development at the University of Cape Town in South Africa waiting to graduate in December 2010.

Santiago Sanchez, Ecuador (PPRE 2001/02)

is presently working in his own company called ‚EnerPro' specializing in solar home systems for rural areas. EnerPro has become the leader in this field of small solar thermal applications in Ecuador during its 5 years of existence. At the moment Santiago is planning to establish a small factory to manufacture solar thermal collectors and electronic components like charge regulators and lamps. Actually he is counting on the support of the PPRE Alumni network expertise for his new idea.
Beside running his own business Santiago is still teaching renewables and energy efficiency at the local university in a specialization programme.

Marco Peter, Germany (PPRE 2002/03)

left Grammer Solar in February 2010 to join the Product Management (Strategy & Business Development) Department with respect to PV System Technology at Schott Solar AG in Mainz, Germany – www.schottsolar.com.

Godfrey Sibanda, Zimbabwe (graduated 2000 in REP, University of Zimbabwe)

wrote in May 2010: „I came to Oldenburg University in 2000 for my industrial attachment which I did at Biomass Technology Group in the Netherlands. PPRE was coordinating our activities then. After doing my postgraduate studies in Energy Economics and Meteorology with Oldenburg University I lost contact with you guys. I will be glad to receive copies of your PPRE newsletters and any other communication.
I had been working for the Research Council of Zimbabwe for the past 5 years promoting Renewable Energy Research and now I am with the University of Zimbabwe Geography and Environmental Science teaching climate change."

Fernando Vega, Honduras (PPRE 2002-2003)

is lecturing in the Department of Renewable Energy at the private John Brown University in Arkansas, US, where they established a BSc-programme on RE recently (www.jbu.edu/science/renewable_energy). Earlier in 2010 he travelled to India, to the state of Bihar in February 2010 to do mission work related in Renewable Energies teaching Pastors and Christian leaders basics of solar energy for solar stove making as well as high efficiency wood stoves. On the way he passed by PPRE, Uni Oldenburg visiting PPRE staff and review some lab related projects.

Stelios Avraamides, Cyprus (EUREC 2004/5)

established his own company in Cyprus in 2007 already, which is called ASES ELECTRICAL SOLUTIONS LTD. He is doing Electromechanical & Energy Consultancy.

Tubtim Limsoontorn, Thailand (PPRE 2004/06)

is employed as Project Coordinator in the Office of Climate Change Coordination at Office of Natural Resources and Environmental Policy and Planning in Bangkok, Thailand

Nancy Chacon Calderon, Guatemala (PPRE 2007/08)

started working in a consultancy with INDE (in the National Electrification Institute). They want to promote RE projects and she is working with them developing a tool for potential investors and help them with the steps to take to develop a project. Additionally they are looking forward for financial institutions in order to support investors.

Ankur Agarwal, India (PPRE 2008/10)

after finishing his thesis at GE Global Research is still in Munich. He is looking out for interesting opportunities in solar/hybrid energy systems and planning, PV installations, collaborations for product development and outreach. Contact him if you are aware of any such opportunities (location is completely flexible but he prefers Europe or India).

Kambulakwao Chakanga, Zambia (PPRE 2008/10)

started her PhD at Next Energy in the field of thin film solar cells right after her PPRE studies.

Tyler Goepfert, US (PPRE 2008/10)

will start his PhD at MIT/WHOI Joint Program in Chemical Oceanography from July 2010. Until then he is working with the PPRE as a tutor.

Abdul Muhaimin Mahmud, Malaysia (PPRE 2008/10)

wrote in June 2010:

"I am currently working with the Public Works Department (PWD) of Malaysia as a Senior Engineer. I just got promoted a couple of months ago. I am involved in managing a rural electrification project using Solar Hybrid System (Solar-Genset) for rural schools in Sabah, Malaysia. In total I have to look after 19 schools with PV sizing capacity range from 20 kWp to 60 kWp. As of today, all the installations are in progress and I really hope the schools can be electrified by end of September this year.

Abdul on site: a 30 kWp PV-System at a rural school in Malaysia

The challenge of the project is not only on the system itself, but I would say more on the accessing to the site. Most of the schools are located in island with only 3 schools can be accessed by land (4X4 drive only). So apart from the hectic schedule to ensure the contractor finishes on time, I still have time to enjoy the beautiful sand of the islands and the nature itself.

Besides the project, I am also a committee member in producing guidelines in the government buildings' Internal Environment Quality and Energy Efficiency for the National Green Building Index.

Francis Mamu Njoka, Kenya (PPRE 2008/10)

resumed his previous job as an Energy Technologist at Jomo Kenyatta University of Agriculture and Technology (JKUAT)

Russom Semere Tesfaselasie, Eritrea (PPRE 2008/10)

has continued working with Phaesun GmbH, where he did his Master thesis.

Athanasia Arapogianni, Greece (EUREC 2008/09)

joined the European Wind Energy Association as a research officer after graduating from EUREC in 2009.

Alexander Loosen, Germany/US (EUREC 2008/09)

joined Lahmeyer International in the Renewable Energy Division after his graduation from EUREC.

Elke Kwapis, Germany (EUREC 2008/09)

joined WindMW GmbH in Bremerhaven right after graduating from EUREC

Juan Esteban Hernandez Rodriguez, Colombia (EUREC 2008/09)

joined HMV Engineers, Colombia after graduating from EUREC.

Omar Gammoh, Jordan (EUREC 2008/09)

continued working with '3 E' in Brussels, Belgium where he did his Master thesis.

Martin Paradine, Canada (PPRE 2008/10)

returned to Canada, to start new job as Community Energy Manager for the City of Fort St. John in BC, Canada.

Hamadou Tchiemogo, Niger (PPRE 2008/10)

is carrying out a technical field study for FRES companies in Mali and South Africa into the use of photovoltaic batteries and charge regulators in Solar Home systems. Since June 2010 he is working in Mali and end of August 2010 he will move to South Africa for while.

SUSTAINABILITY OF ENERGY SUPPLIES IN KENYA

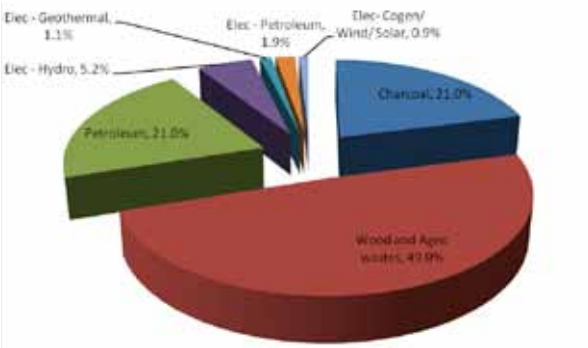
by Bernard Osawa, Kenya (PPRE 1996/97)

Bernard Osawa

Dear PPRE Alumni,

After 5 years of working for Lafarge Cement in East Africa as the Environment and Resources Recovery Manger, I have moved to the public sector as the Director of Renewable Energy and Energy Efficiency at the Energy Regulatory Commission in Kenya. My interest and move into the position was driven principally by my dream to mainstream and make sustainable renewable energy in Kenya in the region as well as give back to society. More than 90% of Kenya, a majority of which are poor rely on biomass for their energy needs. Primary energy supply in Kenya is 80% renewable, but not sustainable. My key objective will be to achieve sustainability of energy supply through planning, regulation and leadership of the sector in Kenya. The energy supply scenario in Kenya is characterized by a high dependence on renewable energy supplying approximately 80% of the total primary energy. While this is extremely desired, the situation is not sustainable. According to available data wood-fuel and other biomass account for 68%, petroleum 22%, grid electricity 9% and other renewable energy sources such as solar electricity, solar thermal, wind power and small hydro contribute about 1%. Biomass provides the energy needs of the traditional sector especially rural and poor urban households, while electricity and petroleum products supply largely the commercial energy needs. The figure shows the detailed breakdown of primary energy sources by type.

In Kenya, energy sector development and financing has focused heavily on conventional commercial energy supplies (grid connected electricity and petroleum) which constitute only 20% of the total primary energy at the expense of the larger household and 'non- commercial' energy. Petroleum is Kenya's major source of 'commercial' energy and has, over the years, accounted for about 80% of the country's commercial energy requirements. While other renewable especially wind, geothermal and hydro are receiving increased attention, it is critical that more attention be paid to the development and implementation of renewable energy and energy efficiency to ensure sustainability of energy supplies in Kenya. I hope I will be up to the task.



Primary Energy Sources by Type

TRAINING ON RENEWABLE ENERGY IN KENYA

by Francis Njoka, Kenya (PPRE 2008/10)

The International Organisation for Migrations (IOM) is one of the organisations playing a lead role in supporting Kenya's internally displaced persons of the 2007/08 post-election violence and the externally displaced persons from neighbouring countries living in Kenya (mainly Kakuma and Daadab refugee camps). One such department within IOM operations is the Livelihoods department which handles issues such as counselling, building-up eco-homes, starting-up farming activities or even initiating small income generating ventures etc. to help the affected communities regain their potentials.

One big problem hindering the realisation of some of these goals is energy. This is especially in the provision of drinking and irrigation water, storage of farm produce, running small businesses and cooking in homes. It was within this brief framework that one of the projects coordinators, Mr. Rajkumar Nagarajar from IOM's Eldoret office felt it was important to train some of his personnel on scalable energy solutions to help them offer appropriate advice and even design suitable projects befitting the communities' needs. He approached our University and through the Institute of Energy and Environmental Technology (IEET), we offered short course trainings on biomass, solar and wind energy lasting for a week each. A total of 24 staff members were trained (8 in each field). The training was conducted from 4th to 21st March, 2010; three days after I resumed duty at the University from my PPRE studies. I, Xavier Francis (PPRE 2001/02) and other colleagues participated in this training. It was a very nice experience to actually share fresh information gained from Oldenburg.

INTERNATIONAL CONFERENCE ON THE DEVELOPMENTS IN RE-TECHNOLOGY, DHAKA, BANGLADESH

PPRE Alumni Shahriar Chowdhury organized an international conference on Renewable Energy (ICDRET, www.icdret.uiu.ac.bd) from December 17-19 in Dhaka, Bangladesh under the umbrella of the United International University Bangladesh. GTZ (represented by the Bangladesh office) was the main sponsor of the event and IEEE was the technical co-sponsor. Eight other RE disseminating companies contributed in the conference as co-sponsors. Conference objectives were

Five PPRE generations at ICDRET
From left: A. Hossain (PPRE 07/09), H. Holtorf (PPRE 88/89), J. Khatun (PPRE 06/08), A.N.M. Zobayer (PPRE 04/06), Prof. H. Gabler and Shahriar A. Chowdhury (PPRE 04/06)

to increase awareness about the adverse effects of global warming and encourage higher research activities in the field of renewable energy in South Asian countries.
74 papers were submitted for the first conference, out of which 63 papers had been selected for publication in the conference proceedings after review. Papers have been received from fourteen different countries namely, India, Nepal, Iran, Italy, Korea, China, Thailand, Japan, Australia, Canada, USA, Germany, Malaysia and Bangladesh.

The conference had 13 sessions, out of them 5 were parallel sessions. All the papers of the first ICDRET conference proceedings is now available in the IEEE Xplore.

The second ICDRET will be held in 2011. PPRE and University of Kathmandu will be the co-organizer of the next ICDRET conference along with United International University.

EXPERIENCE OF SOLAR ENERGY IN INDIA

by Rania Mohammad Elhadi Adam, Sudan (PPRE 2007-09), Energy Research Institute in Khartoum

Solar Energy Centre is one of the largest centres dealing with solar energy in India near New Delhi. The centre works mainly in research and development of solar photovoltaics, solar heating and cooling, and bio-fuel. It has well equipped laboratories for these activities.

I had participated in the training program (Dissemination and diffusion of solar energy technologies) at Solar Energy Centre (SEC). The course lasted for three weeks from 30.12.2009 to 20.01.2010 and covered PV, solar thermal, bio-fuel, and some visits. It was a very good chance to see how India is developing the solar energy sector and how the government promotes renewable energies. During the program the centre arranged a visit to Barefoot college, Tilonia

Rania (middle) visiting SEC laboratory

Rania visiting Training workshop at Barefoot college

south New Delhi where they train illiterate women from India and other developing countries on Photovoltaic technologies, starting from assembling charge controller and lamps for installation of PV system. It is really a challenge because the women are illiterate and after only 6 months they become solar engineers.

Beside the course, India itself is a very nice place which is worth to visit. Although it is very crowded and noisy, the people are so friendly and very generous, and I have not seen such hospitality before. Also it has many tourist places which are very beautiful and interesting.

CANADA: THE WOLRD'S NEXT BOOMING PV MARKET?

by A. Antonopoulos (EUREC 2005/06) - CarbonFree Technology

ABSTRACT: Due to the Green Energy Act of May 2009, the Government of Ontario, Canada will implement North America's first comprehensive feed-in tariff program similar to ones in Europe. With insolation in many areas of the province at par with central Italy, the potential for solar photovoltaic projects is enormous. The paper examines the potential development of solar PV in Ontario and Canada as a result of the feed-in tariffs. The technical, economic, and socio-political factors of solar projects are discussed in detail. Our analysis indicates that solar PV projects in Ontario may have the potential to be profitable, but much depends on the future value of the Canadian dollar, future interest rate levels, the availability of debt, and future equipment costs. Despite the challenges ahead, solar PV in Ontario could certainly boom as a result of the feed-in tariff, and as a result potentially influence other Canadian provinces and U.S. states to adopt similar measures.

INTRODUCTION

Canada, Renewables & Solar

Canada has a long history with renewable energy. In several provinces across the country, electrical generating capacity was dominated by hydropower for a good part of the 20th century, so much so that in many regions "electricity" is still colloquially referred to as "hydro". In Quebec hydropower still dominates, generating nearly all of the province's power and over 49% of all hydropower in the country.

Another notable example is the continued development of the RETScreen software, developed by the Ministry of Natural Resources, and used by over 41,000 people in 196 countries. This clean energy project analysis software allows the user to model renewable energy technologies and energy efficiency projects in order to assess financial feasibility.

Remote regions in Canada's north have also prompted research and development focused on autonomous energy systems powered by combinations of solar PV, wind and diesel generators, for example participation in IEA sub-task 11 on hybrid energy systems.

However, as a whole, non-hydro grid-connected renewable energy has lacked the growth rates seen in places like Europe. While some national support programs exist, such as ecoENERGY (offering $0.01/kWh for 10 years to low-impact renewables like solar), there is a lack of a nationwide policy offering aggressive support for renewable energy.

Ontario and Earlier Renewable Energy Support

The province of Ontario is Canada's most populous region, with 13 million inhabitants. It also serves as Canada's economic engine, accounting for more than 36% of the nation's GDP, and it is one of North America's most important economies.

In line with commitments to close Ontario's coal-fired generation facilities, the provincial government introduced the Renewable Energy Standard Offer Program (RESOP) in 2006 as a form of 20-year feed-in tariff in order to spur the fledgling domestic renewable energy market.

Unfortunately, the program met with limited success, with only 55MW of total renewable energy projects commissioned by last autumn, compared to a target of 1350MW. In particular, solar PV failed take off, with

only 525 kW achieving commercial operation in that same period. The program was frozen by mid-2008 and placed in review.

PV rates of C$0.42/kWh (0.27€) essentially precluded the development of small-to-mid-range systems due to the high installed costs per watt, much higher than seen today in 2009. A few very large over 10MW scale plants were announced (e.g. the 60MW farm development by Opti-Solar), but much fewer smaller developments. In addition to the low tariff, the failure can also be attributed to continued regulatory/utility hurdles without a "right to connect" per se. As for non-solar technologies, a single rate was offered across all technology types (C$0.11/kWh = ~0.07€), further limiting uptake.

However, the situation for renewables in 2009, and for solar in particular, is set to drastically change.

GREEN ENERGY ACT 2009

Highlights

On 14 May 2009, the government of Ontario passed a comprehensive law to support renewable energy and energy efficiency across the province: The Green Energy and Green Economy Act (GEA). The GEA is poised to place Ontario at the forefront of renewable energy development in North America, amending several older pieces of legislation as well as making several important additions.

Most importantly, the GEA allows for:

- Feed-in Tariffs (FIT) following the European model, with differentiated tariffs across renewable technologies for 20+years. The FIT program is administered bythe Ontario Power Authority (OPA).
- Promotion of a decentralized smart grid.
- Removal of barriers and allowing ease of access to transmission and distribution systems, providing a so-called "right to connect", with priority access, and requiring upgrades of facilities to handle the renewable energy systems.
- Reduced permitting and regulatory approvals, such as exemptions from the Planning Act.
- Promoting local industrial development in clean energy sectors.

Ontario is the first jurisdiction in North America (province or state) to adopt a comprehensive long-term feed-in tariff, which is arguably the most successful system to spur the rapid growth of solar PV installations. As one of the continent's most important economies, Ontario, if successful with the GEA, may spark a flurry of feed-in tariffs across the USA and Canada.

Ontario's Feed-in Tariff Program

The Ministry of Energy has charged the Ontario Power Authority (OPA) with the task of developing the Feed-in Tariff program. The OPA is a government-regulated non-profit corporation responsible for procuring electricity supply for the province.

The table(next page) shows the tariffs for solar PV. The rooftop tariffs are at par with tariffs in Europe, surpassing those of Germany and Spain (see below).

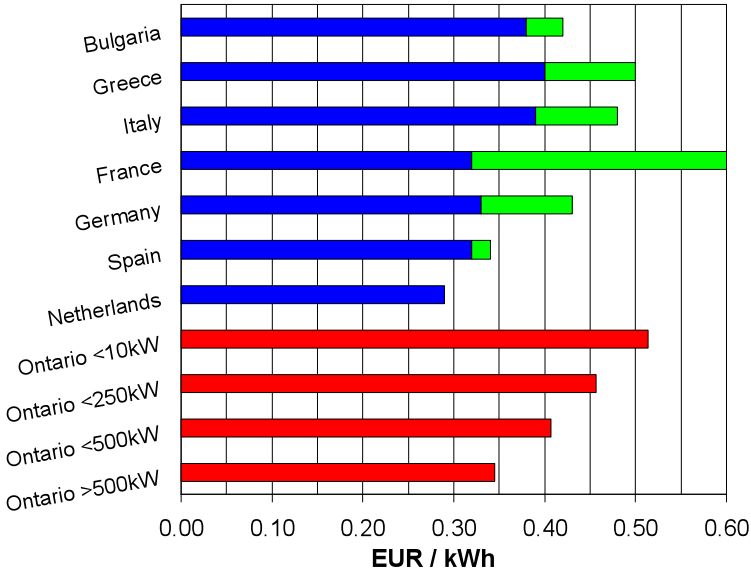
Since March 2009, the OPA has released draft documents outlining the FIT program rules, and conducted several stakeholder consultations for input. However, the program is still in "draft" form, and no FIT application can yet be made. At the time of writ-

Type	Size	¢/kWh	€-ct/kWh*
--	≤10 kW	80.2	51.4
Rooftop	>10 ≤250 kW	71.3	45.7
Rooftop	>250 ≤500 kW	63.5	40.7
Rooftop	>500 kW	53.9	34.5
Ground	>10 kW ≤10 MW	44.3	28.4

*$1 CAD = 0.6404 EUR (30 Aug 2009)

ing, the program was expected to launch in September/October 2009.
Some relevant features of the program for solar PV include:
20 year contract at a fixed price (not inflation adjusted).

- 10MW cap on installation size.
- No annual cap on number of installations.
- No annual automatic digression of prices (proposed initially, but subsequently dropped).
- Any environmental attributes such as GHG-credits or other renewable energy credits are relinquished to the OPA.
- Three years to build a project once a contract has been awarded (with certain milestones required to receive a notice to proceed to construction). However, financial penalties exist for late projects.
- Separate metering: PV generation must be decoupled from building's load, i.e. a building will not be able to reduce its utility payments by using PV-generated electricity.



Rooftop feed-in tariffs in Ontario compared to ranges in Europe (EPIA 2009 data)

- Capacity Allocation Exempt Facilities automatically are to proceed to a contract, without the need to ensure the nearest substation can accommodate the extra generation (given that application is complete and correct). This applies for facilities less than 500 kW connected to 15kV or greater lines, and facilities less than 250 kW connected to power lines under 15kV. In addition, one does not need to provide a refundable "Application Security" with an application (otherwise $20,000 per MW).

- The program and the tariffs are to be revaluated after two years, although the OPA reserves the right to do so earlier.

- Ground-mounted solar projects owned, or partly-owned, by aboriginal and community groups are eligible for a slightly increased tariff (up to 1.5 and 1.0 cents per kWh, respectively).

- "Legacy" projects, i.e. projects stranded part-way through the approval process when the RESOP program was suspended, are to be given priority during the initial phase of the program

Promoting Solar Manufacturing in Ontario

One of the stated aims of the GEA is to promote job growth and a renewable energy manufacturing base in the province.

The Ministry of Economic Development and the Ministry of Energy are planning to implement a domestic content requirement as part of their effort to stimulate local economic growth in the renewables sector. For a facility to be eligible for a FIT contract, a certain percentage of its cost must be from Ontario "domestic sources", and this percentage may increase over time. This may either apply to the entire project cost, or to equipment cost. At the time of writing, the details and percentages had not been specified.

In addition, there are a number of programs to support the location of investment and general manufacturing in the province by the government, for example the Advanced Manufacturing Investment Strategy.

Important Outstanding Issues for the GEA/FIT

In addition to the unknown domestic content requirement, several other issues had yet to be resolved at the time of writing.

A Renewable Energy Approval (REA) shall be required to start construction. The REA is similar to an environmental assessment, and will be issued by the Ministry of the Environment. As initially proposed, provisions for PV greater than 10kW include the requirement to carry out a noise study, as well as to provide financial assurance for decommissioning. Certain elements, especially the noise study, have been the subject of concern to industry groups. The REA process is still under review by the Ministry of the Environment after consultations with industry stakeholders.

Restrictions are currently being considered for ground-mounted projects on certain forms of "prime" agricultural land. This has been both supported and criticized by different members of the farming community and industry. No final decision has been made.

Further issues relate to the requirements of the Building Code, and other municipal laws that often have few or no provisions for PV. Electrical regulations for lightning effects, electrical safety on the DC voltage side, as well as fire safety regulations may also have to be re-examined

Maps of Ontario within Canada, and Southern Ontario

PV POTENTIAL IN ONTARIO: TECHNICAL AND ECONOMIC FACTORS

Climate and Technical Issues

Ontario is a very large land mass located in eastern Canada, covering over 1 million km² – roughly three times the size of Germany. However, over 90% of the population lives in southern Ontario, which is roughly 140,000 km2, and includes the cities of Toronto and Ottawa.

The solar resource in Ontario is at par with northern Italy and northern Spain, with insolation more than 40% higher than parts of Germany (see Table below for a sample).

City	Latitude	Global Horizontal Insolation [kWh/m²/year]
Toronto	43°40' N	1340
Windsor	42°16' N	1471
Ottawa	45°25' N	1377
Thunder Bay	48°22' N	1380
Bruce County	44°44' N	1405
Florence, Italy	43°47' N	1303
Barcelona, Spain	41°23' N	1372
Berlin, Germany	52°30' N	1000

Insolation figures for select cities in Ontario with comparisons to Europe

Despite the high insolation, one of the unique challenges for PV deployment in Ontario is related to the cold, snowy climate. While PV has previously been deployed in regions with snow (e.g. Germany), Ontario is considerably more snowy. In Thunder Bay, which has one of the best solar resources of the province (with insolation at optimal tilt at over 1700 kWh/m²), the depth of snow on the ground is greater than 20cm for an average of over 79 days per year. Winters are quite sunny despite the snowfall, and thus a significant production of annual would be lost if the modules were covered.

Any PV solution for Ontario must therefore take into account the extreme snowfalls that can and do occur. This is much more important for rooftop than for ground-mounted systems. Traditional ballasted rooftop PV systems used in other jurisdictions could be covered with snow for large parts of the year in several parts of the province. Either the expected yields for these systems must be significantly reduced, or the systems

must be placed higher up to avoid snow accumulation. However, higher systems incur significantly higher wind load requirements, and thus extra ballast, which may make the entire weight of the system too much for a roof to support.

Moreover, the Ontario Building Code has changed in recent years, requiring older building roofs to be to reinforced in the case of many roof-related modifications, even if a building had been previously built to code. Thus, even the simple replacement of a rooftop HVAC unit can trigger structural reinforcements in older buildings. Industrial and commercial rooftops are often "value engineered" to the point where they are unable to support additional any loads. Such a situation poses structural engineering challenges for rooftops, and can constrain the economic viability of PV projects as well.
Housing of inverters on rooftops also becomes a concern, as winter servicing in snowy regions may incur additional safety risks and even costs. Placement of the equipment indoors would thus be preferable from a servicing perspective. However, there are advantages to having the PV system completely independent of the building interior, such as less risk when firefighting.

Despite the snow, a benefit of the colder temperatures is higher performance ratios due to decreased module performance degradation. This is even more advantageous if the panels are at a sufficient tilt for the snow to slide off.

Lastly, the availability of useful rooftops in the province is widespread. Buildings with large rooftops dot the suburban landscape, including factories, warehouses, and large "big-box" retail centres. Commercial buildings well over 3,500 m^2, and industrial sites often over 14,000 m^2 are common. In addition, many cities have street grids closely aligned to north-south, and thus many buildings are often closely aligned along those grids, which aides in attaining the optimal solar orientation and space utilization.

Economic Considerations

As shown both the proposed tariffs and insolation levels are relatively high. Will this translate into a solar PV boom in Ontario?

In determining what the tariffs should be, the OPA made the following assumptions for project economics:

- After-tax return on equity: 11%
- Percent Equity: 30%
- Percent Debt: 70%
- Cost of Debt: 7%
- Income Tax Rate: 30.5%

While a ROI of 11% is attractive to many investors, there are a variety of factors that will either help or hinder reaching such returns.

Firstly, project economics contain a foreign exchange risk, as the tariffs are in Canadian dollar, but modules are priced in either US Dollars or Euros. If the US dollar continues to weaken, this will positively affect a project, but the reverse would impair it negatively.
Due to the recent financial crisis, debt levels once seen on projects are not currently possible to achieve. Debt-service coverage ratios of over 1.5 are currently required by lending institutions, potentially limiting project debt to less than the OPA's target amount. One must accept a lower equity return if less leverage is used. While treasury bill and government bond rates remain near historic lows, spreads for other types of borrowing are higher than usual and the OPA's target of 7% may be difficult to achieve, further hindering project economics. For smaller projects, the cost of arrange-

ment fees for debt can also be significant.
In order to maximize economic returns, a project must take advantage of accelerated depreciation. However, only entities that are classified either as a Principal Business Corporation (essentially a manufacturer or energy company) or as a utility may utilize this accelerated depreciation, and they clearly need to have income from other sources to be offset during the early years of the system's operation.
Smaller rooftops may also face limited development, due to the structure of the tariff. Fixed costs, such as legal fees and permitting, are not necessarily lower for smaller systems, and thus many developers may naturally wish to minimize their cost per watt and aim for larger systems, potentially rejecting sub-100kW opportunities.

Because the OPA has chosen to incentivize distributed generation, it has specified a significantly reduced tariff for non-residential ground-mounted projects ($0.44/kWh = ~0.28€). Such a low tariff makes smaller ground-mounted systems very difficult to realize economically.

Another factor that may slow development initially is the lack of solar experience in the province. Most installations in the province have been under 50kW, with only a total of 525 kW developed under the old RESOP program as previously mentioned. As a result, installation and balance of system costs will be substantially higher than in more established PV markets, although we expect this to decrease over time.

Lastly, the ownership model is most important for the project economics. Even with the generous tariffs, simple payback periods are in the 8 to 10 year range for commercial rooftop systems. This often represents too long a period for building owners. An alternative model is for third-party ownership of the system, whereby the building owner is paid rent for the use of the rooftop by a third party generator. Since this concept is very new to Ontario, it is still unclear what the value of rooftop rental is in terms of $/m^2. The location of the building and its tenant rental value in $/m^2 versus what can be offered for roof rental will play a role; if the tenant rental value is low, then any extra income to the building owner for the roof will be of comparatively more value.

CarbonFree Technology is currently in the process of developing several rooftop PV systems in the province, using a third-party ownership. Our initial estimates show that, for the most attractive sites in terms of building location and orientation, installation costs will need to be at the low end of the range currently being achieved in more mature US markets in order for projects to be economic. If equipment and installation costs continue to decline, we may see acceptable economics across a wider field of potential sites. The drastic fall in module prices between 2008 and 2009 further helps the situation.

Taking all the above factors into account, analysis by CarbonFree Technology indicates that an acceptable after-tax ROI can be achievable for rooftop projects, but it may be shy of the OPA's assumption of 11%. As experience in the province grows, this target may become more achievable over time.

SOCIO-POLITICAL CHALLENGES AND FUTURE OUTLOOK

Challenges and Opportunities for Developers and Investors

The greatest opportunities created by the GEA are for users, developers, and investors in the renewable energy sector. Relatively

healthy rates of return, high insolation, and stable political climate make the location attractive.

Due to the lack of previous PV deployment, there are few local companies with extensive experience in development, engineering, and installation of systems, especially large ones. This creates an opportunity for both local companies and also foreign ones to start businesses in Ontario, a process which has already begun.
While the situation is attractive for PV players across the industry, there are several political and "definitional" issues that may affect project development, mostly stemming from the outstanding GEA.

If too high a domestic content requirement were stipulated, most projects would be unviable as there are no major PV manufacturers in the province that could meet the anticipated demand – at least until sufficient manufacturing capacity is created. Early projects would thus be severely constrained or delayed. Inverter manufacturing is also limited, with Satcon historically being the only major Ontario manufacturer. In any case, the content requirement may also be challenged under the North American Free Trade Agreement (NAFTA) and/or by the World Trade Organization if it is found to violate trade agreements, and thus there is still great uncertainty surrounding the issue.

New environmental regulations outlined in the Renewable Energy Approval process discussed earlier may also delay development. In particular the requirement to conduct a noise study for PV has caused concern, a requirement that is generally not seen in jurisdictions with established PV industries.

The definition of a "rooftop" as stated in the current draft rules is also potentially problematic:

"Rooftop means, with respect to a Facility, the wall facing, roof, cover, or other architectural element that forms part of a wind-and-watertight structure and which does not require structural modifications or enhancement to support the weight of the Facility".

If the definition remains as initially proposed, some viable buildings may be excluded. For example, buildings such as barns and parking garages are often neither wind nor watertight. Many regular buildings may require some form of structural reinforcement to support the weight of the facility, and this may jeopardize their FIT status under the proposed rooftop definition.

Limitations may also exist for the change of control of a project, as an applicant granted a FIT contract may be restricted in removing itself from the project for up to 3 years. In addition, once a facility has achieved commercial operation, limitations may be placed on change of control for the first two years. However, as of the time of writing, the OPA was considering broadening the exemptions to such restrictions. If significant restrictions remain, third-party investors may hesitate to commit funds without a clear "exit strategy".

There is also inherent political risk in the longevity of the FIT program. While the contracts will be honoured for 20 years, the program itself may not last. The previous RESOP program was suspended well before the originally proposed review date, leaving many developers with applications stranded in the approval process. Fears that the current program will be cancelled persist even before it has begun.

Challenges and Opportunities for Manufacturers

In contrast to developers, a high domestic content requirement would benefit local manufacturers significantly and potentially draw many new entrants to the market.

Ontario has a highly trained workforce in the manufacturing sector, with the auto industry traditionally playing a very large role. Bordering on the USA, the province can potentially serve as a base for companies looking to sell renewable energy equipment across North America. Foreign companies can also benefit by licensing the manufacture of their equipment to local partners instead of setting up their own facilities.

The government supports the growth of green manufacturing in a number of ways. For example, Ontario has a relatively low total corporate tax rate of 31.5%, which is approximately 3% lower than the US average.

However, there are also a few potential risks that may limit development.
Foreign companies wishing to set up subsidiaries will almost certainly have to set up operations not just for supplying Ontario, but North America and in particular the USA. Potential "buy-American" clauses in the USA may make US locations more attractive. If the cost of modules made elsewhere continues to drop, higher labour costs in North America may erode margins and continue to promote growth in other locations.
Another risk is the longevity of FIT program. If the program does not last long due to a potential change in government or other reasons, manufacturers may end up being "stranded" with no local market to supply.

A Sunny Future?

Despite the challenges ahead, solar PV in Ontario could certainly boom as a result of the FIT. The current program is intended to succeed where previous attempts to support solar PV have failed.

Significant features in favour of PV uptake include the lack of an annual cap, with no automatic digression in FIT prices until the program is revised in two years.

Falling equipment prices, especially modules, over the next few years will work in a project's favour, especially since developers have a three-year window in which to build after receiving their contract.

With Ontario accounting for more than 35% of Canada's GDP, the relevance of the province's actions for the rest of the country should not be underestimated. Some other provinces in Canada are even sunnier than the southern-most areas of Ontario, despite being at the latitudes of northern Europe. For example, global insolation in Lethbridge, Alberta (49.6°N) is 1482 kWh/m^2, and 1876 kWh/m^2 at optimal tilt (compared to Reims in France at 49.3°N with only 1140 kWh/m^2 global insolation).

The forecast looks sunny, not just for Canada, but potentially for the entire continent, with consequences for the global PV industry.

A SHORT DISCUSSION ON CONCENTRATED SOLAR POWER TECHNOLOGIES

by Dr.-Ing Indradip Mitra (PPRE 03/04), Research Scientist, Energy Environment and Water Research Center, the Cyprus Institute

This is a short overview of some of the features on CSP technologies that are commercially available today. It discusses the role of a few major factors which influence the performance of CSP plants. A short survey was conducted to explore the CSP technology and practices and presented in this report in concise manner.

INTRODUCTION

Concentrating Solar Power (CSP) plants utilise Solar Energy by focusing direct beam sunlight at a specific target in order to produce high temperature heat which can then be used for electrical power generation. Most CSP plants comprise of two components: the Light Harvesting section involves the collection of solar energy in a concentrated form and its conversion to heat, and the Heat Utilisation which involves the conversion of heat into useful work (i.e. by generating electrical power or operate various other thermal processes). The fundamentals of the four basic types of CSP plants are well known and therefore will be excluded from this article. CSP plants, as with other solar energy systems, depend on an intermittent source therefore cannot offer a dependable, autonomous and continuous power generation solution. Nevertheless this problem may be overcome by either using a hybrid solution which uses fossil fuel to compensate for unavailability of solar energy or may be combined with various thermal energy storage solutions.

THE NEED FOR CONCENTRATION

The Carnot efficiency defines the physical limit for the conversion of heat into mechanical work:

$$\eta_{Carnot} = \frac{W}{Q_{in}} = 1 - \frac{T_{out}}{T_{in}}$$

where the greater the difference in temperature between the hot and cold reservoir that the engine operates, the greater the efficiency. By decreasing the area from which heat losses occur, greater delivery temperatures can be achieved. The way this is realised is by interposing an optical device between the source of the radiation and the energy-absorbing surface. Concentrating collectors reduce the receiving area by reflecting (or refracting) the incident light onto an absorber of small area thus minimizing thermal loss while at the same time can operate at elevated temperatures and provide significant quantities of useful thermal energy.

SALIENT FEATURES OF CSP UNITS AS POWER GENERATING SYSTEMS

CSP plants share some functional similarities with conventional electricity production power plants (e.g. oil, gas, coal or nuclear) in the sense that their output is thermal energy which is used to generate steam and produce electricity through a steam turbine. In contrast however with conventional power sources, solar radiation as the primary en-

ergy input into a CSP system has no material form, is dilute and is terrestrially accessible only during daylight hours. Its availability depends on location, season, time of day, morphology and momentary meteorological conditions. The main limiting feature of solar radiation is that it cannot be stored directly for later usage. On the other hand, solar radiation is free, indigenous, renewable and free of hazard.

The following constitute some of the most salient characteristics of the CSP Power plants:

Land Requirements

CSP plants require substantially more on-site land area than conventional power plants due to the extended solar harvesting field. On the other hand, in a global sense, no off-site land area is needed for raw material mining, processing, handling and transport, or for the disposal of power production residues.

Separate Elements

In CSP plants the reflective surfaces play the role of the collectors while the radiation is converted into heat in separate elements (e.g. in receivers or absorber tubes).

Design Points

A base load conventional thermal power plant is rated as its nominal (nameplate) output conditions within which the plant is expected to operate for a long time period. CSP plants have 'Design Points' because of the periodic and fluctuating solar energy input. These points are fixed by assuming a specific irradiance at a specific time during a particular day of the year. For example, a design point for Cyprus could be a solar irradiation of 900 W/m2 at noon at equinox. CSP plants are usually rated by design point operating conditions along with a specification of the output power capacity. One must be careful while comparing different CSP plants on the basis of nominal performance because design points may vary between different sites.

Solar Input Variability

Solar insolation, the energy input source for CSP plants, has a high degree of temporal and spatial variability. No prediction or control is possible over availability, quality and quantity at a given site at a specific moment. Thus the role of local meteorological data as well as forecast capability becomes important to estimate the solar energy availability for a specific CSP plant.

Hybridization and Thermal Storage

Utilisation of CSP plants for electricity production on a continuous (24 h) basis vis a vis solar energy availability requires solutions that circumvent the problem. The two most common solutions considered are:

- Utilization of a back-up energy source. This is realised in hybrid plants which often use a fossil fuel auxiliary power generation unit that is coupled in hybrid mode with the CSP plant and which contributes in either augmenting the plant's output or for temporarily substituting solar energy.

- Heat storage is more efficient than storing the produced electrical power for later distribution. However, heat storage of significant amounts of energy requires a very large mass with significant thermal capacity. Energy storage is an area of intense research pursued by many institutions and companies throughout the globe. It is the driving force behind the Hydrogen economy as it provides an on-demand solution for electricity production through hydrogen storage. At the moment the level of maturity of energy storage

technology is still low: technical capability is far from being supported by economical viability. A significant portion of this research is focused on heat storage systems which couple naturally with CSP systems due to their ability to deliver easily high temperatures. These heat storage systems can then cater to both electricity production as well as separate thermal processes (e.g. a CSP project for electricity and thermal desalination).

- For large capacity power systems with Rankine cycle where water/steam are used as the phase change medium in a closed loop and the Brayton cycle with air/gas as working medium in an open loop have reached maturity by being utilized at conventional power systems. Nevertheless the employment of such systems does not translate directly in CSP plants since they might operate under non-steady state, frequently-variable input conditions. This is the main reason why the role of appropriate thermal energy storage capability becomes imperative for CSP plants: in addition to storage it provides a regulatory role for steady thermal flow.

Electricity production and CSP

With regard to electricity production, a number of thermodynamic cycles exist which can be coupled to the thermal production of a CSP plant. The most common are the following:

- Stirling cycle engines which employ air or hydrogen as a working fluid are most attractive solutions for heat input from solar radiation. For given set of temperatures, the Stirling cycle is theoretically the most efficient energy conversion cycle. Also, assuming equal lower temperatures for all cycles, the longer span between upper (about 900 deg. C) and lower operating temperatures is a major advantage for superior conversion efficiency. However, at present the availability of proven robust long-life low-maintenance commercial Stirling systems is non-existent. In the MW range capacity there appears to be no availability of Stirling units at this moment. Several companies claim to be at the verge of commercial launching of Stirling units, typically below the 25 kWe range which will have many applications with renewable systems. Therefore it seems Stirling systems will be suitable in the future for multiple parabolic dish type energy farming applications.

- Organic Rankine cycle (ORC) systems are available below the 30 MW range which use inorganic or organic phase change liquids such as CFC or HCFC in a closed loop. The typical net electrical efficiency of such systems lies below 18%.

Co-generation Schemes

CSP and desalination has been combined before but this combination is realised in a serial way, i.e. by producing electricity which is then used to drive a Reverse Osmosis desalination process. This offers significant advantages in its own and our considerations trivially reduce to this “minimal integration”. Nevertheless the combination of CSP and desalination technologies is also possible by utilising the heat from the CSP plant for thermal desalination in parallel with the electricity production. This method can overall provide a more efficient co-generation scheme by utilising heat losses and electricity production thermal emissions for desalination. In this case, the extraction or back pressure type of steam turbines are most suitable. A detailed study

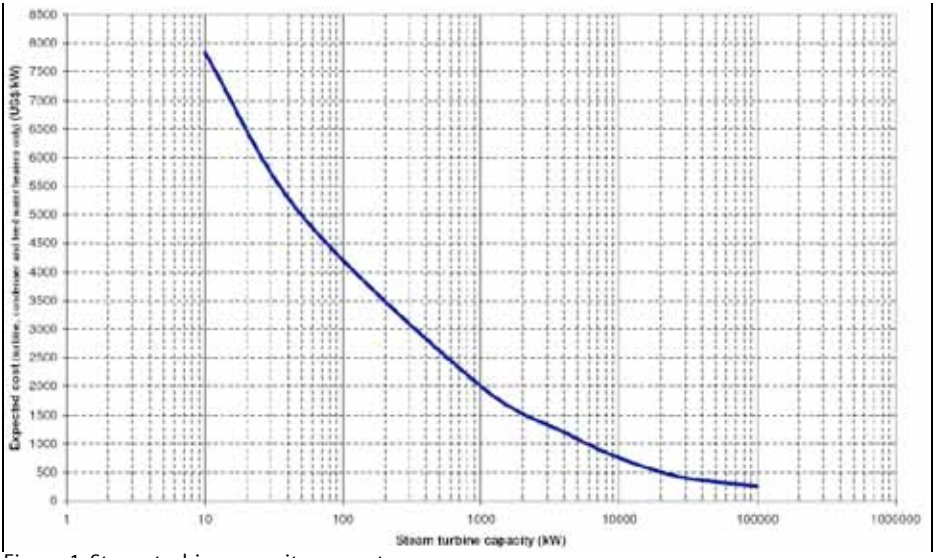


Figure 1: Steam turbine capacity vs. cost

on appropriate steam turbine system has been performed under this project. In general, the turbine system efficiency improves with the increase in capacity of the plant corresponding to a decrease in cost. It can be seen from Figure 1 that the cost of a turbine reaches attractive values beyond 10 MW level. The typical efficiency of a 4 MW system and a 10 MW system are shown below in the Figure 2 and Figure 3.

Normally, the normalized cost of electricity decreases with the increase of the plant capacity not only because of the efficiency

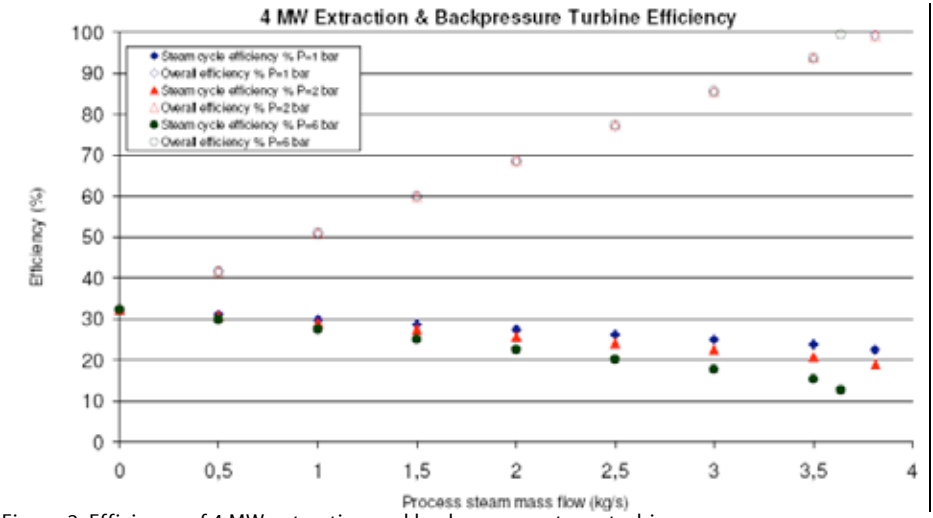


Figure 2: Efficiency of 4 MW extraction and backpressure steam turbine

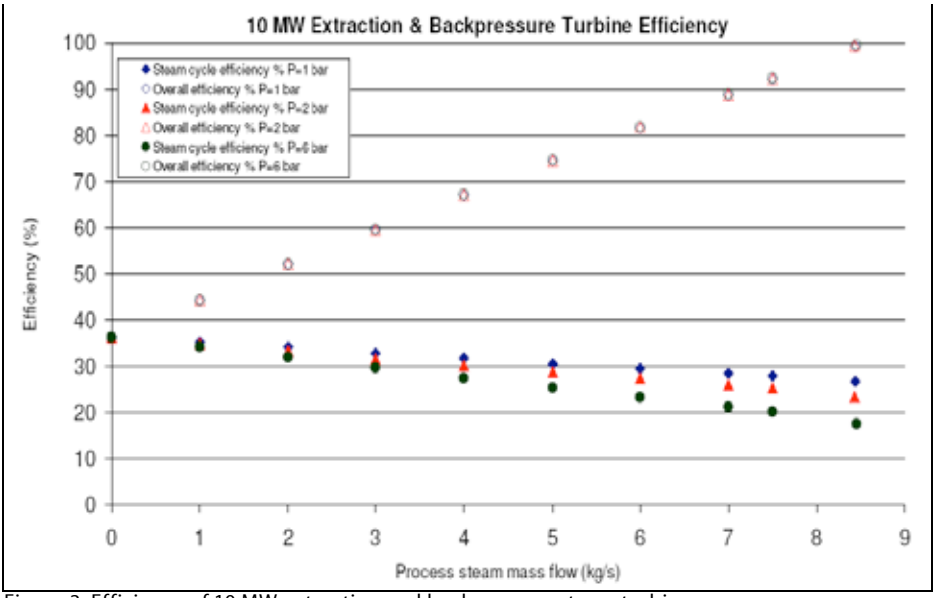


Figure 3: Efficiency of 10 MW extraction and backpressure steam turbine

gain and cost reduction in the power block but also because the cost of solar collectors follow the economies of scale; plant building as well as operation & maintenance costs increase disproportionally with the increase in the plant size.

A FEW IMPORTANT ASPECTS OF CSP

STORAGE

A critical advantage of CSP plants is the ability to store thermal energy. The existence of a thermal storage subsystem, almost definitely implies an oversized collector subsystem relative to the one needed for rated design point output in order to enable plant output and thermal storage simultaneously. The ratio of the collector subsystem's output power at the design point to that needed by the power conversion units for generating nominal output is called 'Solar Multiple' (SM). It is possible to charge the thermal storage by the excess energy collected with SM greater than 1. For a CSP system without storage only operates at its design point for a few hours within a year with solar multiple of one, over sizing the system allows it to operate closer to the design point for more hours of the year. The system with the oversized solar field produces more electricity; thereby reducing the system's levelized cost of energy. However, there is a trade-off between the increased installation cost of the larger system and the increased electric energy output. As the solar field size increases beyond a certain point, the higher cost outweighs the benefit of the higher output. Adding storage to the system introduces additional level of complexity. Systems with storage can increase system output by storing energy from an even larger solar field for use during times when the solar field output is below the design point, but the thermal energy storage system's cost and thermal losses have a negative effect on the levelized cost of energy.

The thermal storage system can act as an internal plant buffer which smoothes the effect of fluctuations in insolation and helps normalise plant operation. It most crucially allows operation during the night or unfavourable weather. Usually heat capacity is given in kWht per cubic meter.

The storage media can be classified mainly in the following ways:

- Sensible heat storage
- Latent heat storage
- Chemical storage

According to the International Energy Agency (IEA), the Levelized Energy Cost (LEC) is reduced by adding more storage up to a limit of about 13 hours (~65% capacity factor). While it is true that storage increases the cost of the plant, it is also true that plants with higher capacity factors have better economic utilization of plant equipment such as the turbine. Since salt storage is inexpensive, reductions in LEC due to increased utilization of the turbine more than compensates for the increased cost due to the addition of storage.

CAPACITY FACTOR

Practically no power plant based on fossil, nuclear or renewable energy sources, operates in the nominal output capacity for the entire year. Although there is a difference between base-load and peak type plants with respect to their capacity factor and the value of energy supply, as a general rule the higher the capacity factor the better the utilisation of the plant. Assuming an equal level of operational reliability at the same site, CSP plants without storage will have the lowest capacity factor. However, a CSP plant is still unable to maintain continuous output for extended periods with a finite storage capacity and solar energy as the only input. One of the performance indicators regarding the maturity of the plant is the comparison of the observed capacity factor with the calculated/predicted value.

MAJOR FACTORS INFLUENCING PERFORMANCE

Irradiation conditions

CSP plants utilise the direct solar radiation. The sun tracking mechanism enables a plant to maximise energy harvest to use as effective input. Thus Direct Normal Irradiance (DNI) values for a specific location are of the utmost importance to any CSP project. Insolation is usually given in the annual distribution of hourly averages of DNI values in kW/ m^2 or in terms of annual distribution of daily averages (kWh/m^2 per day). Some criteria for minimal irradiation conditions have been reported by Winter et al. For normal operation of CSP plants with SM = 1 and without auxiliary input, the minimum need is 300 W (DNI) / m^2 daily average irradiation and at least 3 hours above 600 W (DNI) / m^2 for net output. In the same report, it is also mentioned that from experimental CSP plants the following energy input thresholds ranges were suggested for SM=1:

- parabolic dish: 1.0 - 1.5 kWh (DNI) / m^2 d
- parabolic trough: 2.0 - 3.0 kWh (DNI) / m^2 d
- central receiver: 3.0 – 4.0 kWh (DNI) / m^2 d

It is expected that advanced CSP plants will have smaller thresholds.

DNI is very much location-specific due to local weather and air quality (like aerosols, dust, haze etc) conditions. Thus high quality, locally obtained, solar radiation data from an extended time period are very important for site selection, design and performance predictions of a CSP plant.

Energy storage size

It is technically possible to achieve 24 hours

of output power generation by using a large enough thermal storage unit coupled with a CSP plant. However this has not yet been implemented in any of the existing CSP facilities mainly due to the high cost involved and the storage of relatively low temperatures. The size of a storage subsystem has to be matched and optimised with the collector subsystem. Effective deployment of a storage capability will increase operating hours and, correspondingly, the capacity factor of a CSP plant.

Energy inventory, flexibility and threshold

Winter et al. have stated the importance of thermal inventory (commonly known as thermal mass), in addition to energy stored in a dedicated storage system, which can be helpful to operationally bridge short interruptions in solar energy input caused by passing clouds. This is linked to the inability of fast adjustments to sudden changes in input conditions. The smaller the thermal inertia, the higher the probability of a net output generation under non-steady-state operating conditions.

A CSP plant needs energy to maintain its own operation and even during operational stand-by condition it consumes certain amount of energy. A small auxiliary power consumption (parasitic power) of a CSP plant and low operating thresholds are important design objectives.

Water availability

A major limiting factor for CSP plants is the availability of water to be used in the Rankine Cycle system. CSP plants function best in areas with little rain and, therefore in regions where water is naturally less available. They require massive amounts of water to operate, and for every MWh of electricity produced about 4500 to 5500 litres of water is required. Although in principle, it is possible to substitute water-based cooling by dry-cooling systems, it would reduce the annual efficiency by up to 10% . Some typical water consumption figures from IEA are as follows:

- Parabolic trough pants require about 17500 m^3 / MW-yr,
- Central receiver plants need 2.4 m^3/MWh,
- Parabolic dish systems with Stirling engines do not need water.

CSP plants in islands like Cyprus have a clear advantage because of this water dependency. Moreover, a co-generation of electricity and desalination from sea water would bring down even further the net water requirement in the system by completely or partially replacing the cooling water loop by MED type thermal desalination plant.

Cleanliness

The optical performance of the solar collector field deteriorates by dust, soil and other tiny particles over the reflecting surfaces. Thus it is very important to have a regular and effective cleaning schedule.

Maturity and reliability

Of extreme importance is the degree of maturity and reliability of all components of the CSP plant. High operational efficiency is directly linked to technical reliability of subsystems which in turn is connected to the technical maturity of the technology. There are several research, demonstration and pilot type efforts worldwide on these issues for specific elements (e.g. heliostats, receivers, collectors etc). However, there is a lack of consistent, multi–year performance data from the existing CSP plants as a whole. This is an information deficit of high importance.

DISCUSSION

The Solar Tower type of CSP is the most versatile prime mover because of its ability to use a steam or gas turbine or a hybrid combination. The German Aerospace Agency (DLR) undertook the ECOSTAR (European Concentrated Solar Thermal Road Mapping) study during 2003-2005 under the European Sixth Framework Programme where several different CSP designs were analysed and compared under certain assumptions. According to this study, the molten salt type central receiver system had the high solar capacity factor of 33% followed by parabolic trough (29%) and parabolic dish (22%). The Levelized Energy Costs for a solar – only power facility consisting of several reference CSP systems with a total capacity of 50 MW were also estimated in ECOSTAR.

	Capacity Unit MW	Concen-tration	Peak Solar Efficiency	Annual Solar Efficiency	Thermal Cycle Efficiency	Capacity Factor (solar)	Land Use m²/MWh/y
Trough	10 – 200	70 - 80	21% (d)	10 – 15% (d)	30 – 40 % ST	24% (d)	6 - 8
				17 – 18% (p)		25 – 90% (p)	
Fresnel	10 - 200	25 - 100	20% (p)	9 - 11% (p)	30 - 40 % ST	25 - 90% (p)	4 - 6
Power Tower	10 – 150	300 – 1000	20% (d)	8 – 10 % (d)	30 – 40 % ST	25 – 90% (p)	8 - 12
			35 % (p)	15 – 25% (p)	45 – 55 % CC		
Dish-Stirling	0.01 – 0.4	1000 – 3000	29% (d)	16 – 18 % (d)	30 – 40 % Stirl.	25% (p)	8 - 12
				18 – 23% (p)	20 – 30 % GT		

d=demonstrated; p=projected; ST=steam turbine; CC=combined cycle

Table 1: Performance data for various CSP technologies T

Concentration Method	line concentrating system		point concentrating system	
Solar Field Type	**Parabolic Trough**	**Linear Fresnel**	**Central Receiver**	**Parabolic Dish**
State of the Art	commercial	pre-commercial	demonstrated	demonstrated
Cost of Solar Field (€/m²)	200 - 250	150 - 200	250 - 300	> 350
Typical Unit Size (MW)	5 - 200	1 - 200	10 - 100	0.010
Construction Requirements	demanding	simple	demanding	moderate
Operating Temperature	390 - 550	270 - 550	550 - 1000	800 - 900
Heat Transfer Fluid	synthetic oil, water/steam	synthetic oil, water/steam	air, molten salt, water/steam	air
Thermodynamic Power Cycle	Rankine	Rankine	Brayton, Rankine	Stirling, Brayton
Power Unit	steam turbine	steam turbine	gas turbine, steam turbine	Stirling engine
Experience	high	low	moderate	moderate
Reliability	high	unknown	moderate	high
Thermal Storage Media	molten salt, concrete, PCM	molten salt, concrete, PCM	molten salt, ceramics, PCM	molten salt, ceramics, PCM
Combination with Desalination	simple	simple	simple	Simple
Integration to the Environment	difficult	simple	moderate	Moderate
Operation requirements	demanding	simple	demanding	Simple
Land Requirement	high	low	high	Moderate

Table 2: Comparative summary of different CSP technologies

Molten salt central receiver system have the lowest energy cost of 0.155 Euros/ kWhe followed by the parabolic trough (0.172 Euros/ kWhe) and the parabolic dish (0.193 Euros/ kWhe).

With regards to the solar energy efficiency of the system, the Central Receiver type has the best theoretical values. Although the parabolic dish type system has actually demonstrated the highest annual solar efficiency of 16-18%, the projected annual solar efficiency of a central receiver can reach up to 25% . In the year 2007 the German Aerospace Agency conducted another study called Aqua–CSP (Concentrating solar power for sea water desalination) where performance data for various CSP technologies were estimated. The above tables 1 and 2 have been taken from this study.

It is to be noted here that despite having the advantage with high temperature and efficiency parameters, a central receiver type CSP plant requires large amount of land. Nevertheless, parabolic trough plants need horizontal flat surface, while only the Central type plant can be built utilising uneven land terrain and in steep hilly slopes. Linear Fresnel plants can be built on little slopes or mild uneven surfaces.

Parabolic trough plants are most matured, proven and reliable systems among all types of CSP technologies today, however, they have a low temperature yield. On the other hand, central receiver type plants seem to be more suitable for high temperature applications, higher efficiency along with extended heat storage possibilities despite the weakness that there still exist a lack of operational experience and degree of maturity in this direction.

ACKNOWLEDGEMENT

A detailed review on CSP technologies was conducted during the initiation of the CSP-DSW project of The Cyprus Institute. Please see more about this project on
http://eewrc.cyi.ac.cy/CSP-DSW

PHOTOVOLTAIC RURAL ELECTRIFICATION PROJECTS IN PERU

by Cesar E. Rivasplata (PPRE 1989), Faculty of Sciences, Center of Renewable Energies- CERT, National University Jorge Basadre Grohmann

ABSTRACT

The use of solar energy in Peru is very promissory; there are many projects at the level of rural electrification with PVS impelled by public and private sectors. Many universities in the country offer professions and second specializations in renewable energies, which is an indicator of the positive role that the use of RE will play. The legislation and energy-environmental regulations in Peru are being promoted very strongly by the interaction between the community and the government.

INTRODUCTION

Peru has an area of 1.285.215 Km2 and is the third biggest country in South America.

The solar resource is almost available throughout the country: (4-5 kWh/m^2 day along the coast and through the jungle and 5-6 kWh/m^2 day along the Andean Range and increasing from the northern to southern area

The installed capacity to produce electricity in Peru is 6.6 GW, from which 3.4 GW are

from thermal origin and 3.2 GW are from hydraulic source.

The average percentage of electrification in the nation is 75%, and out of 28 millions Peruvians 75% use electrical power; however 7 million inhabitants lack it.

EXPERIENCES IN PROJECTS OF RPV ELECTRIFICATION

The focus of programs that use photovoltaic systems for rural electrification have been basically sponsored by the Peruvian government as well as international cooperation support. The basic purpose has been to be able to provide minimum power to isolated rural communities by PV in order to meet basic needs of electrical power and light, instead of their use of candles, kerosene-powered lighters; as well as providing information and communication.

In 1986, with German cooperation support, RPV electrification project took place in the poorest rural zones of the Puno Region. This was the first important project that has undertaken a development of rural electrification.

In 1996it was, estimated that in Puno there were about 500 SHS, in Arequipa around 1000, and in the jungle 350.

Nowadays, the situation is different because the use of photovoltaic systems has remarkably increased throughout different Regions of the nation. Telefónica Company in Peru has already installed telecommunication equipment in isolated places and due to security criteria with the provision of about 1000 kW, and for the army and police institutions around 300 kW.

The Ministry of Energy and Mining, by assignment to some universities, has encouraged the development of research and installations in rural electrification; for instance, the work developed by the Center of Renewable Energies of UNI on rural electrification islands (Taquile, Amantani) in Titicaca Lake in Puno.

The experience gained on rural electrification in peninsular isolated regions, such as

the Taquile Island case, is a good example to follow. This project provided with around 300 SHS of 60 Wp each, in the mode of sustainable management which has achieved positive results; as well as social and environmental approach. Within the Taquile Project exists a development of a photo-

voltaic pumping prototype as well to supply water of household use for the population of Taquile. In 2000 an implementation analysis of SPVS was done to supply water (24m³/day) at a nominal height of 200m and along the piped system of 640m, with an energy contribution of $3.7x10^6$ kWh.

At present, the Ministry of Energy and Mining has set goals regarding rural electrification in order to install 6.000 SHS per year; but so far its main project which was started in 1999 financed by PNUD had just installed equipment basically in border zones in the jungle with a certain difficulty 4.500 SPV. Within the projects of rural electrification under the responsibility of PER-MINEM, there is the implementation of photovoltaic systems with productive purposes. The experience in this area is the case of the project that has been developed in the Puno Region with the purpose of providing electrical power to a community of Vilcallamas. The installed power with PV is 2040 Wp.
Recently the European community is giving support to the Euro Solar project –Peru with

130 hybrid solar wind installations of 1.4 kW each, community type.

In 2007 it was estimated that the capacity of installed SPV in Peru is 1.5 MWp, and it is probably that the current pace might have increased around 6 MWp due to the boom of mining issues in the country and important zones, usually highland Andean zones,

where regional government with mining funds are investing on rural electrification in Andean communities.

SUPPORTING INSTITUTIONS

Ministry of Energy and Mining
In legal issues, the Ministry of Energy and Mining is the leading institution at the government level that has propelled a series of actions to promote the rational use of energy and the substitution of conventional energy sources with alternative sources of energy. The search of 500 MW power by RE, witnesses it. There are regulations on the issue of the use of RE in border zones, and there is already a legal project for the use of renewable energies in Peru (www.minem.gob.pe).

CONCLUSIONS

The household photovoltaic equipment, in telecommunications and at a minor scale in productive processes and community use is estimated to be 5 MW. By training people for the use of equipment at various levels, Peru occupies an important strength because there are less than six universities that prepare professionals majored in energy, renewable and solar energies, that is pre-graduate studies or a second specialty and/or post-graduate studies. Various NGOs are promoting the use of renewable energies, at various levels, being remarkable those that focus on training young people in zones considered as poor.

Peru being a paradise of natural resources including the solar resource, it also has areas of insolation and mostly desert zones with values of solar irradiance within 5-6kWh/m2 which could be utilized in order to develop PV and solar thermal conversion systems projects to generate electricity to supply power to be integrated into the net.

BIOENERGY AND RENEWABLE POWER METHANE IN INTEGRATED 100% RENEWABLE ENERGY SYSTEMS

Limiting global warming by transforming energy systems

Abstract of PhD-thesis from Dr. Michael Sterner, Germany (PPRE 2005/07)

The two major challenges in global energy systems are to reduce energy-related greenhouse gas emissions and to maintain energy supply security. This thesis presents a possible solution to both problems. It proposes strategies for the transformation of current energy systems into 100% renewable, stable and almost emission-free energy systems without making use of nuclear energy or carbon capture and storage. Within renewable energy systems, one is facing two difficulties: On the one hand, the fluctuating renewable sources need to be matched with the energy demand, on the other hand, a substitution for high energy density fuels in heat and transport has to be found. Therefore, this thesis examines bioenergy and the newly developed 'renewable power methane' or 'renewable methane' with respect to their potential to solve these problems.

First, bioenergy is analysed in the broader context of climate change, energy systems and land use in order to estimate the sustainable potential of global bioenergy. Then, a techno-economic and ecologic analysis of 78 bioenergy pathways is done in order to identify the strategic role of bioenergy in future energy systems. The potential is linked with this analysis to identify the range of maximum greenhouse gas reduction potential of bioenergy (2.5-16 Gt CO2-eq. yr-1). Due to land-use competition and emissions from land-use, residues are to be favoured as biomass source over energy crops. However, the limited bioenergy potential will neither be sufficient to balance fluctuating renewable power nor to fully replace fossil fuels in heat and transport.

Second, to solve this bioenergy bottleneck, a new approach of converting renewable power into methane via hydrogen and CO2 methanation is developed. Several integrated concepts with CO2 from air, biomass, and fossil fuels are designed. In this way, renewable power can be stored in the natural gas network and used temporarily and spatially flexible for balancing power, for process heat and for long-distance transport. It can be produced basically anywhere where water, air and renewable power are available and thus decrease import dependence on fossil fuels. It can recycle CO2 in the energy system or even act as carbon sink in combination with CO2 storage.

Third, the necessary transformation of energy systems is performed. The key elements are direct renewable power generation, renewable electromobility, heat pumps, renewable power methane and overcoming traditional biomass. By integrating smart

power networks, heat networks and natural gas networks, a full renewable energy supply is possible. Several 100% renewable energy systems are developed, reducing global energy-related emissions by 95%. The 100% renewable power supply was simulated with an hourly resolution. Finally, the role of such a transformation in global climate protection is analysed. It has to be effective until 2050 in order to limit global warming to 2°C. Therefore, there is not much time left for the transformation to start.

The complete thesis can be downloaded from: www.msterner.de/Michael_STERNER_Renewable_Power_Methane_Disseration_2009.pdf

SESAM/ARTES Alumni Workshop in Vietnam; 5-9 Oct 2009

In relevance to the hot issues today on climate change, the SESAM/ARTES alumni had organized a conference and workshop on "Policies And Strategies To Mitigate Climate Change And Energy Poverty in South East Asia and China" from 5 to 9 October 2009 at Hanoi and Halong Bay, Vietnam. More than 30 participants were present in the conference. They are mainly classified as SESAM alumni, came from South Asia and China, such as Vietnam, India, Bangladesh, Thailand, Indonesia, China, etc. Three PPRE Alumni had participated in the conference, namely **Oo Abdul Rosyid (Indonesia, PPRE 1995/1996), Tubtim Limsoontorn (Thailand, PPRE 2004/06), and Jorifa Khatun (Bangladesh, PPRE 2006/08)**.

The workshop is continuing the series of SESAM/ARTES Alumni Workshop supported by the German Academic Exchange Service (DAAD). It gave a chance to the South East Asian SESAM/ARTES Alumni to get scientific subject matter updating, exchange experiences and intensify alumni networking in order to further improve the professional performance of Alumni. The key role which the emerging South East Asian countries and China will have to play in the future in combating climate change justifies considerable efforts to improve the networking of energy experts in the region.
The overall goal of the workshop was to build capacity for promotion, dissemination and wider application of Sustainable Energy Technologies. The objective of the workshop was to build up and improve the professional and personal capacity of the participants to cope with their professional challenges and to build up and formalize an Asian alumni network in the sustainable energy sector. Apart from this the workshop had the following specific objectives:

- Experiences on policy and strategies, R & D and financing as well as business aspects to develop and promote renewable energy and energy efficiency in the South East Asian region have been shared
- Competencies of the alumni on the current development and issues on the renewable energy have been strengthened.
- The cooperation between German development cooperation agencies with South East Asian alumni has been strengthened.
- Framework for Regional level network of South East Asia has been developed and the Asian Energy Alumni Network has been established.

- Country coordinators are trained to build up and manage local alumni associations.

All in all about 36 topics have been submitted and presented during the workshop. The topics can be classified as following sub-topics:

- Impact and Mitigation of Climate Change in South East Asia
- Sustainable Energy Systems: Policies and Implementation Strategies
- Sustainable Strategies to Mitigate Rural Energy Poverty
- Sustainable Energy Development and its impact on Employment and Economy
- Setting Up the Asian Alumni Energy Network

Dr. Oo Abdul Rosyid (Indonesia, PPRE 1995/96) presented his paper with the topic of Renewable Energy Technology for Mitigation of Climate Change And Energy Poverty in Developing Countries: Case Study for Indonesia. Another presentation from **Mrs. Jorifa Khatun (PPRE 2006/08)** with the topic of Sustainable Disposal of Municipal Solid Waste of Dhaka City to Generate Electricity & Organic Fertilizer: A System Dynamic Models. Meanwhile, **Ms. Tubtim Limsontorn (PPRE 2004/06)** presented her paper on Thailand climate change strategic plan and future action plan.

First day of the workshop in the Sofitel Hotel, Hanoi-Vietnam (Rosyid: the 4th front right, Jorifa: 5th front left, and Tubtim: 4th back left)

MONUC: EMPOWERED BY THE SUN

sent by Simeon Obinna Nwaogaidu, Nigeria (PPRE 2007/09)

The United Nations Mission in the Democratic Republic of Congo (MONUC) has tapped into the power of the sun. The Alternate Energy Unit, part of the mission's CITS team, has successfully completed a test initiative that will help make the use of solar power a standard in the mission.

Recognizing that mission ICT equipment depends on a stable power supply, the team has worked to integrate solar power into MONUC as an alternative energy source to keep critical communications equipment running at all times. "In many cases, use of power from grid systems is not cost effective,

and sometimes unavailable, in desired installation locations," explained Laurence Minguell, Chief Communications Officer, MONUC. "Also, engine generators are very expensive to maintain and often unreliable due to the fact that they do not scale up well for long term needs."

In contrast, photovoltaic technology uses solar power to harness the abundant energy of the sun and supports enhanced efficiency, both from a financial and logistical standpoint. With this in mind, the MONUC CITS team developed the Photovoltaic Test Project out of a desire to both 'go green' and explore the reliability of solar power as a source of energy for satellite communications. "Photovoltaic

generators are pollution free and offer a convenient and cost effective solution – free from power bills, fuel deliveries or generator maintenance and grid access," said Mr. Minguell.

Located just below the equator, MONUC HQ in Kinshasa is ideally situated to benefit from solar power. Twelve solar panels were installed on the base by Alternate Energy Unit personnel as part of the test project, which took place from 20 - 27 July 2009. These were mounted with 48 photovoltaic

Solar Power Arrays at MONUC HQ

The MONUC Green Team: Simeon (2nd from left)

modules, the cells of which convert sunlight into direct current electricity. The modules are expected to have lifetime of at least 25 years, with low maintenance requirements.

Lending its time to the project as a 'test subject' was one of MONUC's main satellites; solar panels were used to directly power the satellite and facilitate communications at MONUC headquarters. The result—the panels successfully powered the satellite over the week long period, reinforcing a great effort by the CITS team.

While cost estimates for the test project revealed that solar power, as an alternate energy source, could save the mission almost $800 annually (per site on electricity usage) by powering just one mission satellite, the projected long term benefit is even higher. "Taking into consideration the current price of fuel, as well as the cost of fuel transport to generators at various locations, and generator maintenance expenses, by using solar power MONUC stands to benefit from an even greater savings than the $800," said Mr. Minguell.

Experience with existing photovoltaic products over past years has proven their extreme reliability, low maintenance requirements and minimal operational costs. "Once it is purchased, the cost of producing photovoltaic electricity is constant over the life of the system since the only fuel used is sunlight unlike grid power supply," explained Simeon Nwaogaidu, Alternate Energy Unit Supervisor.

The environmental benefits of using photovoltaic technology also became evident through the test. "It represents true zero carbon emission generation, free from stack emissions associated with back-up diesel power plants," said Mr. Nwaogaidu. Consequently, the initiative could offset the mission carbon footprint by approximately

542.23kg of carbon dioxide a year, correspondingly reducing a sizable chunk of their greenhouse gas emissions.

In addition to measuring environmental and cost benefits, the team completed a detailed analysis and monitoring exercise to ensure optimal conditions, measuring energy levels and observing atmospheric considerations, weather fluctuations, and equipment arrangements. "Even during the worst conditions of insolation, tests proved that the system is performing well and will perform better during the sunny portions of the year" said Mr. Nwaogaidu. "Overall it has improved people's understanding of the contribution of renewable energy technologies and energy efficiency issues."

For the mission, these optimistic results prove that using solar power in conjunction with other energy sources can provide a continuous reliable and sustainable power supply in almost any location. "It has been confirmed that solar hybrid power supply is the best solution for powering communications equipment even under challenging geographic and environmental conditions," he said.

Steps are now in motion to take the test project to the next level and obtain financial support for more widespread implementation. It is also anticipated that the initiative will spread to other missions. Ultimately, the MONUC CITS team hopes to set a shining example and encourage all missions to embrace solar power or hybrid systems as a means to reduce their carbon footprint and sustain peacekeeping operations into the future. "The photovoltaic power project belongs to the sources of renewable energies that raise the greatest hope in the fight against global warming," said Mr. Nwaogaidu.

A GROWING ECO-DOMAIN IN NORMANDY, FRANCE

by Laurent Lesesve, France (EUREC 2004/05)

Long-term evaluations of rural electrification in developing countries made me understand how complex it is to build RE sustainable projects, especially if you are not native. The only solution would be to settle somewhere and work with the population on-site over ten years. Putting up RE installations to supply electricity during 3 to 5 years is only a costly temporary patch with massive frustration as side effect. After 7 years of involvement in developing countries projects, I decided to change my PhD topic to rural electrification in France. For two years I have been working on a project to settle down (nice after 7 years of nomadic life…).

Biogas, a holistic renewable solution

A big question was: Which RE would I like to promote? I chose to focus on biogas, which seems the most relevant one to me. The aim is not only to produce electricity, but to link it to agricultural activities, creating a whole ecosystem. Besides, France shows a huge lack of biogas compared to wind or solar energy, which are already established on the market. In order to locally distribute RE production and organic waste management, our technical approach - stays limited in size: a 100 kWel "dry" system within a percolation process and a 4-5 kWel micro-biogas system to grow spirulina.

Spirulina, a special micro-algae.

Born 3,5 billions years ago, cyanobacterias are the origin of our oxygen and atmosphere. Aztec and Tchad people traditionally ate spirulina for ages. It is very healthy with a vey high concentration of whole proteins (60 to 70%), iron (easily assimilated), beta-carotene (ProVitamin A) and any other vitamins (B12…), enzymes, oligo-elements. It is a natural strong antioxidant and its proved benefits are to strengthen the immune system and to detoxify the body from heavy metals. It doesn't treat a specific disease, but it helps the body to cure itself. The presence of four pigments makes its solar energy conversion efficiency really high, so its protein yields of 50 T/ha/year is 300 times higher than that of cattle. And it needs little water: only 2 500 litres per kg of protein produced (100 000 litres for cattle) . Cultivating Spirulina has many advantages, to do so organically and in our temperate regions is the challenge of today.

Spirulina & Biogas ecosystem

Spirulina culture and biogas production complement each other very well. Spirulina mainly needs CO2, heat and fertiliser, a biogas installation produces all of that with even electricity as "by-product". The goal of this micro system is purely to grow spirulina. Cow and horse manure as main inputs will provide the organic material. In south of France nearly fifty spirulina farmers grow artisan spirulina with chemical fertilizer in greenhouses and without additional heat. Many of them would like to find a more sustainable way to cultivate. In the 8O's, Dr. Ripley Fox had developed the integrated system with spirulina and biogas to bring appropriate technology into villages of developing countries. Today, none of those systems is working anymore, mainly due to socio-cultural reasons. However, the Indian project has been running properly during more than ten years. Therefore I decided to start such an integrated system with spirulina and biogas in Normandy and to focus my PhD on the updating and the adaptation to European standards of this Spirulina & Biogas combination. With that innovation as a first step, the project is to open a pedagogical and experimental farm; the project vision became wider.

Cooperative agricultural biogas system

In a second phase , a bigger biogas system

Spirulina open-pond in South of France (Jardins Coquet, 2007)

is planned to value the local organic matter. In that area of France, horse manure represents a real issue to deal with. In addition, cow dung and grass are available. These inputs are solid ; hence, percolation digesters will be more adapted. This liquid-solid hybrid system is watering the matter from a small additional liquid digester on a regular basis. Thus, less water and energy is required for its operation. The company ARIA Energies has installed such a system on a farm in western France with great success and will support to set up the system in Normandy. The idea here is to gather surrounding farmers within a cooperative project, which provides electricity and heat thanks to a CHP unit . In France, the economical key factor for such a project is the amount of heat used, since it fixes the feed-in tariff. Thus, the heat should cover the needs of other activies. Organic vegetable nursery and spirulina culture were the first steps to an Eco-Domain.

The amazing domain of Bouquetôt

While looking for a land for this Eco-Domain, I met the local community of communes, which owns a beautiful place of 68 ha located 3 km from the coast. Bouquetôt is a piece of land with a river in a valley, some wood, meadows and orchards, in a region fully green throughout the year. Water springs are all over the place and provide drinking water to the region. This is the key point, which has protected the land from any non-ecological use . The community of communes didn't know what to do with this place – until we met. This huge land has given a whole new dimension to the project.

A new Vision for the Eco-Domain

An Eco-Domain is a place where different activities complete one another within rewarding cycles , like an ecosystem. The vision is to gather activities within five fields:

- Organic agriculture,
- Renewable Energies,
- Eco-building,
- Natural healthcare,
- Eco-tourism, art & culture.

Education and trainings would be the bridging aim, permaculture the tool to design that vision into reality and non-violent communication the way to solve potential conflicts. Several meetings have been organized so far to present the project and thus welcome others.

Building the Foundations

Today, Hybrid Energies, as a NGO and also as a company, is responsible for the whole project management. Its biogas and spirulina project is the heart of the future Eco-Domain. First actions on the field of Bouquetôt have started very recently, the integrated system with biogas and spirulina will be set up soon. This year will be focused on validating the system, while production will follow next year. Meanwhile, we are distributing a nice Spirulina from Burkina Faso, Africa to build up the market (supporting malnutrition program there). We are at the early stage of a great project, you will be welcome to visit.

Follow on:

hppt://www.hyes.eu
hppt://www.hybridenergies.org
hppt://www.ecopya.org
http://www.spirulidaire.org

BUILDING A SCHEFFLER SOLAR CONCENTRATOR FOR PERU

by (Damien Puigserver, Florent Dupont, Manfred Amoureux, France (EUREC 2007-08)

The Scheffler reflector is a parabolic solar concentrator very well-suited for small-scale thermal applications in rural areas (distillation, pasteurization, cooking). Its main characteristics is to have a fixed focus point at any time any day of the year using a single axis solar tracking system. Its low cost and the material used which is available everywhere in the world makes this system an attractive system especially for rural areas of developing countries.

During Manfred's stay in Peru, the members of the Grupo-PUCP (see other article) showed much interest in it. So, when Damien said he was interested in working a few months in South America, we talked the Grupo of him coming there to build one and teach its use at the PUCP this summer 2010. On the other hand, Damien prepared a workshop to learn how to build one in Poitiers, France in May 2010, during 3 weeks. It is hosted and co-organized by Florent, who had done his master thesis on distillation with a Scheffler solar concentrator at the faculty of Witzenhausen and is president of the association Tapesine.

We have had many Eurec-PPRE students and alumni taking parts: the three of us, but also Jean Duquette, François Veynandt, Craig Wong, Elias Afeiche, José Fernando Zuniga, Harsh Aggarwal as well as locals from Poitiers and its surroundings.

It has been a good learning experience: we practised our manual skills at which we were yet no-so-expert (welding, drilling, grinding, etc.) but also had the opportunity to discuss many theoretical aspects of concentrated solar power, thanks to the very special design of the Scheffler reflector but also to the presence of François who is doing a Ph.D. on Fresnel solar power plants. Moreover, the workshop was a great opportunity to share the various experiences in renewable energy of the participants.

In Mid May 2010, the reflector was not finished yet, but well advanced. We expect to finish it on time. We will be trying two different types of solar tracking systems.

For any information about the workshop, you may contact the Tapesine association: tapesine@gmail.com

For information about the Scheffler solar reflector: http://www.solare-bruecke.org/

The Tapesine-Team at the Scheffler solar reflector

SOLAR DRYING OF MACA – PROJECT IN PERU

by Manfred Amoureux, France (Eurec 2007-08)

Solar drying of maca

I went to Peru to work with the GTZ on the topic of the solar drying of maca (an Andean edible root vegetable), from Aug. 2009 to march 2010.

After 3 months on this task I worked with the group of support to the rural sector (*Grupo de apoyo al sector rural*) of the catholic university of Peru (*PUCP*). There I spent my time building prototypes for experiments: a very simple micro-biodigestor, a synchronous generator extracted from Hugh Piggot's design of wind turbines and a solar water heating system.

During one of my visits in the area of Junin, a high plateau at 4000 meters altitude where the maca is cultivated, I had come to learn that many people have showers only once every 2 to 6 months, due to the coldness of the water and the weather. They shower only when they visit the main city of the region, where there are public baths with heating.

And still, in an inter-tropical area, at this altitude, there is a lot of sun, judging by the sunburns I had repeatedly on the nose.

Actually Peru already has a well-developed small industry of solar water heaters but it is located more in the south of the country (around Arequipa), and in the region of Junin, they simply never heard of it.

So I went trying to build a cheap DIY water heating system that could give water at 40°C on non-cloudy days. Even if this only enables them to take showers twice a week. That would be a lot of improvement.

I investigated a design of black plastic hoses going through PE transparent plastic bottles, fitted in each other air-tight at the bottom, and laid on the corrugated sheets of metal used as roofs in 90% of the housing with black painting. These bottles thus serve as both a greenhouse and a thermal insulator. The preliminary tests I ran showed it was easy heating water at the desired temperature (40°C).

Unfortunately I left Peru before we completed the system, but we at least had the time to show the effectiveness of the idea and my collaborators from the PUCP should be able to complete the system.

Manfred at his locally produced water heating system

SOLAR POWER TO THE PEOPLE: A CHILEAN EXPERIENCE

by Martin Jacques Coper from Chile, who did a brief presentation about his project in Chile for PPRE-students in June 2010

The Solar Energy Workshop (Taller Solar) is a project led by a group of students from the University of Chile since 2007. It consists of a working space to design and build solar water heaters to use the solar thermal energy in daily life. After some experience gained during Volunteer Summer Jobs in rural areas in the North of Chile, they have started a theoretical-practical workshop for people from inside and outside the University in order to spread this knowledge in popular quarters of Santiago.

Their aim is to encourage the use of this and other renewable energy sources by the population in a country with lots of resources and astonishingly low access to hot water. Besides, they try to contribute to the energy paradigm change, considering the challenges that humankind is facing nowadays.

Martín Jacques-Coper, studied Geophysics (BSc) and holds a MSc degree in Meteorology and Climatology from the University of Chile. In 2009, he collaborated in a Wind Resource Assessment study in Chile, funded by the National Energy Commission (CNE) and directed by the Geophysics Department of the University of Chile (DGF). In 2010 he did an internship at the Center for Wind Energy Research ForWind of the University of Oldenburg in Germany, focused on wind forecasting and predictability of wind extremes, supported by the CNE and the National Commission for Scientific and Technological Research (CONICYT).

During the last five years, he has been actively involved with the Oikos student association and the Taller Solar –Solar Workshop- (founder member), devoted -under several other projects like recycling and the development of a sustainable campus proposal- to promote the use of solar thermal energy by implementing low-cost techniques in rural and urban areas of Northern and Central Chile.

Information:
http://taller-solar.wikispaces.com/Taller+2010


Making of & Installing solar water heater - Summer Volunteer Jobs (Lolol, 2010)

WANTED: ALUMNI AS FRANCHISE TAKERS

by Sibylle Petrak, Germany, PPRE Lecturer from 2004 to 2006

Do you remember your energy meteorology classes? You probably remember Dr. Detlev Heinemann, his inspiring teaching style, but also a lot of heavy math and perhaps even some fear of passing exams. Now, there is something new about energy meteorology that is as sweet as a piece of sugar in a freshly brewed cup of coffee.

A new spin-off, named focus solar, has evolved out of energy meteorology offering PPRE and EUREC alumni new opportunities to earn additional income with consultancy work in solar energy. Sounds interesting? This is how it works: focus solar, founded and managed by Sibylle Petrak, has developed a business model by which solar project developers and investors can obtain all relevant information about solar radiation. This includes customized solar maps, energy yield and optimization analyses, made available through expert reports and data files. These services are offered for nearly all countries worldwide. For a first overview, please visit http://www.focussolar.de.

Now, you as alumni can use these tools for your own business activities. Ask us about becoming a focus solar franchise taker and use our proven business concept for your own consultancy work supporting solar energy projects in your country. You know best the projects being under way in your country. When a project developer asks for an energy yield report, you order it directly on the focus solar web site. You can rely on high-quality information as well as professional display because all materials are prepared for you in Oldenburg in the focus solar corporate design. It's like having an energy meteorology pocket calculator, always ready when you need it for business.

As renewable energy graduates you are in a special place acting as matchmaker between the academic world at the university and the real world outside. You have the knowledge, the academic training, and the experience. Few people in the world are as knowledgeable as you are about solar energy. By working together, we can let the circle of knowledge expand!

Contact:

Sibylle Petrak | focus solar
Marie-Curie-Str. 1 | 26129 Oldenburg
T +49(0)441 36116-560
F +49(0)441 36116-564
E s.petrak@focussolar.de
www.focussolar.de

focus solar

Course	Family Name	1st Name	Tit.	Origin
1987-88	Bekdach	Hussein	Dr.	Lebanon
1987-88	Demel	Lothar	Mr.	Germany
1987-88	Dibor	Alfred	Mr.	Nigeria
1987-88	Fischer	Eric	Mr.	Brasil
1987-88	Heilscher	Gerd	Mr.	Germany
1987-88	Zarate	Carlos	Mr.	Peru
1988-89	Hamad	Bakri	Dr.	Sudan
1988-89	Kimaro	Ainea	Mr.	Tanzania
1988-89	Holtorf	Hans G.	Mr.	Germany
1988-89	Morares-Duzat	Rejane	Dr.	Brasil
1988-89	Nontaso	Ngarmnit	Ms.	Thailand
1988-89	Lu	Bai	Ms.	China
1988-89	Jia	Xi-Nan	Dr.	China
1988-89	Maiga	Alhousseini Issa	Mr.	Mali
1988-89	Oludhe	Christopher	Dr.	Kenya
1988-89	Pietscher	Jochen	Mr.	Germany
1988-89	Rakha	Hassan	Dr.	Egypt
1988-89	Camillo	Roger R.	Mr.	Nicaragua
1988-89	Ramesh	Muthya Praneshrao	Mr.	India
1988-89	Toro Cortes	Francisco	Mr.	Chile
1988-89	Rivasplata	Cesar	Mr.	Peru
1989-90	Gao	Ying	Dr.	China
1989-90	Jahn	Ulrike	Ms.	Germany
1989-90	Kimani	John Muiruri	Mr.	Kenya
1989-90	Han	Wei	Dr. .	China
1989-90	Miranda Murillo	Alexis	Mr.	Honduras
1989-90	Misra	Anil K.	Mr.	India
1989-90	Mukherjee	Partha Sarathi	Mr.	India
1989-90	Reynaldo	Reynaldo	Mr.	Philippines
1989-90	Schwarz	Thomas	Mr.	Germany
1989-90	Tarh	Zaccheus T.	Mr.	Cameroon
1989-90	Thi Hong Hai	Nguyen	Ms.	Vietnam
1989-90	Park	Myong-Sik	Mr.	Korea
1990-91	Barroga	Maria L.	Ms.	Philippines
1990-91	Hassan	Gimba	Mr.	Nigeria
1990-91	Usbeck	Stefanie	Ms.	Germany
1990-91	Ennison	Isaac	Mr.	Ghana
1990-91	Pandey	Krishna C.	Dr.	India
1990-91	Adam	El Fadil	Dr.	Sudan
1990-91	Kioko	Joel M.	Mr.	Kenya
1990-91	Knagge	Edu	Mr.	Germany
1990-91	Mishra	Christanand	Dr.	India
1990-91	Okae	Charles	Mr.	Ghana
1990-91	Osman	Abdalla	Mr.	Sudan
1990-91	Peiris	Wettasingha	Mr.	Sri Lanka
1990-91	Lemus	T. Hernando	Mr.	Bolivia
1990-91	Xie	Enhai	Mr.	China
1991-92	Abel	Bettina	Ms.	Germany
1991-92	Ally	Noel	Mr.	Guyana
1991-92	Gyi	Aung	Mr.	Myanmar
1991-92	Hakiem	Mahmoud El	Mr.	Sudan
1991-92	Ingwe	Anna Naftal	Ms.	Tanzania
1991-92	Kaur	Jagjit	Ms.	India
1991-92	Mansaray	Kelleh G.	Dr.	Sierra Leone

1991-92	Xiang-jun	Ming	Mr.	China
1991-92	Mugisha	Patrick	Mr.	Uganda
1991-92	Santoso	Murtiyanto	Mr.	Indonesia
1991-92	Tegeler	Ludger	Mr.	Germany
1991-92	Nabutola	W. Musungu	Mr.	Kenya
1992-93	Al Kailani	Fayez Jamil	Mr.	Jordan
1992-93	Budiono	Chayun	Mr.	Indonesia
1992-93	Hamid	Mohamed Ali	Mr.	Sudan
1992-93	Kariyawasam	Palitha L.G.	Mr.	Sri Lanka
1992-93	Kassenga	Gabriel	Dr.	Tanzania
1992-93	Lonis Abdu	Bertha	Ms.	Nigeria
1992-93	Magno Desendario	Evelyn	Ms.	Philippines
1992-93	Shresta	Kedar Shanker	Dr.	Nepal
1992-93	Pandya	Udayan	Mr.	India
1992-93	El Asaad	Kawther A.. Mohamed	Ms.	Sudan
1992-93	Mutwaly	Safaá	Ms.	Sudan
1992-93	Wang	Jing Jing	Ms.	China
1992-93	Wafula	James C.	Mr.	Kenya
1992-93	Blaas	Markus	Mr.	Germany
1992-93	Georg	Rolf	Dr.	Germany
1993-94	El-Ghany	Ahmed Fathy	Dr.	Egypt
1993-94	Tubail	As'ad	Dr.	Palestine
1993-94	Tommy	Henry J.M	Dr.	Sierra Leone
1993-94	Nahui-Ortiz	Johnny	Dr.	Peru
1993-94	Leon	Mathias Augustus	Dr.	India
1993-94	Rommel	Mathias	Mr.	Germany
1993-94	Mergia	Mesfin	Mr.	Ethiopia
1993-94	Gadah Eldam	Nagwa	Ms.	Sudan
1993-94	Siefert	Oliver	Mr.	Germany
1993-94	Andriamahefaparany	Olivier Donat	Mr.	Madagascar
1993-94	Rodrigues dos Santos	Rosana	Dr.	Brasil
1993-94	Hurmuzan Kanam	Senda	Mr.	Indonesia
1994-95	Lingbo	Cui	Mr.	China
1994-95	Yanzhao	Dong	Mr.	China
1994-95	Teka	Melis	Mr.	Ethiopia
1994-95	Tolessa	Samson	Mr.	Ethiopia
1994-95	Primo	Gayle	Ms.	Guyana
1994-95	Myint	Mu Yar	Ms.	Myanmar
1994-95	Gautam	Satish	Mr.	Nepal
1994-95	Sellahewa	Raveendra A.	Mr.	Sri Lanka
1994-95	Ntoga	Julius	Mr.	Tanzania
1994-95	Gassir Farouk	M´med Ibrahim	Mr.	Sudan
1994-95	Ghebrehiwot	Debesai	Mr.	Eritrea
1994-95	Mesfin	Yohannes	Mr.	Eritrea
1994-95	Ksoll	Michael	Dr.	Germany
1994-95	Kuntze	Björn	Mr.	Germany
1995-96	Negash	Bereket	Mr.	Eritrea
1995-96	Fraser	Orville	Mr.	Guyana
1995-96	Rosyid	Oo Abdul	Dr.-Ing.	Indonesia
1995-96	Basnet	Diwaker	Mr.	Nepal
1995-96	Ahmed	Maqbool	Mr.	Pakistan
1995-96	Magpoc	Godofredo Jr.	Mr.	Philippines
1995-96	Maltsev	Alexandre	Mr.	Russia
1995-96	Lin	Yeong-Chuan	Mr.	Taiwan
1995-96	Kingu	Elizabeth A.	Ms.	Tanzania

1995-96	Endale Geda	Genene	Mr.	Ethiopia
1995-96	Baba	Abdallah	Mr.	Tunesia
1995-96	Fuentes	Enrique	Mr.	Chile
1995-96	Steinmeier	Ernstjoachim	Mr.	Mexico
1995-96	Nikolic	Milorad	Mr.	Germany
1995-96	Woelk	Karsten	Mr.	Germany
1996-97	Kamberi	Mirela	Ms.	Albania
1996-97	Orlando	Perez	Mr.	Bolivia
1996-97	Celestine Anyam	Awa	Mr.	Cameroon
1996-97	Ye	Zhao Hui	Ms.	China
1996-97	Teshome G/Tsadik	Hiwote	Ms.	Ethiopia
1996-97	Yimer Woldetekle	Nebiyu	Mr.	Ethiopia
1996-97	Gbagbo	Joseph Kofi Nani	Mr.	Ghana
1996-97	Hegde	Gajanana Krishna	Dr.	India
1996-97	Osawa	Bernard	Mr.	Kenya
1996-97	Ballesteros Perez	Miguel Angel	Mr.	Nicaragua
1996-97	Projestus M.	Rwiza /	Mr.	Tanzania
1996-97	Morris	Richard	Mr.	Australia
1996-97	Sancho	Sebastian	Mr.	Costa Rica
1996-97	Dalexis	Walmé	Mr.	Haiti
1996-97	Belz	Matthias	Mr.	Germany
1996-97	Schröter	Wolfram	Mr.	Germany
1997-98	Vásquez Cavieres	Ruben Eduardo	Mr.	Chile
1997-98	Chen	Rong	Mr.	China
1997-98	Zhang	Yin	Dr.	China
1997-98	Castillo Arguello	Guillermo Eduardo	Mr.	El Salvador
1997-98	Abdulkadir Ibrahim	Bekala	Ms.	Ethiopia
1997-98	Ahiataku Togobo	Wisdom	Mr.	Ghana
1997-98	Parthan	Binu	Mr.	India
1997-98	Odeh	Ibrahim	Dr.	Jordan
1997-98	Sichali	Francis	Mr.	Malawi
1997-98	Petrucci	Fernando	Mr.	Argentinien
1997-98	Schröder	Christoph	Mr.	Germany
1997-98	Jackson	Thomas	Mr.	USA
1997-98	Delamo Duch	Alex	Mr.	Spain
1997-98	Endres	Manuela	Ms.	Germany
1997-98	Vanginé	Wooslène	Ms.	Haiti
1997-98	Lustig	Konrad	Mr.	Germany
1997-98	Gomez Vilar	Ramon	Mr.	Spain
1998-99	Masum	Syed Ehteshamul Huq	Mr.	Bangladesch
1998-99	Liu	Hui	Ms.	China, VR
1998-99	Yang	Na	Ms.	China, VR
1998-99	Urena Vargas	Wesly	Mr.	Costa Rica
1998-99	Kekelia	Bidzina	Mr.	Georgien
1998-99	Patil	Samudragupta Ashok	Mr.	India
1998-99	Tiako Ngalani	Christophe	Mr.	Cameroon
1998-99	Jaoko	Hancox Wilson	Dr.	Kenya
1998-99	Chima	Timothy Freeman	Mr.	Malawi
1998-99	Al--Alawi	Ali Salim	Dr.	Sultanate of Oman
1998-99	Chirvase	Dana	Dr.	Rumänien
1998-99	Dlamini	Sibusiso Ndumiso	Mr.	Swaziland
1998-99	Jamiyansharav	Khishigbayar	Ms.	Mongolia
1998-99	Lam	Johannes (Jan)	Mr.	Netherlands
1998-99	Straub	Christoph	Mr.	Germany
1998-99	Oehrens	Juan Sebastian	Mr.	Chile

1999-00	Tadesse	Alemu	Mr.	Ethiopia
1999-00	Khan	Md Mesbah	Mr.	Bangladesch
1999-00	Hoque	Mozammel	Mr.	Bangladesch
1999-00	Ambe	Roseline	Ms.	Cameroon
1999-00	Wang	Di	Mr.	China, VR
1999-00	Paredes	Rodriguez	Mr.	Colombia
1999-00	Subbarao	Sham	Mr.	India
1999-00	Al-Nawaiseh	Bassil	Mr.	Jordan
1999-00	Gamula	Gregory	Mr.	Malawi
1999-00	Dahal	Yubaraj	Mr.	Nepal
1999-00	Musa	Mzumbe	Mr.	Tanzania
1999-00	Sendegeya	Al-Mas	Mr.	Uganda
1999-00	Ziesmer	Andrea	Ms.	Germany
1999-00	Ulziisuren	Enhbold	Mr.	Mongolia
1999-00	Gläser	Bernhard	Mr.	Germany
1999-00	Kuyvenhoven	Simon	Mr.	Holland
2000-01	Islam	Mazharul	Mr.	Bangladesh
2000-01	Fuh	Veronica Manka	Ms.	Cameroon
2000-01	Mu	Yundong	Mr.	China
2000-01	P.V.	Aravind	Mr.	India
2000-01	Srikanth	Subbarao	Mr.	India
2000-01	Gil Guerrero	Algert	Mr.	Mexico
2000-01	Ghimire	Ram Prasad	Mr.	Nepal
2000-01	Anahua Quispe	Edgar Narciso	Dr.	Peru
2000-01	Magessa	Finias Bryceson	Mr.	Tanzania
2000-01	Nguyen	Quoc Khanh	Dr.	Vietnam
2000-01	Islam	MD. Saiful	Mr.	Bangladesh
2000-01	Tang	Hui	Mr.	China
2000-01	Risse	Oliver	Mr.	Germany
2000-01	Abbas	Mushahid	Mr.	Pakistan
2000-01	Tardón Ruiz de Gauna	Saioa	Dr.	Spain
2000-01	Nino	Raul	Mr.	Venezuela
2000-01	von Hauff	Elizabeth Leoni	Ms.	Canada
2001-02	Mohtad	Ibrahim (Shafi)	Mr.	Bangladesh
2001-02	Belle	Vivian	Mr.s.	Cameroon
2001-02	Nanji	Henry Nota	Mr.	Cameroon
2001-02	Sanchez Mino	Santiago Jorge	Mr.	Ecuador
2001-02	Shukla	Anand	Dr.	India
2001-02	Gadde	Butchaiah	Mr.	India
2001-02	Heang	Bora	Mr.	Cambodia
2001-02	Ochieng	Xavier	Mr.	Kenya
2001-02	Dhital	Ram Prasad	Mr.	Nepal
2001-02	Poudel	Om Prasad	Mr.	Nepal
2001-02	Mazimpaka	Ernest	Mr.	Rwanda
2001-02	Abd El Messih	Bahy Saad Abdalla	Mr.	Egypt
2001-02	Umana	Alejandro	Mr.	Colombia
2001-02	Pilalas	Loukas	Mr.	Greece
2001-02	Triantafyllos	Panagiotis	Mr.	Greece
2001-02	Manssen	Thomas	Mr.	Germany
2001-02	Winterfeldt	Jörg	Mr.	Germany
2001-02	Avellaneda de la Calle	Jordi	Mr.	Spain
2001-02	Shah	Sayed Faruque	Mr.	Bangladesh
2001-02	Komilov	Asliddin	Mr.	Usbekistan
2002-03	Asaah	Alice Ghopai	Ms.	Camerroon
2002-03	Saha	Jhantu Kumar	Mr.	Bangladesh

2002-03	Tafesse	Anteneh Guliltat	Mr.	Ethiopia
2002-03	Vega	Fernando Alberto	Mr.	Honduras
2002-03	Irasari	Pudji	Ms.	Indonesia
2002-03	Lee	Joo Yeol	Mr.	Korea
2002-03	Kumar Khadka	Manoj	Mr.	Nepal
2002-03	Mishra	Subhash Kumar	Mr.	Nepal
2002-03	Shao	Jie	Ms.	China
2002-03	Trujillo Quintero	Juan José	Mr.	Colombia
2002-03	Peter	Marco	Mr.	Germany
2002-03	Nacci	Gianpiero	Mr.	Italy
2002-03	Choudhry	Ihtsham Farooq	Mr.	Pakistan
2002-03	Bango Cascon	Alejandro	Mr.	Spain
2002-03	Galsan	Sevjidsuren	Ms.	Mongolia
2003-04	Veneranda Mola	Nicolás Enrique	Mr.	Argentina
2003-04	Ahmed	Firoz Uddin	Mr.	Bangladesh
2003-04	Aman	Julia	Ms.	Bangladesh
2003-04	Ferdinand	Ajamah	Mr.	Cameroon
2003-04	Sanchez Contreras	Julio Rene	Mr.	Colombia
2003-04	Mitra	Indradip	Mr.	India
2003-04	Lawless	Richard	Mr.	Ireland
2003-04	Han	Seong-sook	Ms.	Korea
2003-04	Trinh Viet	Hieu	Ms.	Vietnam
2003-04	Sarran	Mathieu	Mr.	France
2003-04	Bröer	Torsten	Mr.	Germany
2003-04	Michel	Andreas	Mr.	Germany
2003-04	Bandlamudi	George-Chakravarthy	Mr.	India
2003-04	Joppich	Farida Damirovna	Ms.	Kyrgyzstan
2003-04	Dosmailov	Meirzhan A.	Mr.	Kazakhstan
2003-04	Possamai	Everson	Mr.	Brazil
2003-04	Palle Badalge	Iresha Somarathna	Mr.	Sri Lanka
2003-04	Bajracharya	Prashun Ratna	Mr.	Nepal
2003-04	Yandri	Erkata	Mr.	Indonesia
2004-06	Chowdhury	Mohammad Shahriar Ahmed	Mr.	Bangladesh
2004-06	Zobayer	A.N.M.	Mr.	Bangladesh
2004-06	Pena Diaz	Alfredo	Mr.	Colombia
2004-06	Toropov	Maksim	Mr.	Kyrgyzstan
2004-06	Sapkota	Prakash	Mr.	Nepal
2004-06	Aderinto	Suraju	Mr.	Nigeria
2004-06	Henriquez Prevoo	Christian	Mr.	Peru
2004-06	Limsoontorn	Tubtim	Ms.	Thailand
2004-06	Ochieng	David Otieno	Mr.	Kenya
2004-06	Akhtar	Naveed	Mr.	Pakistan
2004-06	Brudler	Evelyn	Ms.	Germany
2004-06	Hermann	Sebastian	Mr.	Germany
2004-06	Tek	Boon Jin	Mr.	Malaysia
2004-06	Moreno M.	Juan Carlos	Mr.	Venezuela
2005-07	Khan	Ahmed Jahir	Mr.	Bangladesh
2005-07	Boruah	Dwipen	Mr.	Indien
2005-07	Maharjan	Bhai Raja	Mr.	Nepal
2005-07	Vera Tudela Carreno	Luis Enrique Domingo	Mr.	Peru
2005-07	Caag Cabaces	Donnalyn Atienza	Ms.	Philippines
2005-07	Jagwe	Wyclif	Mr.	Uganda
2005-07	Mahu	Seth Agbeve	Mr.	Ghana
2005-07	Wickramarathne	Widana G. Hashini K.	Ms.	Sri Lanka
2005-07	Paula Chaves	Patricia Castello Branco	Ms.	Brasil

2005-07	Sanchez Herrera	Diego Alejandro	Mr.	Columbia
2005-07	Wilches Tamayo	Camilo Andres	Mr.	Colombia
2005-07	Beyn	Mulugeta Weldetnsae	Mr.	Eritrea
2005-07	Sterner	Michael	Mr.	Germany
2005-07	Hegel Pellecer	Rodolfo	Mr.	Guatemala
2005-07	Pechlivanoglou	Georgios	Mr.	Greece
2005-07	Peel	Andrew	Mr.	Canada
2005-07	Randig	Sebastian	Mr.	Germany
2005-07	Rojas	Carlos Mauricio	Mr.	Colombian
2005-07	Herráez Hernández	Iván	Mr.	Spain
2005-07	Torio Blanco	Herena	Mr.	Spain
2006-08	Khatun	Jorifa	Ms.	Bangladesh
2006-08	Khatiwora	Nar Bahadur	Mr.	Bhutan
2006-08	Vasconcellos	Marcelo de Lima	Mr.	Brazil
2006-08	Nafiri	Faraida	Ms.	Indonesia
2006-08	Lohani	Sunil Prasad	Mr.	Nepal
2006-08	Singh	Nanik	Mr.	Panama
2006-08	Mekki	Nada Mohamed	Ms.	Sudan
2006-08	Mwakatage	Edwin Sithole	Mr.	Tanzania
2006-08	Patschke	Erik	Mr.	Germany
2006-08	Türker	Burak	Mr.	Turkey
2006-08	McGraw	Sabin	Mr.	USA
2006-08	Wu	Caiyang	Ms.	China
2006-08	Zhang	Wendi	Ms.	China
2006-08	Kaklamanakis	Emmanouel	Mr.	Greek
2006-08	Surkute	Dnyanoba M.	Mr.	India
2006-08	Richert	Bodo	Mr.	Germany
2006-08	Karampela	Panagiota	Ms.	Greece
2007-09	Anwar Hossain	Mohammad	Mr.	Bangladesh
2007-09	Prakash K.C.	Chandra	Mr.	Nepal
2007-09	Nwaogaidu	Simeon Obinna	Mr.	Nigeria
2007-09	Elhadi Adam	Rania Mohammad	Ms.	Sudan
2007-09	Parinyacupt	Unchalee	Ms.	Thailand
2007-09	Mubbala	Ritah M.	Ms.	Uganda
2007-09	Cendrawati	Dian Galuh	Ms.	Indonesia
2007-09	Garcia da Fonseca	Leila	Ms.	Brazil
2007-09	Pabon Restrepo	Giovanni Andres	Mr.	Colombia
2007-09	Achibiri	Nnadozie Stanley	Mr.	Nigeria
2007-09	Potzmann	Silvia	Ms.	Austria
2007-09	Günther	Andreas	Mr.	Germany
2007-09	Bachtiar	Ibnu Kahfi	Mr.	Indonesia
2007-09	Millan	Rosiel	Ms.	Mexico
2007-09	Güner	Bedrettin	Mr.	Turkey
2007-09	Sandris	Georgios	Mr.	Greece
2008-10	Alcazar	Freddy	Mr.	Venezuela
2008-10	Binda Pereira	Mariana	Ms.	Brazil
2008-10	Butler	Blake Allan	Mr.	USA
2008-10	Chakanga	Kambulakwao	Ms.	Zambia
2008-10	Farmani Marzankalateh	Issa	Mr.	Iran
2008-10	Goepfert	Tyler	Mr.	USA
2008-10	Hossain	Md. Motaher	Mr.	Bangladesh
2008-10	Javed	Ahsan	Mr.	Pakistan
2008-10	Mahmud	Abdul Muhaimin	Mr.	Malaysia
2008-10	Njoka	Francis Namu	Mr.	Kenya
2008-10	Paradine	Martin D.	Mr.	Canada

2008-10	Pereira Santos	Rafael	Mr.	Brazil
2008-10	Semere Tesfaselasie	Russom	Mr.	Eritrea
2008-10	Shah	Adnan	Mr.	Bangladesh
2008-10	Tchiemogo	Hamadou	Mr.	Niger
2008-10	Temponeras	Dionysios	Mr.	Greece
2008-10	Thakuri	Sujit	Mr.	Nepal
2008-10	Ullrich	Cédric	Mr.	France
2008-10	Wannapin	Sirinya	Ms.	Thailand
2008-10	Agarwal	Ankur	Mr.	India
2009-11	Cuellar	Alberto	Mr.	Spain
2009-11	Al-Hammad	Hirak	Mr.	Bangladesh
2009-11	Arroyo Klein	Sebastián Allejandro	Mr.	Chile
2009-11	Brown	Nicholas	Mr.	USA
2009-11	Bussières	Frederic	Mr.	Canada
2009-11	Chhatbar	Kaushal	Mr.	India
2009-11	De Vecchi	Rafael	Mr.	Brasil
2009-11	Dola	Edwin Ochieng	Mr.	Kenya
2009-11	Gómez Padrón	María Gabriela	Ms.	Venezuela
2009-11	Hamzeh	Ahmad	Mr.	Palästina
2009-11	Ramon Suarez	Juan Luis	Mr.	Spain
2009-11	Martin Gomez	Juan Pablo	Mr.	Mexico
2009-11	Montealegre	Federico	Mr.	Costa Rica
2009-11	Montoya Rojas	Juan Pablo	Mr.	Venezuela
2009-11	Moreno Chiunti	Celia	Ms.	Mexico
2009-11	Ngoma	Daniel H.	Mr.	Tanzania
2009-11	Noureddine	Ibrahim	Mr.	Lebanon
2009-11	Rodriguez Sanchez	Diana Elisa	Ms.	Mexico
2009-11	Rudenko	Vladislav	Mr.	Russia
2009-11	Weldemicael	Yonas Tesfay	Mr.	Eritrea
2009-11	Wen	Chia Chia	Ms.	Taiwan

EUREC/REMA-students

Course	Family Name	1st Name	Tit.	Origin
2004/05	Aymard	Caroline	Ms.	France
2004/05	Thomas	Denis	Mr.	Belgium
2004/05	Lermitte	Tristan Eugene William	Mr.	UK
2004/05	Clauzonnier	Adrien	Mr.	France
2004/05	Ansell	Duncan Peter	Mr.	UK
2004/05	Adler Gomes Dacosta	João Paulo	Mr.	Portugual
2004/05	Lecesve	Laurent	Mr.	France
2004/05	Avraamides	Stelios	Mr.	Cypress
2004/05	Correia	Stélio	Mr.	Portugual
2004/05	Carrell	Justin	Mr.	UK
2004/05	Mantas	Panagiotis	Mr.	Greece
2004/05	Dimopoulos	Aris	Mr.	Greece
2004/05	Stromboni-Prevost	Estelle	Ms.	France
2004/05	Thiebaut	Romaric	Mr.	France
2005/06	Adnan	Mohammad	Ms.	Pakistan
2005/06	McCracken	Philippe	Ms.	Canada
2005/06	Xuereb	Steven	Ms.	Malta / Canada
2005/06	Lopez Alcala	Leodegario	Ms.	Mexico
2005/06	Sader	Hadi	Ms.	Lebanon
2005/06	Rouze	Jerome	Ms.	France

2005/06	Antonopoulos	Antonios	Ms.	Canada
2005/06	Polizois	Theodoros-Theodoritos	Ms.	Greece
2005/06	Gulliot	Bertrand	Ms.	France
2005/06	Montes De Oca Arjon	Luis	Ms.	Spain
2005/06	Singlehurst	Robert	Ms.	Canada
2006/07	Skarvelis-Kazakos	Spyros	Ms.	Greece
2006/07	Roycroft	Patrick (Paddy)	Ms.	Germany /Ireland
2006/07	Craig	Mark Kenton	Ms.	Canada
2006/07	Bennett	Valerie	Ms.	UK / Canada
2006/07	Perini	Leonardo	Ms.	Italy
2006/07	Di Lorenzo	Lisa	Ms.	Canada/Italy
2006/07	Martinez-Streignard Viana	Vanesa	Ms.	Venezuela
2006/07	Gil Zapata	Miguel	Ms.	Spain
2006/07	Edge	Tad Michael	Ms.	USA
2006/07	Troncoso Lago	Juan Antonio	Ms.	Spain
2006/07	Marques Malcato	Silvia	Ms.	Portugal
2006/07	Teksan	Yunus	Ms.	Turkey
2007/08	Tanguy	Yann	Mr.	France
2007/08	Chacon Calderon	Nancy	Ms.	Guatemala
2007/08	Del Cid Lemus	César Roberto	Mr.	Guatemala
2007/08	Townsend	Michael	Mr.	US
2007/08	Phillips	Ian	Mr.	US
2007/08	Veynandt	François Charles A.	Mr.	France
2007/08	Goy	Solène	Ms.	France
2007/08	Wong	Craig John	Mr.	US
2007/08	Baldus-Jeursen	Christopher	Mr.	Canada
2007/08	Cuddihy	Alan	Mr.	Ireland
2007/08	Paterakis	Petros	Mr.	Greece
2007/08	Qwen	Emma Louise	Ms.	UK
2007/08	Lynch	Mairead	Ms.	Ireland
2007/08	Gillard	Xavier	Ms.	France
2007/08	Manginas	Georgios	Ms.	Greece
2008/09	Adams	Brian	Ms.	USA
2008/09	Arapogianni	Athanasia	Ms.	Greece
2008/09	Chatzipanagi	Anatoli	Ms.	Greece
2008/09	Emmerich	Roy	Ms.	South Africa
2008/09	Gammoh	Omar	Ms.	Jordan
2008/09	Gkinis	Ioannis	Ms.	Greece
2008/09	Hernandez Rodriguez	Juan Esteban	Ms.	Columbia
2008/09	Kwapis	Elke	Ms.	Germany
2008/09	Loosen	Alex	Ms.	USA
2008/09	Perez	Miguel	Ms.	Venezuela
2008/09	Rojas	Sergio	Ms.	Costa Rica
2008/09	Teixeirinha	Patricia Alexandra	Ms.	Portugal
2008/09	Thomas	Jaimie	Ms.	Costa Rica
2009/10	Jalia	Aquil A	Mr.	India
2009/10	Konstantinos	Asproulakis	Mr.	Greece
2009/10	Adham	Atallah	Mr.	Lebanon
2009/10	Paola	Cadau	Ms.	Italy
2009/10	Andreea	Costache	Ms.	Romania
2009/10	Luis Felipe	Gonzalez Munoz	Mr.	Mexico
2009/10	Can	Ibrahimoglu	Mr.	Turkey
2009/10	Theodoros	Kotsonis	Mr.	Greece
2009/10	Pedro	Peno Gama	Mr.	Spain

2009/10	Giuseppe	Petrazzuolo	Mr.	Italy
2009/10	Sundus	Ramli C.	Ms.	Malaysia
2009/10	Etienne	Thomassin	Mr.	France
2009/10	Jose F.	Zuniga	Mr.	Mexico


DO YOU HAVE AN IDEA FOR YOUR PROJECT YET?
NO, I'M WAITING FOR INSPIRATION.
YOU CANT JUST TURN ON CREATIVITY LIKE A FAUCET. YOU HAVE TO BE IN THE RIGHT MOOD.
WHAT MOOD IS THAT?
LAST-MINUTE PANIC.

PPRE/EUREC-STUDENTS 2009/11