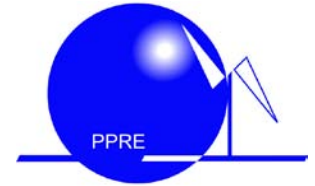


International Conference

01 – 02 October 2012



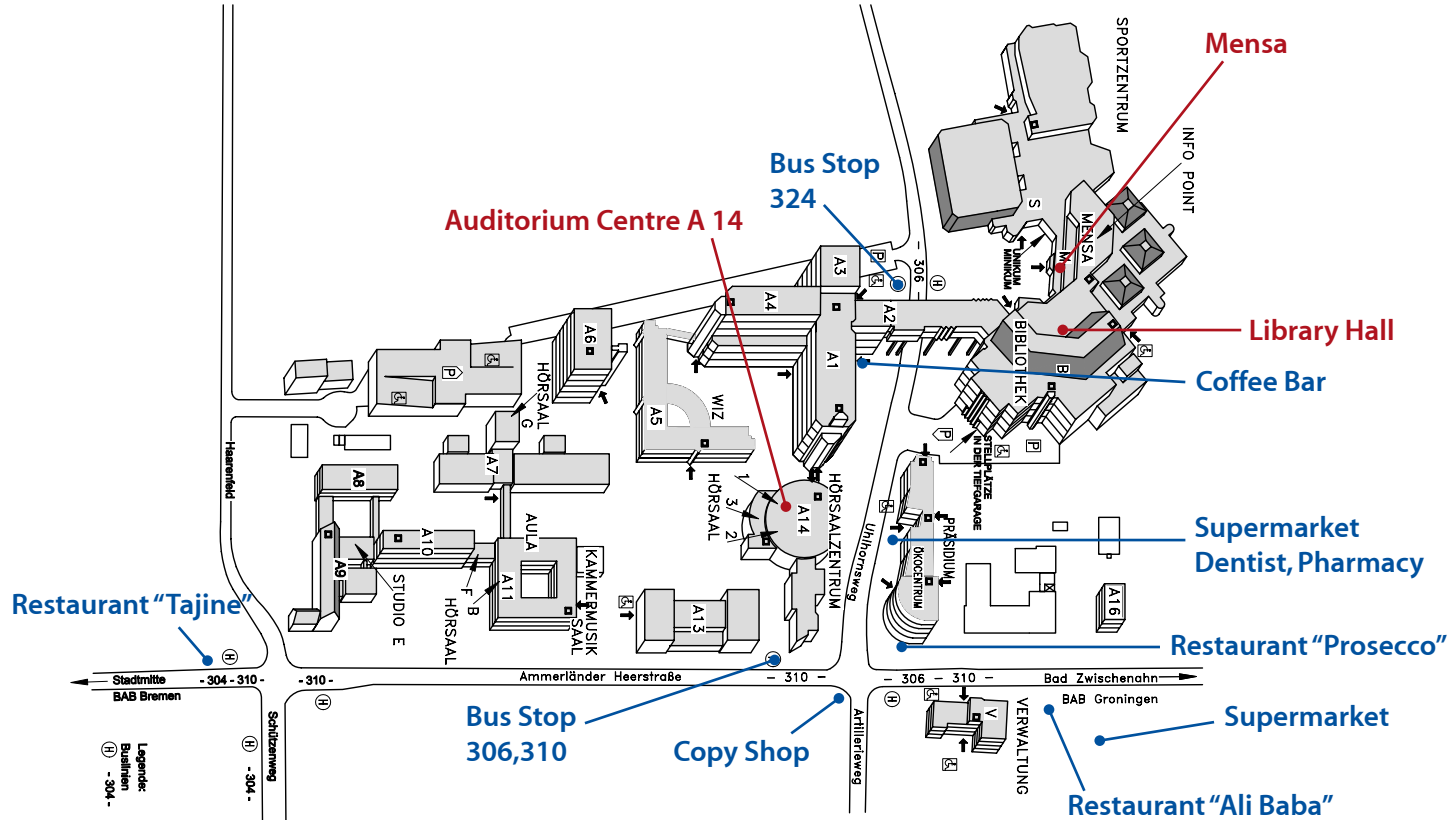
Renewable Energy 2030 – Experts' Visions

25th Anniversary of the Postgraduate Programme Renewable Energy (PPRE)

Conference Programme

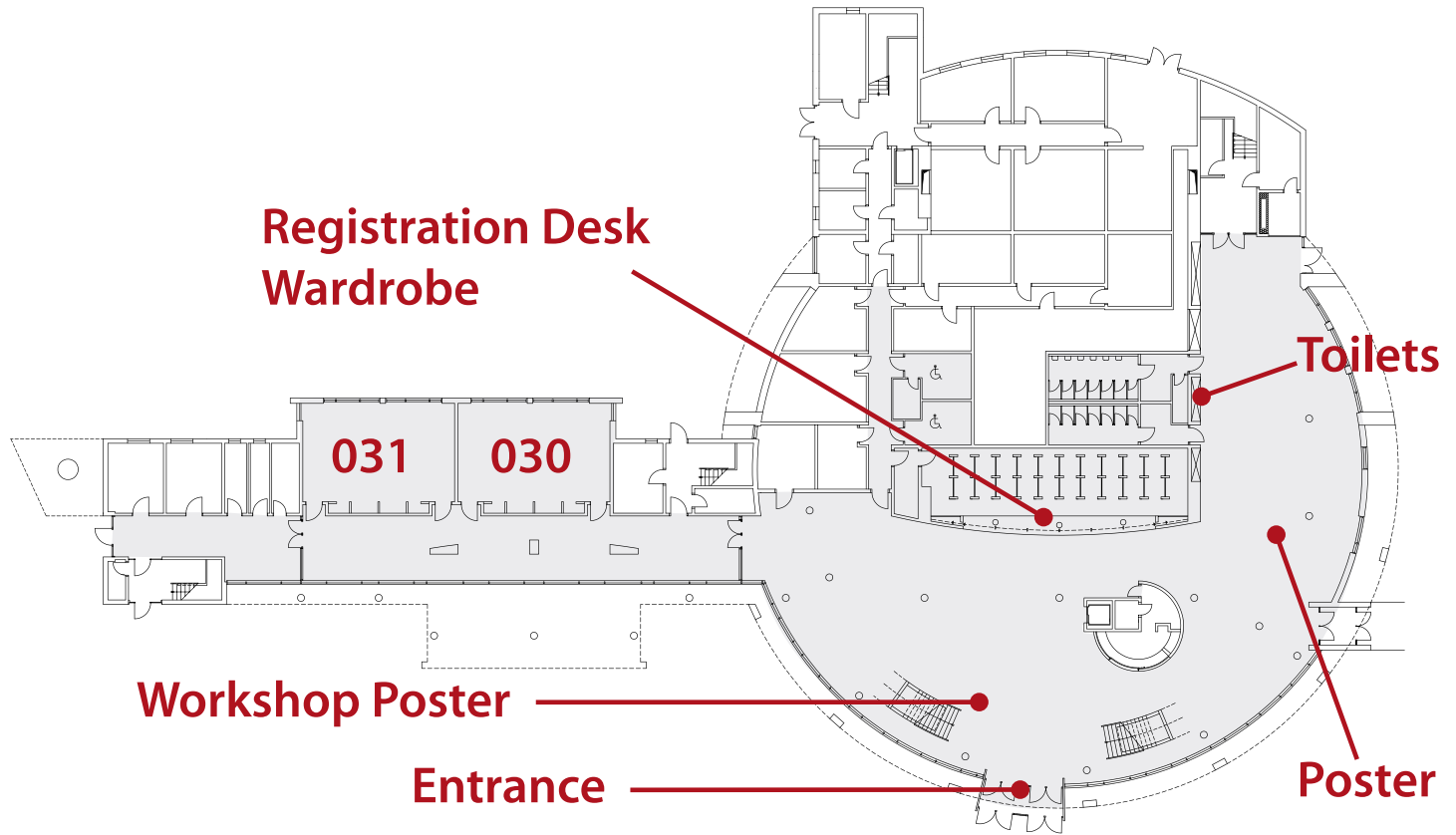
University of Oldenburg Campus Uhlhornsweg

For descriptions see page 12 – Facilities at the Conference Venue



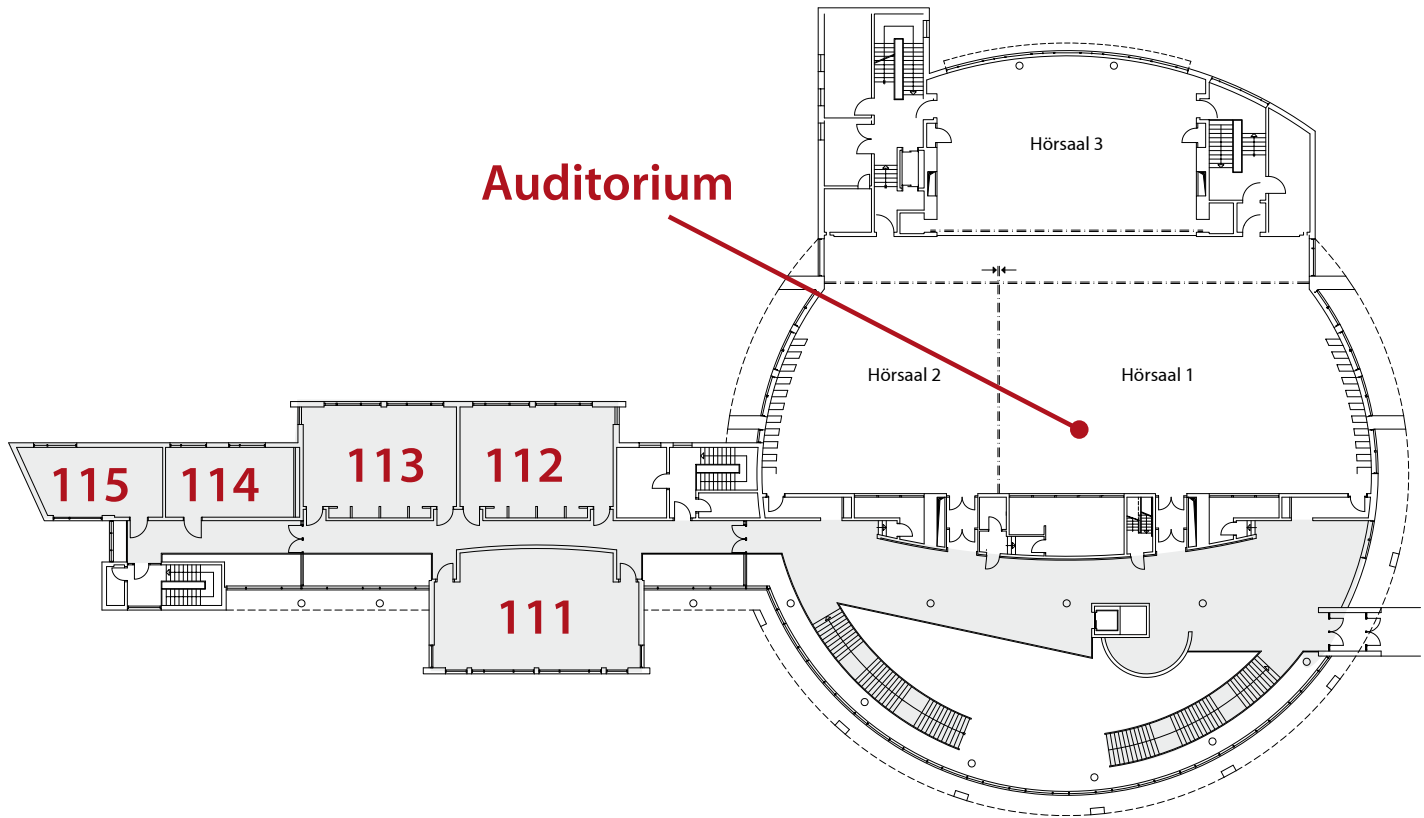
A 14 Ground Floor

For descriptions see page 12 – Facilities at the Conference Venue



A 14 First Floor

For descriptions see page 12 – Facilities at the Conference Venue



FIRST DAY - 01 OCTOBER 2012

8:30 am – 9:45 am	REGISTRATION	A14 - Foyer
10:00 am – 10:45 am	<p>CELEBRATION CEREMONY “25 YEARS OF PPRE”</p> <p>Welcome Addresses:</p> <p>Babette Simon, President, University of Oldenburg</p> <p>Ramesh Muthya, PPRE Alumnus, India</p> <p>Michael Golba, Managing Director, Postgraduate Programme Renewable Energy (PPRE)</p>	A14 - Auditorium
10:45 am – 12:30 pm	<p>KEYNOTE SPEECHES</p> <p>Joachim Luther, “Solar Energy - State of the Art” Former Head of Fraunhofer Institute for Solar Energy Systems, Freiburg (ISE, 1993 - 2006)</p> <p>Daniel Kammen, “Science, Technology and Policy to Achieve Universal Energy Access” Founding Director of the Renewable and Appropriate Energy Laboratory (RAEL)</p>	A14 - Auditorium
12:30 pm – 2:15 pm	LUNCH BREAK	
2:15 pm – 4:00 pm	<p>KEYNOTE SPEECHES</p> <p>Claudia Kemfert, “Economic Chances of a Smart Energy Transition” Head of the Department Energy, Transportation, Environment at the German Institute of Economic Research (DIW), Berlin</p> <p>Reinhard Loske, “Green Growth - A Realistic Promise?” International Climate and Energy Policy Advisor. Former Senator (State Minister) in the State of Bremen (2007 - 2011)</p>	A14 - Auditorium
4:00 pm – 4:30 pm	COFFEE BREAK / POSTER SESSION “REGIONAL CHALLENGES AND POSSIBLE SOLUTIONS FOR FUTURE ENERGY SUPPLY”	A14 - Foyer
4:30 pm – 5:00 pm	<p>INTRODUCTION TO PANEL DISCUSSION</p> <p>Binu Parthan, Energy and Environmental Advisor, India. Former Deputy Director General for the Renewable Energy and Energy Efficiency Partnership (REEEP)</p>	A14 - Auditorium
5:00 pm – 6:30 pm	<p>PANEL DISCUSSION: RENEWABLE ENERGY 2030 - EXPERTS’ VISIONS</p> <p>Moderation: Reto Weiler, Rector of Hanse-Wissenschaftskolleg - Institute for Advanced Study (HWK), Delmenhorst</p> <p>Participants: Joachim Luther, Daniel Kammen, Claudia Kemfert, Reinhard Loske, Binu Parthan</p>	A14 - Auditorium
7:00 pm – 10:00 pm	DINNER BUFFET	Library Hall

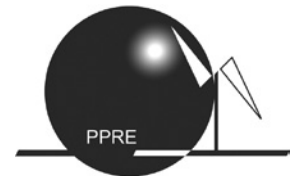
SECOND DAY - 02 OCTOBER 2012

8:30 am – 8:50 am	REGISTRATION				A14 - Foyer	
9:00 am – 9:30 am	WELCOME & INTRODUCTION TO THE SESSIONS Anil Kumar Misra , Indo-German Energy Programme, GIZ, India				A14 - Auditorium	
9:30 am – 10:45 am	PARALLEL SESSIONS					
	O1-1: Solar Energy A14 - 113	O2-1: Wind Energy A14 - 112	O3-1: Biomass Energy A14 - 030	W4-1: Workshop New Energy Lab A14 - 111		
10:45 am – 11:15 am	COFFEE BREAK / POSTER EXHIBITION					A14 - Foyer
	P1-1: Solar Energy	P2-1: Wind Energy	P3-1: Biomass Energy	P4-1: New Energy Lab		
11:15 am – 12:30 pm	PARALLEL SESSIONS					
	O1-2: Solar Energy A14 - 113	O2-2: Wind Energy A14 - 112	O3-2: Biomass Energy A14 - 030	W4-2: New Energy Lab A14 - 111		
12:30 pm – 2:00 pm	LUNCH BREAK					
2:00 pm – 3:15 pm	PARALLEL SESSIONS					
	O5-1: System Integration and Management A14 - 030	O6-1: Energy Policy and Economics A14 - 112	O7-1: Energy and Development A14 - 113	O8-1: Higher Education and Capacity Building A14 - 111		
3:15 pm – 3:45 pm	COFFEE BREAK / POSTER EXHIBITION					A14 - Foyer
	P5-1: System Integration and Management	P6-1: Energy Policy and Economics	P7-1: Energy and Development	P8-1: Higher Education and Capacity Building		
3:45 pm – 5:00 pm	PARALLEL SESSIONS					
	O5-2: System Integration and Management A14 - 030	O6-2: Energy Policy and Economics A14 - 112	O7-2: Energy and Development A14 - 113	O8-2: Higher Education and Capacity Building A14 - 111		
5:00pm – 6:00 pm	FEEDBACK & FAREWELL				A14 - AUDITORIUM	

International Conference

Renewable Energy 2030 – Experts' Visions
25th Anniversary of the Postgraduate Programme Renewable Energy (PPRE)

01 – 02 October 2012



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In 1987, when the Postgraduate Programme Renewable Energy (PPRE) was established, renewable energies were seen by many as something exotic. Those of us old enough to remember may recall how politicians, economists, society, and even science considered fossil fuels including nuclear energy to be the only tangible energy option. But what was then perhaps unimaginable is today reality:

where our energy comes from, and the entire energy industry for that matter, is undergoing an historical, foundational change. Renewable energies have now, in a very broad sense of the meaning, reached the mainstream of global society. Climate change and the Fukushima catastrophe have had a major impact in moving this process along, and it is clear that there will be no turning back.

Germany undoubtedly plays a leading role as we advance into a new energy era. More than 15 percent of Germany's electricity generation is now comprised of wind and solar energy. This is a result not least of all due to extensive efforts in the scientific realm. It is now, for example, possible to generate reliable predictions on the availability of these fluctuating sources of energy. This is a very important requirement for efficient energy generation and consumption. Science has also made key contributions to increasing the output of wind

and solar facilities. The field of renewable energy is not limited to the natural- or engineering sciences, but involves computer science ("smart grids") and economic sciences ("sustainability") as well.

Just as interdisciplinarity is an essential factor in these developments, internationality is also of key importance for renewable energies. In this respect, it is only logical that the many facets of research and application, coupled with the viewpoints of the various regions of the world, are presented and discussed at this conference.

The University of Oldenburg is the ideal setting for this event. We not only were one of the first institutions to be involved in the fields of renewable energy and environmental issues, but continue to pursue and perform outstanding research and teaching. I would like to wish all participants inspiring communication, instructive, productive experiences, extensive insights and the planting of seeds for new personal and professional contacts.

A handwritten signature in black ink, appearing to read "B. Simon".

Prof. Dr. Babette Simon
President, Carl von Ossietzky Universität Oldenburg

Lower Saxony Ministry for Science and Culture



The transition to a sustainable energy supply is a key challenge for research, industry and politics. Here, it is crucial to increase the contribution made by renewable energy, as well as significantly increasing energy efficiency. Also problems of system development, storage, acceptability and cost need to be resolved.

The field of renewable energy is therefore one of Lower Saxony's research policy strategic priorities. Lower Saxony's government has put together a package of measures which, in line with its energy policy goals, will support the pending restructuring of energy supply.

I am therefore very pleased that the University of Oldenburg has chosen this topic for its scientific event in honour of the 25th anniversary of the Postgraduate Programme Renewable Energy (PPRE). I would like to wish you all many interesting discussions and good results.

A handwritten signature in black ink, reading "Johanna Wanka".

Prof. Dr. Johanna Wanka
Lower Saxony Minister for Science and Culture

German Academic Exchange Service (DAAD)



Dear Participants of the PPRE's Anniversary Conference,
Dear Alumni,

Each year, more than 12.000 students from Latin America, Africa and Asia complete their studies at a German university, and many of them subsequently return to their home countries. Regardless of whether they were supported during their study or research stay by the DAAD, by other German funding or intermediary organisations, by their own governments, or even if they funded their studies themselves, and no matter whether they completed a full course of studies or spent only a semester in Germany – they are all alumni of German universities.

On behalf of the German Academic Exchange Service, it is my great pleasure and honour to greet you all on this truly memorable and joyful occasion – the 25th Anniversary of the Postgraduate Programme Renewable Energy of the University of Oldenburg.

This PPRE jubilee coincides with another anniversary: the DAAD's funding scheme "Development-Related Postgraduate Courses" celebrated its 25th birthday this year, too. Funded by the Ministry for Economic Cooperation and Development (BMZ), this DAAD programme supports a range of

postgraduate courses at German Universities in the fields of trade, business, industry, administration and science. What makes this especially worthy of mention is that PPRE has been an integral part(ner) of this funding scheme from the very beginning. The results speak for themselves. Since 1987, the DAAD has been able to provide more than 220 scholarships for young professionals from developing and emerging countries for PPRE.

Despite steadily increasing awareness of the need for Renewable Energy worldwide, we still have a long, hard path ahead of us to fulfill the Global Action Plan for the Proliferation of Renewable Energy. This is crucial, not only due to the dangers of climate change, but also in consideration of the imminent depletion of fossil fuels, the vulnerability of energy dependent societies and recent as well as future resource conflicts. Therefore, more than ever before, we need internationally educated experts and professionals who have been equipped with the necessary knowledge and know-how to deal with today's problems and who can make a contribution towards coping with them.

What we need, in other words, is people who have acquired valuable experience in various jobs, in various walks of life in their respective home countries. People who have made the effort to leave home, their job, their friends and social network, and in many cases their family, in order to expand their previous knowledge and qualify themselves further for

the challenges lying ahead of them. These are excellent reasons for the DAAD to support motivated young people from all over the world with scholarships for postgraduate studies.

However, the DAAD is just what we call an intermediary organisation. We don't do scientific research on wind energy, photovoltaics or biomass. We don't teach, we don't train. As an association of the German Institutions of Higher Education, this work is actually being done by our members, the German universities. For this reason, the academic teachers and supervisors of PPRE deserve sincere thanks for the work they have done, not only for designing and setting up this course but also for keeping it going and making it an international first class choice for postgraduate students.

No less important than the allocation of scholarships is the support of our universities for a wide variety of alumni activities, so that these alumni form long-term bonds with Germany and their former host universities. That's one reason why it is especially pleasing to see how many PPRE alumni have accepted their invitations to this anniversary conference and have participated with personal contributions and by bringing their own individual experiences into the professional discussions, making this event possible.

Many alumni of the University of Oldenburg's Postgraduate Programme Renewable Energy are working for companies. It is very important for them to remain networked with their

former host institution in Germany and German partners, both from other organizations and from the private sector, in order to ensure that joint projects are sustained over the long-term. We are convinced that alumni activities foster dialogue among all partners. Moreover, seminars for experts and continuing training, as well as the establishment of specialist alumni networks and alumni summer schools also serve to encourage and promote intensive exchange of information and experience among alumni and the revitalisation of old networks as well as the creation of new ones, as exemplified during the 2012 Alumni conference in Oldenburg.

We would like to encourage all alumni to keep in touch with each other, with your German university and with the DAAD. Publications like this make exchange beyond the borders of subjects and countries possible.

We are looking forward to continuing the successful cooperation.

With Best Wishes and Kind Regards,



Anke Stahl

Head of Section, Development-Related Postgraduate Courses, German Academic Exchange Service (DAAD)

Dear Participants,

it is a great pleasure and honour for us to welcome you to the Conference Renewable Energy 2030 – Experts' Visions at Carl von Ossietzky University. As you all know this is not an ordinary conference: The Postgraduate Programme Renewable Energy (PPRE) celebrates its 25th anniversary this year. So, in addition to the scientific event we want to get together and celebrate with our former students, colleagues, friends and all guests. There will be a lot of time and space to meet and re-meet, sometimes after many years, in order to talk and discuss, spend time with each other and – make new plans.

This conference, put under the theme 'Renewable Energy 2030', takes place against the background of an almost unimaginable increase in the importance of Renewable Energy over the last three decades. This applies to the implementation of Renewable Energy Technologies into the energy systems in all world regions, including ambitious electrification programmes, e.g. very prominently in China and Brazil. In Germany electricity generation from wind, solar, biomass and hydropower had already surpassed 20% in 2011. Currently there are well over 300.000 jobs directly related to Renewable Energy in Germany. Almost every German university offers at least some lectures related to Renewable Energy. An increasing number has established fully-fledged study programmes with different profiles attracting thousands of candidates: preferably at Master, but increasingly also at Ba-

achelor, PhD and professional training level. Research itself has diversified enormously, within its traditional areas and beyond its borders: Not only wind energy, photovoltaics and biomass have made a significant career in research and education but now also geothermal, tidal and wave energy. Renewable Energy is no longer restricted to a particular technique or to a particular scientific field: Physics, engineering sciences, chemistry, biology and mathematics but also economics and politics are involved. Furthermore, not only 'small is beautiful', but also the term 'big' becomes ever more related with Renewable Energy.. This development is now sufficiently advanced to reflect also the number and volume of international research calls and conferences including funding - addressing ever more Renewable Energy topics.

In conclusion, Renewable Energy has reached the main stream in almost all scientific disciplines of research and education and in all social systems of the world society.

With this in mind and given that PPRE since its establishment has trained its students in all major Renewable Energy Technologies, this conference will showcase different technologies (e.g. wind, photovoltaics, biomass, storage technologies, and energy meteorology) with its latest research achievements. In line with PPRE's international focus this conference will address opportunities as well as diverse approaches to implementing Renewable Energy from experiences in different

regions of the world, with a strong focus on the developing and emerging economies. Additionally there will be a focus on international Higher Education.

In order to discuss visions concerning Renewable Energy another 25 years ahead, it is not enough, however, to confine this conference to purely technical and educational aspects or solutions. This is why we were looking for key persons, representing distinctive perspectives on a future society and its energy systems. We are especially pleased to be able to have the professors Joachim Luther, Dan Kammen and Claudia Kemfert as well as Drs. Reinhard Loske and Binu Parthan with us. With their several years of international experience from distinguished scientific disciplines in various high-level positions they will share their visions with us, whilst focusing on the role of the energy systems of a future society. Their keynotes will be followed by a moderated panel discussion, which we are pleased will be moderated by Prof. Dr. Reto Weiler, Neurobiologist at the University of Oldenburg and rector of the Hanse-Wissenschaftskolleg. In this panel discussion we would explicitly like to stress the question of unlimi-

ted growth and do not want to stop at a critical discussion of the role of renewables. In future energy system's scenarios the renewables will - without any doubt - take a prominent role, but this – most likely – won't be sufficient enough to cope with the depletion of fossil fuels, the progressing climate change and the demand for access to modern forms of energy in all regions of the world. Therefore in future energy research and education have to look even more intensively for allies, within its disciplines, the universities and beyond.

In addition, there will be a workshop, to discuss and assess the chances and options of establishing a follow-up 'Energy Building' (Energielabor), for the hosting and representation of Renewable Energy education and research at Oldenburg University, involving additional actors in the field.

The conference reception and dinner will be held on Monday 1 October 2012.

We hope you will enjoy the conference and wish you an enjoyable and inspiring stay in Oldenburg with interesting discussions and meetings.

Jürgen Parisi
(Conference Chair)

Konrad Blum, Michael Golba, Edu Knagge
(Programme Committee)

Andreas Günther
(Conference Manager)

International Review Panel

All abstracts have been evaluated and graded independently by three members of our international review panel consisting of 19 reviewers. Abstracts have been allotted to reviewers within the respective thematic foci. Based on the grades

that we received for each abstract from our reviewers, we calculated an average grade for every abstract, and then ranked all abstracts accordingly.

PV Aravind, TU Delft, Netherlands

Konrad Blum, Universität Oldenburg, Germany

Evelyn Brudler, Universität Oldenburg, Germany

Mohammad Shahriar Chowdhury, United International University, Dhaka, Bangladesh

Michael Golba, Universität Oldenburg, Germany

Andreas Günther, Universität Oldenburg, Germany

Detlev Heinemann, Universität Oldenburg, Germany

Ivan Herraes, Universität Oldenburg, Germany

Hans Gerhard Holtorf, Universität Oldenburg, Germany

Edu Knagge, Universität Oldenburg, Germany

Indradip Mitra, GIZ, Chennai, India

Ekkehart Naumann, International Consultant, Vienna, Austria

Jörg Ohland, Universität Oldenburg, Germany

Juan Roberto Paredes, InterAmerican Development Bank, Washington, United States of America

George Pechlivanoglou, SMART BLADE GmbH, Berlin, Germany

Wolfgang Pfaffenberger, Jacobs University Bremen, Germany

Ingo Riedel, Universität Oldenburg, Germany

Godfrey Sibanda, Chinhoyi University of Technology, Zimbabwe

Tania Parveen Urmees, Murdoch University, Perth, Australia

Conference Team

Carl-von-Ossietzky Universität Oldenburg

Conference Chair

Jürgen Parisi, Germany

Conference Manager

Andreas Günther, Germany

Program Committee

Konrad Blum, Germany

Michael Golba, Germany

Edu Knagge, Germany

Organizing Team

Claudia Braden, Germany

Leonie Ibing, Germany

Julia Rudman, Germany

Juan Pablo Villa, Argentina

Student Volunteers

Alexandra Armeni, Greece

Madhumita Gogoi Gogoi, India

Cuauhtemoc Adrian Jimenez Martinez, Mexico

Ronald Ketter, Kenya

Mohamed Mamdouh Labib, Egypt

Diana Milena Morales Ardila, Colombia

José Luis Palacios E., Ecuador

Virginia Ruiz Albacete, Spain

Binita Shrestha, Nepal

Alexander Tsegai Wassie, Eritrea

Facilities at the Conference Venue

For the maps of the facilities, please see the cover pages of this booklet.

Venue

The conference will take place at the main auditorium building A14 at Uhlhornsweg 86, 26129 Oldenburg. If you follow Ammerländer Heerstrasse coming from the city centre the building can be found on the left hand side at the junction of Uhlhornsweg and Ammerländer Heerstrasse.

Registration

The conference starts with the registration on Monday, 1st October, from 8:30am to 9:45am at the Registration Desk of A14 (see Facilities). Every participant will receive a conference folder and a name badge. It will be possible to modify the name badge if necessary.

The conference folder contains the conference programme, an English version of the Mensa menu and a city map.

Room Plan

The conference rooms are located on the ground floor and first floor of A14 Auditorium Centre. The Celebration Ceremony, Keynotes and Panel Discussion on the first conference

day will all take place in the Auditorium. The Dinner Buffet in the evening will be in the Library Hall.

The second conference day will start with an Introduction in the Auditorium. The Parallel Presentation Sessions will take place in seminar rooms on the ground floor and first floor; see information on the cover page.

Printing and Copy Facilities

All papers will be available online via the conference administration system at <https://www.conftool.net/ppre2012/sessions.php>. We will not provide hardcopies of presented papers. Across the road from the main conference venue (building A14), at the corner of Ammerländer Heerstraße and Artillerieweg, you will find a Copy Shop that offers copying and printing facilities.

Other Facilities

In Uhlhornsweg, across the road from building A14, you will find an organic supermarket, a dentist and a pharmacy. In the vicinity of the University campus you will also find cafés, restaurants and supermarkets, as described below.

Please ask at the registration desk for more detailed information.

Meals and Drinks at the Conference Venue

There will be free coffee and tea during the coffee breaks of the conference. On Monday evening a sponsored welcome dinner will be held in the Library Hall. Non-sponsored meal times are to be paid for by the participants themselves.

Drink and food can be bought at the University's Mensa (cafeteria) or Coffee Bar. Both are open from 8.30am to 4pm. The closest supermarkets are the organic supermarket (Koopmann; open from 8.30am-7pm) opposite the A14 and Combi (Ammerländer Heerstr.122; open from 8am-10pm).

Lunch is available at the Mensa from 11.30am to 2pm. You can choose between different main courses and side dishes, which you can combine according to your preferences. An English version of the menu is included in the conference folder. Downstairs in the Mensa building, off to the left, there is a snack bar with a coffee machine.

There are also some restaurants in the vicinity of the university, e.g. proSecCo Café&Restaurant, Ali Baba and Tajine. Directions to these can be found on the cover page.

Dinner Buffet

In the evening of the first conference day, Monday, 1st October, starting from 7pm there will be an informal buffet in the Library Hall (see map for directions). We would like to invite you to join the evening reception.. This will be an ideal opportunity to get together with former colleagues and comrades, PPRE alumni and new students, to exchange memories and make new contacts.

Leonie Ibing (vocals) and Jonas Mosebach (piano) will provide the musical accompaniment for the evening with relaxing jazz, pop, R&B and soul music.

Hotels Oldenburg

Acara Hotel

Address:
Am Stadtmuseum 12
26121 Oldenburg

Phone: +49-441-20550

Website:
www.acara-hotel.de

Antares Hotel

Address:
Staugraben 8
26122 Oldenburg

Phone: +49-441-92250

Website:
www.antares-hotel.info

Hermes Hotel

Address:
Ankerstr. 19
26122 Oldenburg

Phone: +49-441-77939100

Website:
www.hermes-hotel-oldenburg.de

Etzhorner Krug

Address:
Butjadinger Straße 341
26125 Oldenburg

Phone: +49-441- 3616700

Website:
www.etzhornerkrug.de

Altera Hotel

Address:
Herbartgang 23
26122 Oldenburg

Phone: +49-441-219080

Website:
www.altera-hotels.de

CCH City Club Hotel

Address:
Europaplatz 4 – 6
26123 Oldenburg

Phone: +49-441-8080

Website:
www.cch-hotel.de

Hotel Alexander

Address:
Alexanderstr.107
26121 Oldenburg

Phone: +49-441-98020

Website:
www.alexander-hotel.info

Hotel Heide

Address:
Melkbrink 49-52
26121 Oldenburg

Phone: +49-441-8040

Website:
www.hotel-heide.bestwestern.de

Hotel Sprenz

Address:
Heiligengeiststrasse 15
26121 Oldenburg

Phone: +49-441-8008880

Website:
www.hotel-sprenz.de

Hotel Wieting

Address:
Damm 29
26135 Oldenburg

Phone: +49-441-92400

Website:
www.hotel-wieting.de

Zum Lindenhof

Address:
Bloherfelder Straße 210
26129 Oldenburg

Phone: +49-441-951910

Website:
www.zumlindenhof.de

Trend Hotel

Address:
Jürnweg 5
26215 Wiefelstede

Phone: +49-441-96110

Website:
www.trend-hotel-oldenburg.de

Tourist Hotel

Address:
Brokhauser Weg 11
26160 Bad Zwischenahn (in
Ofen, district of Oldenburg)

Phone: +49-441-69091

Website:
www.tourist-hotel.de

Youth Hostel

Address:
Alexanderstraße 65
26121 Oldenburg

Phone: +49-441-87135

Website:
www.oldenburg.jugendherbergen-nordwesten.de

Public Transport and Conference Transport

From Bremen Airport / Central Station to Oldenburg Central Station

Bremen Airport is situated just a few kilometres south of the city centre and offers daily flights to and from major hubs like Frankfurt, Amsterdam, Paris, London (Stansted) or Munich.

By Road

Coming from the Autobahn junction "Oldenburg-Ost" take the A28 to „Emden/Leer“. Leave the Autobahn on exit "Haarentor" and take a right turn into "Ammerländer Heerstraße" at the first traffic light. Follow the street for 800 meters and turn left into "Uhlhornsweg" at the second intersection. Parking facilities are available on the university campus.

By Train

(Deutsche Bahn, www.deutschebahn.com/en/start.html)

A valid train ticket from Bremen to Oldenburg can either be purchased on the Deutsche Bahn homepage in advance (print out before you go to Germany) or at the ticket machine at Bremen Airport.

Your stops are

FROM: Bremen Hbf
TO: Oldenburg (Oldb.)

This ticket will be valid in the whole regional public transportation network (including trams and buses in Bremen, the regional train connection between Bremen and Oldenburg, as well as buses in Oldenburg) on the according day.

From Bremen Airport the main railway station in Bremen (Bremen Hauptbahnhof) can be reached directly by tram no. 6 which stops just 50 meters from the airline check-in desks. At peak times the tram runs every 10 minutes.

Oldenburg offers national (Intercity and Intercity-Express trains) as well as regional train connections. Train connections to major German cities are quick, comfortable and run on an hourly basis: Berlin 3.5h, Hannover 1h, Hamburg 1h, Cologne 4h, Frankfurt 4h.

A suitable regional train from Bremen to Oldenburg runs hourly, starting from 00:15h up to 23:15.

Another suitable regional train (direction: Norddeich Mole) leaves Bremen towards Oldenburg every second hour starting from 6:45 until 22:54. Both trains take about 40 minutes.

For detailed information on your train departures please pay attention to the timetable at Bremen Central Station.

By Bus

(PublicExpress, www.publicexpress.de)

From Bremen Airport and Bremen Central Station there is a direct bus connection to Oldenburg Central Station and also to Oldenburg University (Campus Haarentor) three times a

day (see www.publicexpress.net/routes/aurich-bremen/timetable-aurich-bremen):

Central Station departure	6:30	9:45 (not on Sundays)	11:45 (not on Sun- days)	13:35	16:45	18:45	20:45	23:30
Airport departure	6:45	10:00	12:00	14:00	17:00	19:00	21:00	23:45
Arrival at Oldenburg Central Station	7:50	10:50	12:50	14:50	17:50	19:50	21:50	00:25
Arrival at Oldenburg University	8:00	11:00	13:00	15:00	18:00	20:00	22:00	00:35

From Oldenburg Central Station to Oldenburg University

By Bus

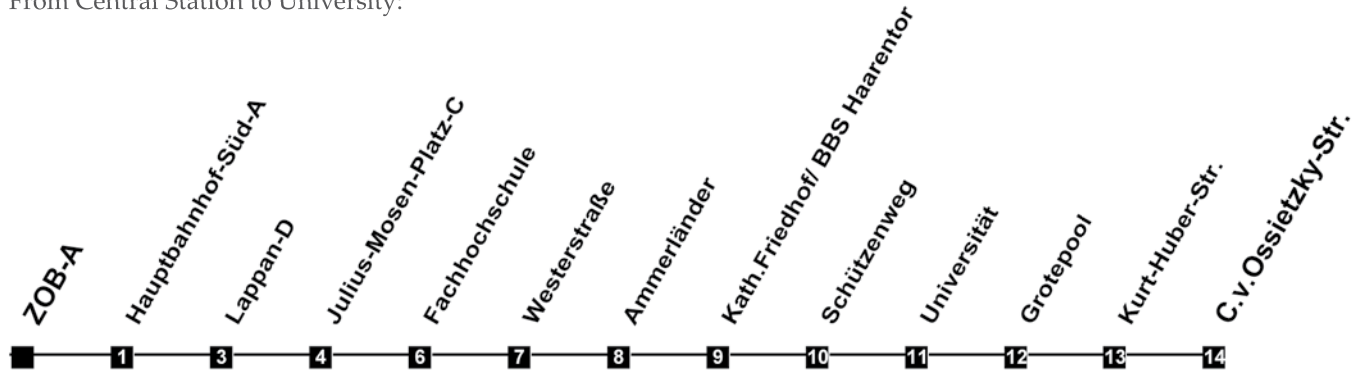
From Oldenburg Central Station (“ZOB” or “Hauptbahnhof”) there are two bus connections to the university, namely bus no. 306 heading for “Universität” and bus no. 310 heading for “Wehnen/Famila Center”. Passengers have to exit the bus at the station “Universität” to reach the university campus across the street. All buses from Oldenburg Central Station pass the city centre (“Lappan”).

From Your Hotel to Oldenburg University

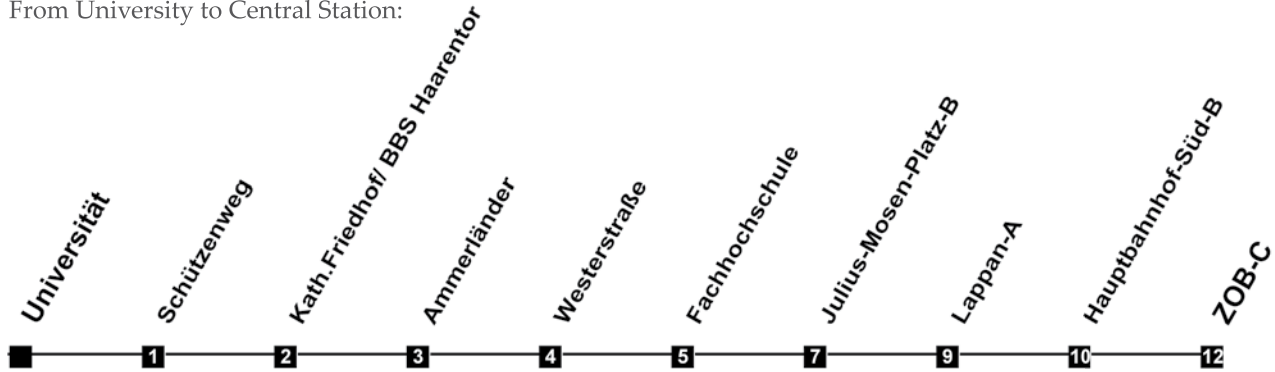
Detailed descriptions of how to get from your hotel to Oldenburg University and bus schedules are available on our website (<http://www.visions2030.uni-oldenburg.de/>). All buses in Oldenburg meet in the city center (“Lappan”) and at the Central Bus Terminal (“ZOB”) at Oldenburg Central Station. If you are not already in one of the lines 306 or 310 you will have to change here for bus no. 306 heading for “Universität” or bus no. 310 heading for “Wehnen/Famila Center”. As described above, bus stop “Universität” is the right one to exit in order to reach the university campus across the street. Guests staying at hotels in the city center may get on the bus (lines 306 or 310) at “Lappan” bus stop.

The following images shows the bus stations from ZOB towards university and from university towards ZOB. The numbers in the boxes indicate the time of the bus journey in minutes.

From Central Station to University:



From University to Central Station:





Deutscher Akademischer Austausch Dienst
German Academic Exchange Service

Change by Exchange – the German Academic Exchange Service

The German Academic Exchange Service (DAAD) is the largest funding organisation in the world supporting the international exchange of students and scholars. Since it was founded in 1925, more than 1.5 million scholars in Germany and abroad have received DAAD funding. It is a registered association and its members are German institutions of higher education and student bodies. Its activities go far beyond simply awarding grants and scholarships. The DAAD supports the internationalisation of German universities, promotes German studies and the German language abroad, assists developing countries in establishing effective universities and advises decision makers on matters of cultural, education and development policy.

Its budget is derived mainly from the federal funding for various ministries, primarily the German Federal Foreign Office, but also from the European Union and a number

of enterprises, organisations and foreign governments. Its head office is in Bonn, but the DAAD also has an office in the German capital, Berlin, to which the famous Berlin Artists-in-Residence Programme (Berliner Künstlerprogramm) is closely affiliated. It maintains contact with and provides advice to its main partner countries on every continent via a network of regional offices and information centres. The DAAD runs over 250 programmes, through which it funds about 70,000 German and foreign scholars worldwide per annum. These programmes range from semesters abroad for undergraduates to doctoral programmes, from internships to visiting lectureships, and from information-gathering visits to assisting with the establishment of new universities abroad. It supports the international activities of German institutions of higher education through marketing services, publications, the staging of events and training courses.

The DAAD's programmes have the following five strategic goals:

- to encourage outstanding young students and academics from abroad to come to Germany for study and research visits and, if possible, to maintain contact with them as partners life-long;
- to qualify young German researchers and professionals at the very best institutions around the world in a spirit of tolerance and openness;
- to promote the internationality and appeal of Germany's institutions of higher education;
- to support German language, literature and cultural studies at foreign universities;
- to assist developing countries in the southern hemisphere and reforming countries in the former Eastern Bloc in the establishment of effective higher education systems.

Further information is available under www.daad.de.



DAAD/Christian Lord Otto



**Niedersächsisches Ministerium
für Wissenschaft und Kultur**

The Ministry for Science and Culture of the Land of Lower Saxony

The Lower Saxon Ministry of Science and Culture is responsible for 21 higher education institutions and for numerous non-university research facilities and associations as well as the promotion of the regional culture and heritage conservation.

In cooperation with the higher education institutions, we are promoting the educational profile of Lower Saxony's higher education sector and the development of Bachelor and Master Degree courses. Moreover, the State is opening the universities for new target groups such as professionally qualified employees without higher education entrance qualification and is facilitating lifelong learning. As part of the Higher Education Agreement 2020, between the federal and the state government, up to 35,500 new places for first-time students should be created in Lower Saxony by 2015. Our aim is to

safeguard the future opportunities of the younger generation. At the same time we are helping to counteract the anticipated shortage of skilled workers.

Lower Saxony is set on strengthening research by focus on specialization, the development of innovative networks and the promotion of co-operations between science and industry. Future-oriented research groups are active, for example in the energy and climate sector, in the fields of health and recreation, agriculture and nutrition, mobility and logistics as well as education. There are also Clusters of Excellence, Collaborative Research Centres and Research Groups as well as Graduate Schools and Research Training Groups.

Since the establishment of the Niedersachsen Institutes of Technology (NTH) in 2009 the strategic focus and competitiveness of the Universities of Hannover, Braunschweig, and

Clausthal, is enhanced by cross-institution networking and profiling of common priorities in the natural sciences and engineering. The intention is to promote excellence in research and education in technical and scientific fields.

Culture in Lower Saxony includes theatres, heritage conservation, libraries and museums as well as visual arts, literature, music, community arts, art schools, cultural education of young people, scientific exchange with other countries, local heritage society and the promotion of local culture. Art and culture are important for people's sense of belonging and identification with their social environment and heritage. They also create jobs and have a positive impact on the innovative capability of society.

For further information please contact the press office:

Niedersächsische Ministerium für Wissenschaft und Kultur
Referat Presse- und Öffentlichkeitsarbeit

Leibnizufer 9, 30169 Hannover

Tel.: 0511/120-2599, Fax: 0511/120-2601

E-Mail: pressestelle@mwk.niedersachsen.de





The Hanse-Wissenschaftskolleg: Energy Research on an Advanced Level

The Hanse-Wissenschaftskolleg (HWK), an Institute for Advanced Study, is a non-profit foundation, incorporated under German civil law by the German federal states of Lower Saxony and Bremen and by the City of Delmenhorst. Its primary goal is to support and inspire excellent and innovative research in Germany and the World. It offers junior and senior scholars (Fellows) the opportunity to concentrate on research projects without the distraction of routine commitments and to gain insights from other disciplines and other scientific traditions. Fellows have the opportunity to cooperate with colleagues at neighboring universities (i.e. Bremen and Oldenburg) and research institutes in the region. This allows us to offer laboratory space for scientists from the natural sciences and to help strengthen the northwest region as a center for scientific research. Our art program “art in progress” is another important ingredient to the HWK as a place of interdisciplinary exchange and inspiration. Artists live together with scientists at the HWK and enrich the academic exchange through the presentation of their work and the personal exchange with other fellows. National and international conferences, invited seminars, summer or winter schools and lectures enhance the HWK’s profile. We bring top scientists from all over the world to Northwestern Germany for an intense and productive exchange of ideas

with regional partners. Detailed information about the HWK in general and the Fellowship application procedure can be found on the HWK website (www.h-w-k.de).

Research Profile

Four research areas define the interdisciplinary character of the HWK:

- Energy Research - Sustainability, Climate protection, Reliability – Challenges for the Energy Industry, Politics and Society
- Marine and Climate Research - Understanding the Anthropocene
- Neurosciences and Cognitive Sciences - Brain Worlds
- Social Sciences - Contested (Dis)Arrangements – Societies between Conflict and Cohesion

Energy Research at the HWK

Within its research area Energy Research, the HWK promotes, among others, projects addressing the following topics:

- Use of regenerative energies: higher efficiency, storage, distribution and grid integration
- Energy efficiency, intelligent grid management (electromo-

bility, supply-adjusted control of energy-hungry appliances, etc.)

- Theoretical and experimental investigations related to the concept of energy (particle and gravitation physics)
- Renewable energies and the environment: for example, effects of the exploitation of resources, material flow in wind energy, changes in the landscape
- New dependencies and geopolitical uncertainties through the expansion of regenerative energies?
- Correlations between demographic change and changes in energy requirements and supply structures
- Dealing with verified findings and with uncertainties in politics and society: communication of scientific results to the public

The HWK encourages past and future Fellows to introduce new topics into the institute and the research landscape of Northwestern Germany.

PPRE and the HWK

Since Energy Research was started at the HWK in 2010, the institute has cooperated closely with the PPRE program. Interdisciplinary seminars with political scientists and physicists, discussing the development of (renewable) energy world-wide, or a one-day course about "100% Renewable Energy in Europe – Let the Weather Decide" (concerned with building a model for an energy region) are just two examples. Fellows of the HWK participated in seminars or workshops with PPRE students, one of them Daniel Kamen from UC Berkeley, physicist and co-author of several

IPCC Reports on Climate Change. Plans exist for an intensified future cooperation involving more Fellows of the HWK and hosting seminars, schools etc. for PPRE students as well as students from other Oldenburg programs that deal with energy topics.

PPRE alumni and current students are invited to regard the HWK programs as an opportunity for continued involvement in excellent research, especially for projects in collaboration with colleagues in Oldenburg. Anyone interested in these opportunities, should contact the research manager for this area, Mr. Wolfgang Stenzel.

Wolfgang Stenzel

Hanse-Wissenschaftskolleg

Lehmkuhlenbusch 4

27753 Delmenhorst, Germany

Fon: +49 (0)4221 9160-103

E-Mail: wstenzel@h-w-k.de



Programme Information

Session Chairs

Session Chairs are requested to come to their respective room prior to the start of the session. They introduce the session and the speakers, make sure that the time available is divided equally between the papers to be presented, and guide the discussion with the audience. At the end of the presentation session, the chairs moderate the final discussion with a focus on the conference theme “Renewable Energy 2030 – Experts’ Visions”.

Presentations

In a typical presentation session of four papers, the average time available for each presentation is 20 minutes, leaving time for a short discussion afterwards. Each presentation session is divided into two parts with a coffee break in between for the poster session (details see below).

All session rooms will be equipped with a projector and a computer. Our default assumption is that you will use these for your PowerPoint or PDF presentation. The use of personal laptops is strongly discouraged. If you have special software needs, please contact the organisers.

Please come with the files required for your presentation on a flash memory key (USB stick) and avoid the use of file names like visions2030.ppt, as this may replace your colleagues’ presentation. Our student volunteers will be happy to help in case of difficulties.

Poster Sessions

The conference organisers see poster presentations as a very communicative form of presenting contributions and we would welcome a lively debate during the poster sessions. This booklet contains individual poster assignment numbers for each poster that corresponds with a poster board (see section “Parallel Sessions” from page 37). Please mount your poster next to your number.

There are two slots for poster sessions: Tuesday from 10.45am – 11.15am and 3.15pm – 3.45pm. Please attend the session that has been allocated to you.

Keynotes

Time Mon, 1 October 2012
Morning Session, 10:45 am – 12:30 pm
Afternoon Session, 2:15 pm – 4:00 pm
Panel Discussion, 5:00 pm – 6:30 pm

Location A14 - Auditorium

Joachim Luther

Solar Energy – State Of The Art

Daniel M. Kammen

Science, Technology And Policy To Achieve
Universal Energy Access

Claudia Kemfert

Economic Chances Of A Smart Energy
Transition

Reinhard Loske

Green Growth – A Realistic Promise?

Binu Parthan

Introduction To Panel Discussion

Reto Weiler

Moderation of Panel Discussion
“Renewable Energy 2030 – Experts’ Visions”

DANIEL M. KAMMEN



Daniel M. Kammen is the class of 1935 distinguished Professor in the Energy and Resources Group (ERG), in the Goldman School of Public Policy and IN Professor of Nuclear Engineering in the Department of Nuclear Engineering at the University of California, Berkeley. He is also the founding Director of the Renewable and Appropriate Energy Laboratory (RAEL).

Kammen received his undergraduate degree in physics from Cornell University (1984), and his masters and doctorate in physics from Harvard (1986 & 1988) for work on theoretical solid state physics and computational biophysics. Kammen received the 1993 21st Century Earth Award, recognizing contributions to rural development and environmental conservation from the Global Industrial and Policy Research Institute and Nihon Keizai Shimbun in Japan.

Dr. Kammen's research interests include: the science, engineering, management, and dissemination of renewable energy systems; health and environmental impacts of energy generation and use; rural resource management, including issues of gender and ethnicity; international R&D policy, climate change; and energy forecasting and risk analysis. He is the author of over 250 journal publications, a 10 books, including one

on environmental, technological, and health risks (Should We Risk It?, Princeton University Press) and numerous reports on renewable energy and development. He has been featured on radio, network and public broadcasting television and in print as an analyst of energy, environmental, and risk policy issues and current events. His recent work on energy R&D policy appeared in Science, and Environment, and has been featured on PBS, KQED, CNN, and in many newspapers via the Reuters news service.

Kammen is a member of the Intergovernmental Panel on Climate Change (Working Group III and the Special Report on Technology Transfer) that shared the 2007 Nobel Peace Prize. Dr. Kammen served as the inaugural chief technical specialist "The Clean Energy Czar" for the World Bank in 2010 - 2011, and is now the lead scholar of the Fulbright Nexus Program On Energy And Climate for the US State Department, where he also serves as an envoy for secretary of state Clinton in the Environment And Climate Partnership For The Americas (ECPA) Program.

Recently, the American Association for the Advancement of Science (AAAS) and Science Magazine published an online bio about Daniel Kammen (<http://membercentral.aaas.org/blogs/member-spotlight/dan-kammens-race-against-climate-change>).

Science, Technology And Policy To Achieve Universal Energy Access

Advances in energy and information technology are opening new opportunities for modern energy services to reach the 1.5 billion people today who lack access, and the additional one billion or more who have problematic access that is intermittent, unreliable or, too great a financial burden. This lack of access is a major impediment to sustainable economic growth, and has crippling health impacts in some cases. In this talk Prof. Kammen describes and argues for a coordinated approach to bring new clean energy options and opportunities to the global poor.

Related Papers:

Casillas and Kammen: The Energy-Poverty-Climate Nexus (Science, 2010)

Nakićenović, Kammen et al: Sustainable Energy For All, Task Force 2 Report (2012)

CLAUDIA KEMFERT



Prof. Dr. Claudia Kemfert is since 2009 Professor of Energy Economics and Sustainability at the private University, Hertie School of Governance, in Berlin and Head of the department Energy, Transportation, Environment at the German Institute of Economic Research (DIW Berlin) since April 2004. Her research activities concentrate on the evaluation of climate and energy policy strategies.

Claudia Kemfert advised EU president José Manuel Barroso in a „High level Group on Energy and Climate“. She was awarded in 2006 as top German Scientist from the German research foundation, Helmholtz and Leibniz Association. In 2011 she was awarded with the Urania Medaille as well as B.A.U.M. environmental award for best science.

For further information please have a look at Claudia Kemfert's website (<http://www.claudiakemfert.de/en.html>).

Economic Chances Of A Smart Energy Transition

Today's society faces major challenges like no other before. Fossil fuels such as oil, gas and coal are finite and produce on combustion dangerous greenhouse gas. The terrible disaster in Japan has led to a change in nuclear policy in Germany. The goal of the federal government to increase the share of renewable energies from 17 percent today to 80 percent over the next four decades is feasible in principle. However, the correct and courageous steps are to be taken. Not only the development of renewable energy is important, but at the same time the network has to be expanded significantly and, above all, significantly more electricity storage capacity has to be created. Gas power plants as an actual bridge technology are very well suited for coupling with renewable energy because of its flexibility and reduced climate impact.

The energy transition is technically feasible. But does it also make economic sense? Or does it completely isolate Germany? Will our society be threatened by a de-industrialization, do we have to live with blackouts and electricity price rises? And: who pays for this energy transition? Prof. Dr. Claudia Kemfert deals with these questions and underlines the economic chances which lie in a smart energy transition.

REINHARD LOSKE



Reinhard Loske now works as an International Climate and Energy Policy Advisor. In the five years prior to this he was Senator for Environment, Construction, Transport and European Affairs of the Free Hanseatic City of Bremen. His decision to leave this position was prompted by the ending of the legislature period. During the period 1998 to 2007 he carried out several functions as a Member of the German Parliament. 1992 to 1998 saw him working as an academic member of staff at the, then newly founded, Wuppertal Institute for Climate, Environment and Energy. Here he had the position of project manager for "Climate Policy" and head of the research group "Sustainable Germany". Through research visits to Africa and South America he gained a deeper insight into the links between the environmental and social issues. With his books and essays Reinhard Loske has influenced the debate on sustainable development in Germany and beyond. His commitment to linking economic and environmental issues, lead to him receiving the „Adam Smith Prize for Environmental Economic Policy“ from "Green Budget Germany" („Forum Ökologisch Soziale Marktwirtschaft“) in 2008. Reinhard Loske, with a doctorate in economics and habilitation in political sciences, is a self-confessed commuter

between the worlds of research and politics. Reinhard Loske grew up in Westphalia. Strong influences in his life were the involvement in his grandparent's farm as a child and adolescent and his commitment to conservation. He and his family now live in Bad Muenstereifel, North Rhine-Westphalia. Further information (in German) are available at Reinhard Loske's website (<http://www.loske.de/>).

Green Growth – A Realistic Promise?

There is no doubt that increasing energy efficiency and the share of renewable energies do not only contribute to climate protection but also have a lot of secondary benefits: from increased competitiveness on global future markets to job creation, from improved energy security to generating regional value added, from future cost savings (when fossil fuel prices continue to rise) to stimulating GDP growth. However, there are also „dark sides“ of this type of „green growth“: Rebound effects may eat up the gains in efficiency and renewables, so that CO2 emissions stay high. The resources needed for a 100% supply with renewables are also limited and may turn out to be bottlenecks. The philosophy of „ever more“ is not sustainable and the hope, that this may just continue by „greening the growth“ is an illusion. So my basic thesis is, that technological progress in energy technologies is needed, but it has to be embedded in a strategy of real sustainable development, including conservation, sufficiency and enoughness. Technological change has to be accompanied by cultural change, social innovations and lifestyle change.

BINU PARTHAN



Dr. Binu Parthan is an alumnus of PPRE and an independent energy and environmental advisor. Parthan has over 18 years of professional experience in financing, policy and technology aspects of clean energy and climate change. He was the Deputy Director General for the Renewable Energy and Energy Efficiency Partnership (REEEP) till mid-2012 and was also the executive director of IT Power

India, an international energy advisory company during 1997-2004. Parthan holds a Doctorate in Low-carbon Energy from the Technical University of Graz, Austria and Masters degree in Industrial-Mechanical engineering from the National Institute of Technology, Calicut, India and Masters degree in Renewable Energy from University of Oldenburg, Germany. His professional experience covers 14 countries including developing countries in Asia, Africa and Latin America. Parthan has also authored, co-authored or edited 7 books and authored/co-authored 21 publications and papers apart from 47 professional reports.

Introduction To Panel Discussion

Renewable Energy currently constitutes about 15% of the global energy mix and during the UN year of sustainable energy for all in 2012, the UN has set an objective of doubling the share of renewables to 30% by 2030. The panel will consider the opportunities and challenges of meeting this objective and offer their perspectives. In particular the experts will address questions around financing, technology, efficiency, trade and jobs offering their vision and perspectives.

During the introduction to the panel discussion Dr Parthan will also reflect on the key notes of the four speakers on solar energy, universal energy access, challenges of a clean energy transition and challenges associated with green growth. He will also add additional thoughts from a developing country perspective.

RETO WEILER

Moderation of Panel Discussion “Renewable Energy 2030 – Experts’ Visions”



Professor Reto Weiler is the Rector of the Hanse-Wissenschaftskolleg (Institute for Advanced Study, HWK) in Delmenhorst, where he in 2010 has started the HWK's youngest research area, Energy Research. At the same time he is, and has been since 1986, Professor for Neurobiology at the Carl von Ossietzky University in Oldenburg, where he besides many other duties has been Vice President for Research.

Recently, in August, 2012, he was appointed as vice-dean for the research focus Neurosensory Science at the newly founded European Medical School at the same university. Prof. Weiler is a member in several Scientific Advisory Boards. From 2004 until 2012 he belonged to the Neuroscience Panel of the Deutsche Forschungsgemeinschaft.

After undergraduate studies in Biology at the University of Zurich in Switzerland, he earned both his Ph.D. and the habilitation degree at the Ludwigs-Maximilians-Universität in Munich, where he also was Assistant Professor. His research brought him for longer stays to Pisa/Italy, Calgary/Canada, and, first as Visiting Professor and since 2002 as Honorary Professor to the University of Queensland in Brisbane/Australia. He has coordinated many research projects, for exam-

ple a Collaborative Research Center (SFB) and a Research Unit (DFG-Forschergruppe).

Reto Weiler's work was honoured by several awards and prizes, among them the Max Planck Research Prize (Germany, 1990), the International Research Award awarded by the National Research Council of Australia (1997), and the Boycott Prize from the Federation of American Societies for Experimental Biology (USA, 2012).

Prof. Weiler's research interests focus on the retina especially to contribute to the understanding of the functional architecture of the retinal network and the synaptic interactions which enable the retina to generate the elementary visual features. The complexity of the retinal network and its processing mechanisms can only be elucidated via a multi-method approach. Accordingly his lab's approach combines molecular, neuroanatomical and electrophysiological techniques.

Both within his own discipline, the neurosciences, and generally in academia, Prof. Weiler has always been very interested in new developments and interdisciplinary activities. He has supported new institutions and contributed his urge for knowledge and his talent to bring together representatives of very different disciplines.

O1 Solar Energy – Oral Presentations

Time Tue, 2 October 2012, 9:30 am – 12.30 pm

Location A14 - Room 113

Session Chair **Mohammad Shahriar Chowdhury**, United International University, Bangladesh
Jörg Ohland, Universität Oldenburg, Germany

Presentations

- **Mahshid Sam**, University of Victoria, Canada:
Capture the sun: Large-area ordered nanostructures for organic solar cells
- **Eugene Ernest van Dyk**, Nelson Mandela Metropolitan University, South Africa:
Development of Low Concentrator Photovoltaics Modules
- **Edison Guevara Bastidas**, WEI, École des Mines d'Albi:
Performance assesment of a linear Fresnel Reflector Collector Prototype
- **Ibrahim Khalil Odeh**, University of Jordan, Jordan:
Status, economic viability and investment prospects of large scale PV applications with a case study from Jordan

01-1:1 Capture the sun: Large-area ordered nanostructures for organic solar cells

Mahshid Sam, Alexandre G. Brolo, Rustom B. Bhiladvala

University of Victoria, Canada

Hybrid polymer-nanoparticle organic solar cells promise low cost, but currently have a low efficiency. These solar cells use a blend of polymer and nanoparticle phases, sandwiched between two electrodes. Some mechanisms for reduction of efficiency are the recombination of excitons before they reach the nanoparticle; some electrons not having a contiguous nanoparticle path to the electrode; and the material resistivity and contact resistance of nanoparticles. Replacing the disordered blend of nanoparticles by a forest of nanowires (NWs) grown out from the face of the photocathode can offset the efficiency loss, but light trapped by the nanowires without reaching the polymer will reduce conversion efficiency. An economical method of producing large-area arrays of suspended NWs, parallel to and clamped to the photocathode, at predetermined locations, may be expected to improve electron transport without loss of efficiency due to light trapped by NWs.

We present development of an inexpensive, bottom-up, directed-assembly technique to fabricate large-area position-controlled arrays of NWs of different materials, metallic or semiconductor, with different core and surface properties and with intimate contact to the photocathode. Such arrays would be expensive to make with top-down electron-beam lithography, which would also inhibit use of multiple mate-

rials. We synthesize gold, silver, silicon, rhodium and zinc oxide NWs with high aspect ratio by deposition in aluminum oxide templates. Field emission scanning electron microscopy showed a high-yield of wires over 10 μm long and 200-300 nm in diameter. One of the strongest advantages expected from this method for cell design would be an increased absorption of light incident in the space between the NWs. We show that it is possible to select the distance between the NWs, to seek the best balance between light trapping in the polymer and exciton transport to the NW acceptor.

01-1:2 Development of Low Concentrator Photovoltaics Modules

Eugene Ernest van Dyk (1); Blake Allan Butler (2); Ross Schultz (1); Jacques Gerber (1); Mario Benecke (1); Frederik Vorster (1)

1: Nelson Mandela Metropolitan University, South Africa; 2: Sacramento Municipal Utility District, USA

Low concentration photovoltaic (LCPV) systems have the potential to substantially reduce the levelised cost of electricity when compared to flat-plate photovoltaics (PV). The reduction in cost is realised by replacing expensive PV cells with cheaper optical components to concentrate incident solar irradiance onto a receiver by either reflection or refraction and by tracking the sun. CPV modules consist of three interrelated subsystems, viz., the optical, electrical and the thermal subsystems, which must be taken into consideration to ensure optimum module design and performance. Successful optimization of these subsystems requires the balancing of cost, performance and reliability. In the project on the development of LCPV systems at the Nelson Mandela Metropolitan University (NMMU) various prototype modules were designed, built and evaluated with respect to the three subsystems and overall performance. Initial studies were based on a faceted “V-trough” reflector design with the PV receiver in the bottom of the trough. Although low concentrations of 2.4X were easily achieved, higher concentrations were limited by the physical height of the trough. The initial studies also showed that passive thermal management and optimum electrical configuration of the PV receiver were also

achievable. Subsequent designs included the faceted reflectors with vertical or horizontal receivers configured to maintain a low module height-to-width ratio, but still increasing the concentration ratio. Design considerations for the optical subsystem include maximising the reflector aperture area to PV receiver area, while maintaining uniform illumination intensity across the solar cells. This paper will report on the various design considerations, discussing the optical and thermal models employed to achieve concentration ratios of the order of 5.3X. Results documenting the progress of the project in terms of concentration ratio achieved and LCPV module performance will also be presented.

O1-2:1 Performance Assessment of a Linear Fresnel Reflector Collector Prototype

Edison Guevara Bastidas

WEI, École des Mines d'Albi

Linear-Fresnel-Reflector technology is a promising option for the exploitation of the small and medium scale power generation sector, as it is less expensive than other concentrating technologies. However, low efficiency is a drawback that has to be improved. In the present work, a 3m² concentrator surface LFR collector prototype installed at the "École des Mines d'Albi-Carmaux" (France) is experimentally tested in order to assess its performance and identify design improvements. The sun tracking system is revised and improved. An equation-of-time-based sun position algorithm is substituted by a more accurate one, based on a simplified version of "The Astronomical Algorithms". Thanks to the new algorithm, calculation errors in sun altitude and azimuth angles are <0,01° and power losses of 30% are saved. After implementation, the accurate operation of the sun tracking system is validated. A theoretical approach, based on the geometrical optics of the prototype, is addressed to identify the parameters of the optical efficiency. A time-dependent factor is identified, which depends on the angle of incidence of direct solar radiation. Based on this, the optical efficiency is expected to vary between 0,17 and 0,31 depending on the angle of incidence. Performance tests are run to the collector. It is found an average power output of 510W at an average global ef-

iciency of 0,21. During the test's time span, the overall efficiency varies from 0,14 to 0,26 with a minimum at solar noon. The thermal efficiency is found to be $\geq 0,83$. The theoretical approach proved to be accurate. Improvement possibilities are highlighted: higher quality mirrors, better accuracy in the sun tracking system's driving mechanism and higher optical performance of the receiver. An output of 900W could be reached after the improvements.

O1-2:2 Status, economic viability and investment prospects of large scale PV applications with a case study from Jordan

Ibrahim Khalil Odeh

University of Jordan, Jordan

Economic viability of photovoltaic, diesel and grid connected water pumping systems is investigated and compared for system capacities in the range 1500 m⁴/day to 100,000 m⁴/day. Actual performance data from installed systems are considered in calculating systems outputs for base case scenarios. Sensitivity analysis is carried out to generalize results for other locations and conditions. Several scenarios of the effect of variation components prices, electricity tariffs, diesel fuel prices, operation cost and interest rate on the output water unit cost (US\$/1000m⁴) are investigated. Investment prospects in PV water pumping applications for different selling price scenarios of water have been investigated. A case study project for on grid PV electrification with different capacities of up to 1000 Megawatt is investigated. Investment prospects under different tariff scenarios is studied and demonstrated. Sensitivity analysis to generalize results for other locations and other conditions are analyzed

P1 Solar Energy – Poster Presentations

Time Tue, 2 October 2012, 10:45 am – 11.15 am

Location A14 - Foyer

Presentations

- **Ingo Riedel**, Universität Oldenburg, Germany:
Thin Film Photovoltaics R&D at the University of Oldenburg
- **Regina Nowak**, NEXT ENERGY, Germany:
Investigation on novel concepts for light management in thin film a-Si:H solar cells
- **Fernando Antunes**, Universidade Federal do Ceará, Brazil:
A Three-Phase DC-AC Converter to Apply in a New Concept of Photovoltaic System Connected to the Utility Grid
- **Murat Buyukcoskun**, Concentrator Optics GmbH, Germany:
Thermal Deformation Impacts on SOG Fresnel Lens Performance
- **Erkata Yandri**, Self-employed, Indonesia:
Cell by Cell Temperature Distribution of PV/T collector using Compact PV/T Simulator
- **Kudakwashe Munjeri**, University of Zimbabwe, Zimbabwe:
Selective Absorber for low cost Geyser

P1-1:1 Thin Film Photovoltaics R&D at the University of Oldenburg

Ingo Riedel

Carl von Ossietzky Universität Oldenburg, Germany

Since 2007 there is a rather new research group at the University of Oldenburg focusing the physics and material science of thin film solar cells. The group is embedded into the Energy and Semiconductor Research Laboratory (EHF) in the Department of Physics and is supported by the local energy provider EWE. The thin film section comprises 25 members with background in physics, chemistry and engineering. A large pool for analysis of thin film, interface and device characteristics as well as a cluster deposition system for automated fabrication of CIGS and CZTS thin film solar cells forms the infrastructural basis of our research activities. This contribution gives an overview on our current research activities in the field of thin film photovoltaic cells based on chalcopyrite and kesterite semiconductors. While the first part addresses the scientific scopes and analytical methods, the second part will highlight our collaboration with national industrial enterprises and research institutes and will highlight our strategy how we transfer fundamental science to commercial energy applications.

P1-1:2 Investigation on novel concepts for light management in thin film a-Si:H solar cells

Martin Theuring, Regina Nowak, Martin Vehse, Karsten von Maydell, Carsten Agert

NEXT ENERGY EWE-Forschungszentrum für Energietechnologie e. V., Germany

Light trapping due to rough interfaces is a common and industrially applied technique in amorphous silicon thin film solar cells. The induced scattering enhances the absorption and consequently the conversion efficiency of the device. There are several concepts to improve the light management beyond the standard transparent conductive oxide (TCO) structuring achieved by chemical wet etching. Here, we present the different approaches for light trapping, that are currently under investigation in our group. Conductive zinc oxide nanorod arrays can be grown in an electrochemical process. Their properties, such as the size and the array geometries, have a strong influence on the performance, when the nanorods are used as a light trapping mechanism in a solar cell. Using multidimensional simulations we optimize the rods' shape and distribution, which can be experimentally controlled by the fabrication conditions. In addition to the nanorod arrays, we investigate more symmetric geometries, such as one- and two-dimensional gratings. Periodic structures can lead to an improved light management

by utilizing their diffraction and mode guiding properties. A third technique to enhance the absorption capabilities of silicon thin film solar cells is to incorporate metal particles in the cell structure. Plasmonic effects arising from the interaction of photons with the metal electrons allow favorable light scattering in the absorber layers.

P1-1:3 A Three-Phase DC-AC Converter to Apply in a New Concept of Photovoltaic System Connected to the Utility Grid

Saulo Castro Ximenes, Fernando Antunes, Abnadan Martins

Universidade Federal do Ceará, Brazil

This work shows a study of a DC-AC converter with control of active and reactive power that will be inserted into a new grid-connected PV system proposal. The PV system proposal consists in photovoltaic panels supplying energy to a 311 Vdc bus with a battery bank on it and a three-phase inverter next. With a system like that it is possible to use several ways to provide power to a load connected to the 311 Vdc bus. When the production of power is over to the required by the load, part of this power is sold to the electric company. When the production is not enough to supply the load, the PV system requires power from the electric company. The reason why a 311 Vdc bus is adopted is because with that it is possible providing direct DC supply to several devices, avoiding power losses in additional stages of conversion. The DC-AC converter has a power of 2kW and will be connected to an utility grid of 380 V line. To make it possible to connect the DC-AC converter to the electric grid, we need an additional conversion stage to raise the voltage in a bus of 311 Vdc to 600 Vdc. This stage consists of a DC-DC converter which should allow the power flow in both directions and will have an output power of 2 kW. The obtaining of the transfer functions neces-

sary to design the controllers of the DC-AC converter will be developed considering the dq0 transformation or Park's transformation. Simulation results will validate the correct operation of the DC-AC converter and its precedent DC-DC conversion stage. In short, this article aims to study the DC-AC converter and its previous stage DC-DC.

P1-1:4 Thermal Deformation Impacts on SOG Fresnel Lens Performance

Murat Buyukcoskun, Hans Philipp Annen

Concentrator Optics GmbH, Germany

Silicone-on-Glass (SOG) Fresnel lenses are flat optical elements used in concentrating photovoltaics (CPV). SOG lenses are produced by casting silicone prisms onto a glass substrate. The casting process is done at elevated temperatures in order to shorten the curing time of the silicone. Due to the lower temperatures during operation or testing of the lenses, the differences between the thermal expansion coefficients for silicone and glass cause thermal deformation of the prisms which results in compromised optical efficiency. The possibility to simulate prism deformations using finite element simulation methods had been shown earlier. In this study, thermal induced deformation of SOG Fresnel lens prisms is analyzed by Surface Profile Measurement and Finite Element Analysis (FEA) methods. First, various curing temperatures are chosen within a range of 27-90 °C. Two identical SOG lens samples are manufactured for each curing temperature. Prism deformation on one sample set was examined by surface profile measurement method. An FEA was also run for study temperatures and results from both analyses were compared. In order to better observe patterns of thermal deformation and overall lens performance, the sec-

ond set of samples was subjected to an optical efficiency test. Focus quality (FQ) images were taken and observed in order to further analyze thermally affected lens performance. FEA results were also fed to optical ray-tracing software for comparison. The study is expected to contribute to knowledge on temperature induced performance determinants of SOG Fresnel lenses.

P1-1:5 Cell by Cell Temperature Distribution of PV/T collector using Compact PV/T Simulator

Erkata Yandri

Self-employed, Indonesia

Electricity and heat can be collected directly from sunlight, using a combination of the photovoltaic (PV) panel and the thermal collector, which is called hybrid photovoltaic and thermal collector, PV/T collector. With the increasing number of applications of PV/T collector, its total performance is very important. PV module temperature is a parameter that is often used to determine the performance of a PV panel or hybrid PV/T collector. In outdoor applications, PV module temperature usually is predicted by simply using the data given by the PV manufacturer and the local weather data. The problem is, with the ever-changing outdoor conditions, the PV or PV/T collector module will never reach the steady-state condition, causing wrong prediction of the PV module temperature. That is reason why we want to investigate the basic of PV module temperatures thorough its temperature distribution, in order to get more accurate prediction and also to understand the behavior of the PV/T system. In this research, we compare the thermal distribution of PV/T collector under electricity generation (PV on, called PV/T mode) and without electricity generation (PV off, called T-mode). For more intensive work and more controlled conditions, the

experiment has been done indoor during the steady state condition. For this purpose, we constructed a compact PV/T simulator, by combining mono-crystalline type PV cell and PVC type T absorber for PV/T collector, using halogen lamps as the light sources for the simulator. The data were collected by placing 32 measurement points in the middle position of each PV cell then the data recorded by a data logger with 30 seconds sampling time. As the result, quantitatively we found there is a significant difference of temperature distribution, which are $52^{\circ}\text{C} \pm 7.2^{\circ}\text{C}$ for PV/T-mode and $54^{\circ}\text{C} \pm 6.9^{\circ}\text{C}$ for the T-mode, quantitatively.

P1-1:6 Selective Absorber for low cost Geyser

Kudakwashe Munjeri, Louis Olumerkor

University of Zimbabwe, Zimbabwe

The electric geyser consumes more electricity than any other domestic appliance in any home. The conventional hot water system in Zimbabwe is based on the immersion type or the dry element type. In either case, the geyser may be responsible for 30-40% of the total monthly family electricity bill. As at now the monthly electricity may be considerably reduced by using solar absorber geysers. These geysers are however very expensive and not readily affordable. Most of the cheaper ones have rather poor efficiencies. This research shows that low cost efficient geysers could be constructed by using selective solar absorbers prepared by the sol-gel technique. Carbon-in-silica films were fabricated using sol-gel synthesis of silica and carbon precursor materials, followed by carbonization in an inert atmosphere. This was followed by mixing the synthesized carbon and silica in tetraethyl orthosilicate-only. The resultant was spin-coated on aluminium and steel substrates. 15 wt% acetic acid anhydride was added to the sol to reduce cracks in the film during the drying stages. The highest solar absorptance attained was 0.95 and the lowest emittance obtained was 0.1. An optimum performance of 0.88 for solar absorptance and 0.41 for thermal emittance has been achieved. These values are comparable to the specifications of commercially available solar absorbers.

The sol-gel technique of producing solar selective absorber surfaces is promising to compete favourably with other techniques, especially for its low cost of running and of initial investment.

O2 Wind Energy – Oral Presentations

Time Tue, 2 October 2012, 9:30 am – 12.30 pm

Location A14 - Room 112

Session Chair **George Pechlivanoglou**, SMART BLADE GmbH
Ivan Herraez, Carl von Ossietzky Universität Oldenburg, Germany

Presentations

- **Alexandra Pehlken**, COAST, Universität Oldenburg, Germany:
How critical is wind energy?
- **Ivan Herraez**, Universität Oldenburg, Germany:
Numerical Study on Boundary Layer Fences for the Enhancement of Wind Turbine Performance
- **George Pechlivanoglou**, SMART BLADE GmbH:
The path towards the future “Smart Wind Turbine” design
- **Hadi Sader**, Fichtner GmbH & Co. KG, Germany:
Geothermal wind turbine cooling

02-1:1 How critical is wind energy?

Alexandra Pehlken (1), Jorge Marx Gómez (2), Rosa García Sánchez (3)

1: COAST, Carl von Ossietzky Universität Oldenburg, Germany; 2: VLBA, Oldenburg University, Germany

3: Bremer Institut für Produktion und Logistik GmbH – BIBA

Wind energy is known as renewable energy which often correlates to sustainable energy supply. Recently the awareness of the public for components to construct wind turbines has risen. The majority of materials in wind turbines represents steel and concrete which are known for being available on long term and are even easy to recycle. Looking at material supply for the electronic part of the wind turbine we identify critical metals in the nacelle, respectively the generator. Besides the importance of the rare earth element “neodym” for gearless drive technology only few information is available for a detailed metal content in wind turbines. A similar picture is available by looking on the rotor blades. The percentage of rotor blade mass compare to the whole wind turbine is quite small (less than 2 mass %) but the costs represents about one quarter of the whole turbine costs. Additional the recycling of rotor blades is not solved at all. No producer responsibility applies to rotor blade producers since the technology is new and considered as sustainable technology. Only few information is available on rotor blade recycling while the mass of recycling mate-

rial is growing every day. The answer in Germany for rotor blade recycling is often: repowering. But can this be the solution for sustainability by looking just at the next user who is buying and running our old wind turbines? What is happening with the wind turbines after their second life cycle? The presentation will present a study on materials needed for an operating wind energy plant. We focus on materials availability in the future and highlight critical materials. The recycling possibility is also included in the full paper.

02-1:2 Numerical Study on Boundary Layer Fences for the Enhancement of Wind Turbine Performance

Ivan Herraez (1), Bernhard Stoevesandt (2), Joachim Peinke (1)

1: Carl von Ossietzky Universität Oldenburg, Germany

2: Fraunhofer IWES, Institute for Wind Energy and Energy System Technology, Oldenburg

3: Bremer Institut für Produktion und Logistik GmbH – BIBA

The blade root region of wind turbines must withstand constantly high fluctuating loads. For this reason, it is usually designed focusing on structural performance. This presents the disadvantage that the resulting aerodynamic characteristics are often very poor. Furthermore, the blade root operates most of the time at high angles of attack. As a consequence, flow separation on the blade root occurs during most of the turbine operating time. The separated flow typically travels outwards in the spanwise direction because of centrifugal forces. In this way, outer regions of the blade are also affected by the flow separation taking place initially in the root region. The overall aerodynamic performance of the rotor is therefore negatively affected. One solution for avoiding this problem is the use of Boundary Layer Fences (BLF). These devices are flat plates mounted on the suction side of the blade in the airflow direction and their purpose is to mitigate radial flows. In this work, a detailed investigation on BLF is carried out by means of Computational Fluid Dynamics (CFD) simulations. The simulations, which rely on

the steady-state and transient Reynolds Averaged Numerical Simulation (RANS) method are carried out with the open source numerical toolbox OpenFOAM. In an initial stage of this project, a simulation model of a wind turbine rotor without BLF has been extensively validated against measurements from the MEXICO wind turbine. The complex 3-dimensional radial flow pattern has been satisfactorily predicted by the simulations. The simulation model has then been extended to include BLF on the blades. Several configurations of BLF including different sizes, positions and number of these devices have been considered and analysed. The results demonstrate that, although an increase in the energy yield is possible, much care must be put into the BLF design in order to achieve the aimed performance improvement.

02-2:1 The path towards the future “Smart Wind Turbine” design

George Pechlivanoglou

SMART BLADE GmbH, Hermann Foettinger Institute TU Berlin

Wind turbines are being constantly developed with a rapid increase in size and capacity. The continuous upscaling however leads to significant design, manufacturing, transportation and operation problems. Some of the largest and most heavily loaded components of wind turbines such as the blades are at the limits of their material and design properties. Current large wind turbine blades, bearings and other components suffer from extreme and fatigue loads, stochastic turbulence loads, tower shadow effects e.t.c. At the same time the existing wind turbine designs and control systems are not able to provide optimal load and power management, therefore new concepts are developed in this field. Active flow control (AFC) solutions are consequently becoming very attractive since they can offer detailed and fast aerodynamic response. Innovative wind turbine controller concepts are also a part of the new exciting development process. The focus of the current presentation is initially to pinpoint the current problems of wind turbine design with respect to upscaling and reliability. Furthermore the work of the presenter and others around the world in the field of innovative wind turbine design will be briefly described. The

implementation of new load management techniques, innovative wind turbine components and new trends in wind turbine design and simulation tools will be discussed. The outcome of the talk is the description of the future of wind turbine design with respect to the new generation of multi Megawatt turbines.

02-2:2 Geothermal wind turbine cooling

George Pechlivanoglou (1), Hadi Sader (2)

1: Smart Blade GmbH; 2: Fichtner GmbH & Co. KG, Germany

Even though the main components of a wind turbine have a relatively high efficiency, they dissipate a part of the energy into heat. The heat is a small fraction of the produced energy but with modern multi megawatt machines a substantial amount of heat has to be dissipated through the cooling system of the wind turbine. As it becomes more common to place the transformer inside the tower of the turbine, its cooling adds up to generator and gearbox in the cooling cycle of the turbine. Driving a big volume of air with ambient temperature through the tower and the nacelle brings with it dust and particles from the outside and possibly sand and salt which could be harmful for the components placed there. On the other hand and especially in warmer regions, the high ambient temperature makes the air cooling system less efficient and the needed flow of air even bigger. In this paper the possibility of cooling wind turbines with the help of a geothermal loop will be discussed. The focus will be on having a closed liquid cooling circuit for the turbine that benefits from the relatively constant temperatures underground and avoiding using polluted air. Technical solutions for such a cooling system will be dis-

cussed and their technical and economical feasibility judged. The technical potential of this solution is to influence the design methodology of wind turbines and their components and to potentially provide alternative uses for the recovered waste heat. The economic benefits include the extended lifetime of the components due to high quality cooling and no contamination/corrosion due to air inlets. Furthermore the “waste heat” of the turbine can be used locally for separate low temperature processes thus adding to the total revenue of wind turbines. Possible applications are also presented in the current paper.

P2 Wind Energy – Poster Presentations

Time Tue, 2 October 2012, 10:45 am – 11.15 am

Location A14 - Foyer

Presentations

- **Stanislav Rockel**, Universität Oldenburg, Germany:
Impact of turbulent inflow on a model wind turbine
- **Hendrik Heißelmann**, ForWind - Universität Oldenburg, Germany:
New anemometers for 2D wind measurements on different scales
- **Joaquim Eloir Rocha**, Universidade Tecnológica Federal do Paraná, Brazil:
The Energy Processing by Power Electronics and its Impact on Power Quality
- **George Pechlivanoglou**, SMART BLADE GmbH, Germany:
QBlade: OpenSource Horizontal and Vertical Axis Wind turbine Design and Simulation

P2-1:1 Impact of turbulent inflow on a model wind turbine

Stanislav Rockel, Joachim Peinke, Michael Hölling

Carl von Ossietzky Universität Oldenburg, Germany

Investigations on full scale wind turbines are very costly and the boundary conditions in field experiments are hard to capture and impossible to control. Wind tunnel experiments are very economical and can be carried out under defined and reproducible conditions, although they suffer from scaling problems. A model wind turbine was developed to perform wind tunnel experiments under different wind conditions to gain insight about its dynamical behavior. The model experiment was designed to obtain the mechanical power of the turbine by measurements of the applied torque and rotational frequency. The advantage over electrical power measurements is that the influence of electrical and frictional losses can be minimized. For the torque measurement a sensor based on strain gauges was developed. The rotational frequency is given by a magnetic encoder which delivers 400 pulses per revolution. In experiments the turbine is operated under laminar and different turbulent inflow conditions. While a classical square grid generates wind fields with a Gaussian distribution of wind velocities, a fractal grid was used to mimic the highly intermittent velocity distribution which is usually found in atmospheric wind fields. In the present work, the impact of different inflow conditions on the performance of the model wind turbine is in-

vestigated. In particular the influence of turbulence intensity and intermittency on physical quantities such as torque and rotational frequency is shown.

P2-1:2 New anemometers for 2D wind measurements on different scales

Hendrik Heißelmann, Jaroslaw Puczyłowski, Joachim Peinke, Michael Hölling

ForWind / Carl von Ossietzky Universität Oldenburg, Germany

Experimental investigations of turbulent atmospheric flows are an essential tool for the characterization of atmospheric turbulence and the validation of simulations in wind energy and meteorology. Therefore, highly resolving and robust sensors are needed for multi-dimensional measurements on different length scales. We present two new drag-based sensors developed at the University of Oldenburg, which make use of the laser pointer principle also known from atomic force microscopy. This technique allows for the detection of small displacements of the active parts of the sensor and thus enables a high temporal resolution. Both anemometers use a laser in combination with a two-dimensional position sensitive detector (2D PSD) to detect the deflection of a tiny cantilever in case of the atmospheric 2D Laser-Cantilever-Anemometer (2D ALCA) and the deflection of a sphere in case of the Sphere Anemometer, respectively. The 2D ALCA was developed to perform two-dimensional measurements of atmospheric flows on small scales. The spatial resolution of the 2D ALCA is given by the cantilever dimensions of 0.4mm x 1.5mm (width x length) and the sensitive measurement method allows for a temporal resolution in the order of a few kHz. We present data acquired in turbulent laboratory flow as well as under atmospheric flow condi-

tions and compare it to data from commercial anemometers. As larger spatial and temporal scales are of interest for wind energy applications, the standard sensors are cup and sonic anemometers. Since they suffer from several problems, the new Sphere Anemometer was designed as an alternative sensor for simultaneous two-dimensional measurements of turbulent atmospheric flows on a time scale of about 15ms and a spatial scale of several cm. We present comparative measurements in atmospheric flows performed with Sphere Anemometer, cup anemometer and sonic anemometers. Results show the Sphere Anemometer's ability to compete with the standard sensors in wind energy.

P2-1:3 The Energy Processing by Power Electronics and its Impact on Power Quality

Joaquim Eloir Rocha, Walter Denis Cruz Sanchez

Universidade Tecnológica Federal do Paraná, Brazil

The paper discusses the electrical architectures adopted in wind turbines and its impact on the harmonic flux at the connected electric network. The integration of wind electric generators with the power grid needs energy processing by power electronics. It shows that different types of wind turbine generator systems use different types of electronic converters.

This work provides a discussion on harmonic distortion taking place on the generator side, as well as in the power grid side. The contribution deals with the analysis of power quality parameters of grid connected wind energy converters based on different types of electronic converters. Power quality parameters such as harmonics and interharmonics are analyzed.

P2-1:4 QBlade: OpenSource Horizontal and Vertical Axis Wind turbine Design and Simulation

Juliane Wendler (1), David Marten (1), George Pechlivanoglou (1,2), Christian Navid Nayeri (1), Christian Oliver Paschereit (1)

1: Hermann Föttinger Institute, TU Berlin, Germany; 2: SMART BLADE GmbH, Germany

The current paper presents an OpenSource wind turbine blade design and performance simulation and analysis platform. The QBlade platform is being developed at the Technical University of Berlin (Hermann Föttinger Institute - Wind Energy Research Group). This modular platform is developed within the Qt programming environment and it also incorporates the functionality of successful OpenSource software codes. The versatile and very accurate airfoil design and simulation code XFOIL or M. Drela is incorporated in the QBlade platform. This allows for a simple and quite accurate airfoil performance simulation. Additionally several 360° AoA airfoil polar extrapolation methodologies are implemented (e.g. Viterna and Montgomerie) in order to assist the user with an efficient wind turbine blade design. The blade design module incorporates several features from the successful aircraft design and simulation XFLR5 platform in addition to several blade design and shape optimization routines. It is worth mentioning that custom blade optimization routines are implemented for HAWTs as well as for VAWTs. A 3D OpenGL visualization window and powerful blade export functions allow the designer to visualize the designs and export them for manufacturing.

The turbine simulation is accomplished by a Blade Element Momentum Theory (BEM) algorithm for horizontal axis wind turbines and a double-multiple-stream-tube (DMS) algorithm for vertical axis wind turbines. Tip and Root loss corrections are applied in both cases as well as Glauert corrections for turbulent wake state. The versatile turbine simulation module, allows the simulation of an actual wind turbine, including gearbox and generator losses, variable speed controller as well as blade pitch. Finally a multi-parameter simulation module allows the simulation of all the turbine operational envelope. This feature is very useful for the development of custom controller strategies and for the investigation of the turbine characteristics in several operation states.

O3 Biomass Energy – Oral Presentations

Time Tue, 2 October 2012, 9:30 am – 12.30 pm

Location A14 - Room 030

Session Chair **Godfrey Sibanda**, Chinhoyi University of Technology, Zimbabwe
Konrad Blum, Universität Oldenburg, Germany

Presentations

- **Mathias Augustus Leon**, University of Guelph, Canada:
Biomass Upgrading by Torrefaction for Energy Use: A Market Perspective
- **Udo Kulschewski**, Universität Oldenburg, Germany:
Physical properties of Anaerobic Slurry
- **Godfrey Sibanda**, Chinhoyi University of Technology, Zimbabwe:
A feasibility study of biogas technology in solving sanitation problems in peri urban suburbs, a case study of Harare
- **Laurent Lecesve**, HyES - Hybrid energies & Eco-Systèmes, France:
Spirulina & biogas Integrated Eco-System, a sustainable solution to combine food and energy to supply European needs

03-1:1 Biomass Upgrading by Torrefaction for Energy Use: A Market Perspective

Mathias Augustus Leon

University of Guelph, Canada

Biomass is a promising source of sustainable, carbon-neutral energy for the post-fossil fuel era. Although abundant and renewable, the combustion properties of biomass pose several challenges during the thermal conversion process, limiting its use as a co-firing fuel in power plants. Torrefaction is known to address most of these challenges to a reasonable extent. It is a thermal pre-treatment process that enhances the thermo-chemical properties of biomass in terms of energy density, hydrophobicity and grindability, thus enabling the torrefied biomass to be used as a regular fuel in power plants, like coal. While several studies have been conducted on biomass torrefaction, most of them have focused on lab-scale analyses of biomass composition and characterization of torrefied biomass in terms of calorific value and grindability. Only a few have examined the feasibility of using torrefied biomass for commercial energy use applications. This study presents an overview of the market perspective on the torrefaction technology, and discusses the recent developments in the commercialization efforts. The various designs of tor-

refaction systems commercially available are discussed, and their pros and cons analyzed. From the study, it can be observed that torrefaction technology is still in the early stages of market development, and is yet to establish itself as a viable commercial option for large-scale deployment.

03-1:2 Physical properties of Anaerobic Slurry

Udo Kulschewski

Carl von Ossietzky Universität Oldenburg, Germany

The situation inside operating biodigesters is largely unknown: flow and mixing pattern, possible short-cuts, stratification of material, chemical transformations, even the temperature profile. This is certainly due to the difficulties in accessing the reactor volume and in procuring samples from across. Biochemical analysis of a multitude of samples with respect to a yet ill defined (larger) set of variables need a lot of time, well equipped laboratories and experience, to determine small differences. For a dynamical picture of the proceedings one would need to take samples at short intervals while the extraction every time disturbs the reactor content. Sensors which yield specific parameters in a liquid are rare, costly and often even not applicable in these anaerobic conditions (e.g. pH-meters or dissolved gas sensors). The other way round, one could ask which properties can be measured easily electronically, instantaneously, in situ, and which could give information on degradation status and movements. Possibly a set of physical variables could reflect a combination of chemical properties and one could establish a mathematical relation between them. Electrical conductivity goes with the number of ions, their size, and the amount of gluey molecules and seems a good candidate. As it varies with the frequency (in liquids one has to use AC) this dependency

might give additional information. The electrical permittivity between two plates is less expedient because of the plates' interference with the flow, but magnetic permeability measured with larger ring coils, less obstructing the flow, distinguishes between diamagnetic and paramagnetic molecules and seems interesting. Concepts for such sensors as well as first measurements are presented, on samples in beakers as well as from inside an operating reactor. These measurements are part of a larger strategy to develop a method for analysing the reactor proceedings and finally discriminating essential features of the reactor design, shall be presented in a poster.

03-2:1 A feasibility study of biogas technology in solving sanitation problems in peri urban suburbs, a case study of Harare

Godfrey Sibanda (1), Downmore Musademba (1), Hermis Chihobo (1), Lazarus Zanamwe (2)

1: Chinhoyi University of Technology, Zimbabwe; 2: University of Zimbabwe

This study investigates the feasibility of converting organic waste into energy using biogas technology to address sanitation problems in peri-urban suburbs of Harare, Zimbabwe. These suburbs with an estimated population of 156975 are unique in that they are not connected to the Harare main water sewer system. A baseline survey was conducted to determine the quantity of biodegradable human and kitchen waste (N=60). Biodigester sizing and costing was done for various scenarios mainly household standalone, single centralised suburb and combined suburbs centralised biogas models. In addition potential biogas conversion to electricity was done for single centralised suburb and combined suburbs centralised biogas models. This was followed by a cost benefit analysis of employing combined suburbs biogas technology. A combined suburbs centralised biogas model was found to be the most feasible scenario producing 7378m³ of biogas per day with electricity production capac-

ity of 384 kW .There is a potential of wood savings of 6129 tonnes/year, paraffin savings of 2.556 tonnes/year and greenhouse benefits of 980 tonnes of CO₂ equivalent emissions/year and attracts U\$2940 from carbon credits sales per year. The study recommends adoption of the biogas technology because of its potential to address both economic and sanitation challenges being faced by local authorities in developing countries particularly, improved hygienic conditions, energy supply chronic epidemics and sewer reticulation.

03-2:2 Spirulina & biogas Integrated Eco-System, a sustainable solution to combine food and energy to supply European needs

Laurent Lecesve

HyES - Hybrid energies & Eco-Systèmes, France

The vision of HyES is to create a local sustainable autonomy in order to meet the main human needs: food, health and energy. As we believe that the “problem is the solution”, the answer to all our needs may be to enable a synergy between energy production and agricultural activity. Micro-algae and biogas are two fields related to Renewable Energies (RE), which attract more and more scientific interest. Biogas plants with a CHP Unit produce electricity and heat as well as fertilizer. Today the heat is rarely valorised in rural areas. Spirulina requires warm water to grow. The combination of both opens a great opportunity regarding a sustainable future. The results of experimentations show that spirulina can grow

in north European climatic conditions thanks to heating the ponds. Moreover this culture may be done without using chemical fertilizers on a micro-farm scale.

P3 Biomass Energy – Poster Presentations

Time Tue, 2 October 2012, 10:45 am – 11.15 am

Location A14 - Foyer

Presentations

- **Udo Kulschewski**, Universität Oldenburg, Germany:
Requirements for a Methodology to inspect the Transformation processes in Anaerobic Digesters
- **Melis Tekla**, SNV Ethiopia:
Household biogas projects, challenges and the way forward in Ethiopia
- **Walter Kipruto**, Carbon Africa Limited, Kenya:
Enhancing monitoring methods for household energy projects:
A case of improved cookstove projects
- **Ernest Mazimpaka**, National University of Rwanda, Rwanda:
Woodfuel in Rwanda: Impact on Energy, Poverty and Environment
- **Santiago Sanchez**, ENERPRO, Ecuador:
Construction of a 300 kW Biomass Power Plant From Palm Shell Residues in a Rural Community In Ecuador Under a Public Private Partnership Scheme

P3-1:1 Requirements for a Methodology to inspect the Transformation processes in Anaerobic Digesters

Udo Kulschewski

Carl von Ossietzky Universität Oldenburg, Germany

Anaerobic digestion of organic waste as a complex process of many interacting sub-processes, cannot be judged by a single, integral parameter, like the gas yield, what is one starting point for this poster. A view on global substance cycles wants to motivate to look at further reaching goals and therefore sets the scope of what the methodology should be able to observe of the degradation process. It is actually more of a transformation process: some organic input is transformed into gas, but other is hardly altered (lignin), some goes into cell material. Innumerable pathes are possible through the regime of microbiological reactions, influenced by the geometry of the digester and the flow patterns inside, the operational schedule and input composition, outer conditions like temperature and gas amount in the storage, and internal conditions from previous biochemical reactions, like buffer capacity or bacterial activity, stratification or bacterial and particle retention. To distinguish various reactor designs and discriminate relevant details of construction or operation, a methodology needs to determine the major pathways of transformation contributing to the overall outcome: biochemically as well as spatially. The requests on a methodology and the pre-requisites to establish one are depicted. As a subset of meas-

urements for the methodology physical properties occur, which are possible to measure instantaneously and in-situ. The poster wants to shift the discussions on the outcome of anaerobic digestion to a larger perspective and hopes to stimulate global collaboration on the challenge to understand and mold the proceedings in these bioreactors.

P3-1:2 Household biogas prospects, challenges and the way forward in Ethiopia

Melis Tekla

SNV Ethiopia

For many years biogas as rural energy option in Ethiopia was limited in number for its dissemination. A likely reason for this is the fact that many of those units were given for free. As a result, a commercially viable supply chain was not developed, many potential consumers were not interested to invest, and specific financial products. Ethiopia is considered one of the ideal countries in terms of livestock population in only 4 regions over one million households have potential to have biogas plants. In this regard SNV-Ethiopia with collaboration of Ministry of Water and Energy has developed a National Biogas Program. Currently over 3000 biogas plants constructed and expected to be constructed 9000 plants until the end of 2013. With participation of the private sector the dissemination is taking place and the production is increasing from over time. On the other hand there has been limitation in the area of development of stoves for local meal cooking (injera), extensive slurry applications and active private sector involvement. It is already observed in rural households they have started enjoying the benefits of biogas in terms of organic fertilizer applications, lighting in rural settings which helped households to improve educational status of children, biogas helped women to involve in other social gatherings,

the health and sanitary conditions totally improved and the biogas sector accommodated in creating employment opportunities. One household witnessed in putting his unit as “my biogas is like small factory for the production of organic fertilizer”. Hence the dissemination can be increased over time through addressing the most critical challenges in terms of putting efficient appliance development and supply chain systems; capacity development support for active involvement of the private sector; strong research and development linkages with academic and research institute in the field.

P3-1:3 Enhancing monitoring methods for household energy projects: A case of improved cookstove projects

Walter Kipruto

Carbon Africa Limited, Kenya

Over 40% of the world's population rely on traditional use of biomass for energy needs which has been shown to have negative impacts on public health, environment and quality of life. As a result, there is increased global attention towards household energy issues by various stakeholders through promotion and implementation of improved cookstove programmes. However, existing monitoring methods for cookstove programmes have been reported to have challenges such as high cost, complexity, accuracy and reliability e.t.c. Therefore, there is need to enhance the monitoring methods for improved cookstove programmes in order to mitigate these challenges. The possibility of applying Stove Use Monitoring Systems (SUMs) in enhancing monitoring of adoption and usage of cookstoves and estimation of fuel consumption has been investigated. SUMs are low cost, small and rugged temperature data loggers. The objectives were to investigate: the factors affecting fuel consumption; the operation and characteristics of the SUMs; and the use of SUMs in assessing the adoption and usage of stoves under real field settings. The results obtained have confirmed that SUMs are capable of recording and storing stove use data and therefore provide accurate, documentable, non-intrusive, un-

biased and reliable means for monitoring improved cookstove projects. They can therefore be used to complement and enhance the existing survey methods in providing useful information for determining and monitoring the adoption and usage of improved cookstoves. On the other hand, fuel consumption patterns for stoves in the field are highly variable and dynamic hence making the estimation of fuel consumption a complex process. This therefore makes it difficult to reliably estimate fuel consumption based on stove performance parameters such as fuel consumption rate. However, the use of conservative fuel consumption rates with correction factors may be explored for cookstoves that show a stable and predictable performance such as batch fed cookstoves.

P3-1:4 Woodfuel in Rwanda: Impact on Energy, Poverty and Environment

Ernest Mazimpaka

National University of Rwanda, Rwanda

Rwanda's geographical and socio-economic situation have shaped the energy situation and limited access to modern fuels. Woodfuel is the main source of energy for households and its trade a source of income and jobs in rural areas. Due to repeated division of ancestral property by traditional inheritance of land, currently 85.2% of households' land holding is less than 1 ha. This is insufficient to grow food and fuelwood for a household of the average size of 5.5 persons. Without well documented reports of the individual impact of each deforestation factor, woodfuels have been most blamed. This paper investigates how the current woodfuel industry impacts on energy, poverty and forests by analysing policy instruments and a field survey to assess their implementation. Considering woodfuel consumption under an only environmental or energy perspective has resulted in a search for a narrowly environmental or energy solution. Both failed to solve the problem of forest depletion. Current regulations limit the benefits traditionally derived from woodfuel commoditisation leading to a negative attitude towards the implementation of policy instruments, thereby in fact increasing forest depletion. The processes involved in producing

charcoal and using it as a cooking fuel are inefficient and resource intensive. The barriers to large dissemination of improved cooking stoves include .availability, relatively low cost of woodfuels, lack of improved stove diversity on the local market and weak .government policy in regard to the woodfuel industry. Policies aiming to substitute or reduce woodfuel consumption, have not achieved the desired results and their implementations have not unarguably reduced deforestation. In that way I recommend the community-based woodfuel production and forest replenishment associations as sustainable management approaches to mobilise community support for sustainable forestry management and woodfuel production.

P3-1:5 Construction of a 300 kW Biomass Power Plant From Palm Shell Residues in a Rural Community In Ecuador Under a Public Private Partnership Scheme

Santiago Sanchez, José Luis Palacios

ENERPRO, Ecuador

This paper is based on a study done by the company Ener-Pro during the year 2011 for the Santo Domingo Power Utility in Ecuador. The consultancy dealt with the use of waste biomass residue from palm shell to generate electricity in a power plant. Different agricultural crops energy potential were analyzed and two main options were selected, making use of the condition of Ecuador as one of the largest palm oil exporters in the world. The palm shell is a residue that comes from palm oil extraction factories and it is collected in big quantities and burned non efficiently on the open air and most of it is spread in the fields without any energy benefit. The community of Plan Piloto is located next to some palm oil extraction factories that secure the supply of palm shell for the power plant. Villagers of Plan Piloto are inhabitants with low income and a poor standard of living. The construction of a power plant in the area of Plan Piloto will enable the people to benefit from the revenues of the energy sold to the grid applying the existing feed in tariff of UScent 11 per kWh. The execution of the project is based on a public private partnership scheme. The technical and economic analysis to install a power plant

based on palm shell and bamboo cane in order to generate 280 kW was done in the consulting. The project has been proposed for international non reimbursable funding for the construction as part of the IICA initiative with support from Finland.”

W4 New Energy Lab – Workshop

Time Tue, 2 October 2012, 9:30 am – 10.45 am

Location A14 - Room 111

Session Chair **Hans-Gerhard Holtorf**, Universität Oldenburg, Germany
Kristie Kaminski Küster, Universität Oldenburg, Germany

W4-1:1 Workshop New Energy Lab

Hans-Gerhard Holtorf, Kristie Kaminski Küster

Carl von Ossietzky Universität Oldenburg, Germany

The old Energielabor was planned in the late 1970ies and built in the early 1980ies. It was a demonstration, pilot and research object as an alternative to the mainstream idea of a nuclear energy based energy supply for Germany. Old Energielabor was an outstanding building at this time. Many many things have been learned and adopted in energy saving building design and energy supply since then. Furthermore various education programmes have developed at the University of Oldenburg and Oldenburg itself on Renewable Energy (RE). This results in the demand for a new building which hosts different levels and types of RE education in Oldenburg, allows communication across the disciplines and serves as a symbol for Oldenburg's efforts to train on RE. On the occasion of the 25th anniversary of the first RE master programme in Oldenburg the kick off of the development and eventually a New Energielabor is planned. The workshop consists of four parts: In an introductory session, a poster session, a group work session and a comprising session. In the introductory session different stakeholders of RE education in Oldenburg will present the state of the art of modern buildings, possible actors in the RE education in Oldenburg and the contributions they can make to the planning of a New-Energielabor. These talks serve as warming up for the following poster session. In the poster

session different aspects of RE education, new buildings and concepts will be presented. The posters further motivate the participants of the workshop for the following brain storming. Three groups will work individually on Modern energy saving buildings and their energy supply Stakeholders of RE education in Oldenburg and their demands for a New-Energielabor (lecturing space, labs, offices, organisation, intercultural and interdisciplinary communication) Corporate Identity by architecture The results of this brainstorming will be presented to all workshop members and at the end of the conference to the conference members. The participants of this workshop will be multidisciplinary: members of the ministry of education of Lower Saxony, didactic methodology research groups, school teachers, RE master's students, architects, architectural master's students, members of the municipality of Oldenburg and RE traineeship institutions. Any interested conference participants are welcome to give their input.

05 System Integration and Management

Oral Presentations

Time Tue, 2 October 2012, 14:00 pm – 17.00 pm

Location A14 - Room 030

Session Chair **Indradip Mitra**, GIZ GmbH, Germany
Detlev Heinemann, Carl von Ossietzky Universität Oldenburg,
Germany

Presentations

- **Stefan Weitemeyer**, NEXT ENERGY, Germany:
MOSES - A Modelling Tool for the Analysis of Scenarios of the European
Electricity Supply System
- **Elke Lorenz**, Universität Oldenburg, Germany:
Short-term Prediction of Solar Photovoltaic Power
- **Stefan Bickert**, Universität Oldenburg, Germany:
Financial Measures for Electric Vehicles. Supporting the Integration of
Renewable Energy in the Mobility Sector in Germany
- **Indradip Mitra**, GIZ GmbH, Germany:
SolMap project in India's solar resource assessment

O5-1:1 MOSES - A Modelling Tool for the Analysis of Scenarios of the European Electricity Supply System

Stefan Weitemeyer, Thomas Feck, Carsten Agert

NEXT ENERGY EWE-Forschungszentrum für Energietechnologie e. V., Germany

Recent studies have shown that a transition of the current power supply system in Europe to a system almost entirely based on fluctuating Renewable Energy Sources by mid-century is possible. However, most of these scenarios require a significant amount of storage and/or quickly adjustable gas power plants as back-up power capacities to ensure the security of electricity supply. This would imply high additional investments and operating costs. Hence, alternative options should be investigated first. Here we present a first outlook of our simulation model MOSES which will be able to analyse different target states of the European electricity system in 2050. Long-term meteorological data series are used to optimise the capacity mix of RES in Europe. One of the main elements of our tool is a simplified European grid model which will be used to calculate the load flows in a transnational electricity network. In addition, alternative options for reduction of additional back-up power like the expansion of the transmission grid, the use of demand-side management and/or the installation of overcapacities will be implemented. The results will be used to

evaluate current national and European build-up targets for renewable energy for 2050 on their robustness regarding a stable target system.

05-1:2 Short-term Prediction of Solar Photovoltaic Power

Elke Lorenz, Detlev Heinemann

Carl von Ossietzky University Oldenburg, Germany

One of the largest challenges of solar photovoltaic power generation is its high weather-dependent variability. This behavior happens on all time scales but practically is most important in the time range between some hours and three days. The power sector is currently facing a paradigm shift. The formerly demand-driven power generation in conventional power plants is expected to be replaced more and more by a supply-driven energy system with large amounts of volatile renewable power. If no large storage capacities are added demand and supply have to match each other at any time and therefore the renewable power generation should be known as precise as possible. This information is used for the allocation of reserves based on the expected PV power, optimization of the scheduling of conventional power plants, and optimization of the value of the produced PV electricity in the market. The paper describes the general set-up of such prediction systems and gives examples of their performance. Especially a regional PV power prediction system providing forecasts of up to 2 days ahead with hourly resolution is presented. The approach is based on forecasts of the global model of the European Centre for Medium-Range Weather Fore-

casts (ECMWF). It includes a post-processing procedure to derive optimized, site-specific irradiance forecasts and explicit physical modeling steps to convert the predicted irradiance to PV power. A regional power forecast then is derived by up-scaling from a representative set of PV systems. In addition to the prediction based on a numerical weather model those using cloud motion vectors from satellite images have shown their potential in a temporal range of 30 minutes to 6 hours. The current status of this technique is also briefly presented.

O5-2:1 Financial Measures for Electric Vehicles. Supporting the Integration of Renewable Energy in the Mobility Sector in Germany

Stefan Bickert

Carl von Ossietzky Universität Oldenburg, Germany

The transformation of energy systems towards sustainability is one major challenge of today's generation. For the mobility sector electric vehicles (EV) have the potential to contribute to this transformation through the operation of vehicles with renewable energy. This can only be realized if EV evolve in the market. Next to the high potential EV are linked with limited driving ranges and high costs. Analyses have shown that costs of EV exceed costs of conventional vehicles today and in the near future. Therefore, financial measures are one possibility to support the market integration. In this paper we consider financial measures from various actors involved in the context of EV and answer the research questions: Which financial measures can support the market integration of EV in Germany for private consumers? Which impacts are linked to these measures? In a first step, an overview of financial measures that are in operation within and beyond Europe is given. Financial measures can be operated by the government or by the industry. A possible compensation of grid services (vehicle-to-grid) is also considered. A second step accesses financial measures regarding their efficiency. For this, a set of indicators has

to be created and applied. In addition, the practicability of measures is considered. Finally, selected financial measures can be integrated in the analysis of costs of EV. In a previous work the costs of EV have been analysed by displaying Total Costs of Ownership. By the integration of measures in this analysis the cost-effect can be investigated for the total costs as well as the type of costs in the lifetime of a vehicle. By displaying financial measures for EV this paper provides an analysis of possibilities to support the integration of EV in the market and the integration of renewable energy in the mobility sector.

O5-2:2 SolMap project in India's solar resource assessment

Indradip Mitra (1), Kaushal Chattbar (1), Ashvini Kumar (3), Godugunur Giridhar (3), Ramdhan Vashist (1), Richard Meyer (2), Marko Schwandt (2)

1: GIZ GmbH, Germany; 2: Suntrace GmbH, Germany;

3: Ministry of New and Renewable Energy, Government of India

So far reliable and precise insolation data, particularly on direct irradiance, are not easily available in India. Ministry of New and Renewable Energy (MNRE) of Government of India (GoI) has awarded a project to Centre of Wind Energy technology, Chennai in the year 2011 to set up 51 Solar Radiation Resource Assessment (SRRA) stations using the state-of-the-art equipment in various parts of the country. The technical configuration of the SRRA stations consist of measurement of global, diffuse and direct normal solar irradiances with sensors mounted on solar tracker in addition to measurement of associated meteorological parameters, like, air temperature, relative humidity, wind speed and wind direction, atmospheric pressure and precipitation. The GoI project has synergy with SolMap project, which is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in cooperation with the MNRE. SolMap project contributing to SRRA project in establishing quality checks on the data obtained as per International protocols and helping data processing to generate investment grade data. The SolMap project also aims to develop solar radiation atlas for the country. This project is funded by the International Climate

Initiative (ICI) of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), Government of Germany. SRRA stations have been configured with high standard equipments and sensors, and are powered by PV with battery banks making them independent of grid electricity. Temporal resolution of is high with data streams having 10 seconds sampling and 10 minutes averaging rate. Such a large scale and detailed investigation on solar resource is the first time in the country. This paper describes this network of data collection and discusses some of the preliminary results from the data analysis. The outcomes of this project are of crucial importance to the solar energy deployment scenario in India.

P5 System Integration and Management

Poster Presentations

Time Tue, 2 October 2012, 15:15 am – 15.45 am

Location A14 - Foyer

Presentations

- **Benjamin Wagner vom Berg**, Universität Oldenburg, Germany:
Supporting Vehicle-to-Grid Services by intelligent mobility planning systems
- **Eva-Maria Hammer**, NEXT ENERGY, Germany:
Redox-Flow Batteries: Potential and Future Prospectives
- **Nadine Jacobs**, NEXT ENERGY, Germany:
Efficient Use of Resources in Energy Converting Systems
- **Leyla Topal**, NEXT ENERGY, Germany:
Evaluation of gas composition and temperature influences on alkaline anion exchange membrane fuel cell (AAEMFC) performance
- **Hans Georg Beyer**, Universitetet i Agder, Norway:
Meteorological forecasts for the benefit of the operation of domestic hot water systems using electrical auxiliary heaters in weak grids – an example from Brazil
- **Jan Bekkering**, Hanze University of Applied Sciences, Netherlands:
Spatial modeling of a sustainable gas supply chain by matching supply and demand

P5-1:1 Supporting Vehicle-to-Grid Services by intelligent mobility planning systems

Benjamin Wagner vom Berg, Daniel Stamer, Sven Kölpin

Carl von Ossietzky Universität Oldenburg, Germany

The ecological dimension of sustainability in the meaning of consumption of natural resources is one important topic of our times. The transportation of goods and persons has a major impact on resource consumption and emissions. Electric vehicles are not solving these problems but they are offering a chance for a change of the mobility behavior towards an eco-friendly mobility. This change of behavior needs new transportation offers, new business models and new information systems. But at the end the customer has to change his behavior. Within a Customer Relationship Management this change of behavior may be brought forward. The ideas of this paper are based on a software system (Jinengo) that was developed by an university project group. It enables the consumer to plan his intermodal mobility easily by a smart phone app. A CRM system is connected to influence the consumer towards a more sustainable behavior. Electric vehicles store electric energy in batteries. This means that with a growing number of electric vehicles, more electric energy can be stored and sent back to the electric grid when high network loads appear (Vehicle-to-Grid-Approach). The introduced software system can be used to influence a users' decision when he uses his electric vehicle for travelling or when he uses another mean

of transportation and makes his electric vehicle available as energy storage. With this approach it might be possible to compensate the efficiency problems of renewable energy sources (e.g. high network loads by wind energy). Another idea is to use the collected data to analyze the behavior of electric-vehicle users. The knowledge that is contained in the data enables energy companies to predict the load-cycles of the electric-vehicles that are used in a specific region. Furthermore, the knowledge can be used to optimize the locations of loading-stations for the electric vehicles.

P5-1:2 Plasma Treatment Activation of Graphite Felt Electrodes in Vanadium-Redox-Flow-Batteries

Eva-Maria Hammer, Lidiya Komsiyaska

NEXT ENERGY EWE-Forschungszentrum für Energietechnologie e. V., Germany

RE sources cover up to 20% of the power and energy demand of Germany. However the fluctuation and unpredictability of RE sources lead to instabilities in the electrical grid. Therefore the development of stationary storage devices has become of a great importance to stabilize fluctuations in energy supply out of renewables. Batteries for large scale grid storage require durability for a large number of cycles as well as calendar life, high round trip efficiency, an ability to respond rapidly to changes in load and input. Among Redox-Flow-Systems especially the Vanadium-Redox-Flow-Battery (VRFB) is a promising candidate to fulfill many of these requirements. However, the high costs currently prohibit a broad application of VRFBs. Since the used components such as electrodes, current collectors and membranes contribute significantly to the general costs, new materials with improved performance are needed. In the frame of the present contribution oxidizing plasma pretreatment is used for the improvement of the electrocatalytic activity of graphite cloth electrodes for VRFB. The influence of the working gas media and the processing parameters on the catalytic activity and the surface morphology are demonstrated. The electrocatalytic properties of the graphite felt electrodes were examined by cyclic voltammetry and electrochemical impedance spectroscopy.

Furthermore, the physical and structural properties were studied using SEM and CT measurements. Our results show, that oxidizing plasma treatment lead to an enhancement of the electrocatalytic activity of the graphite felts and competitive results compared to other techniques, like heat- and chemical activation. Furthermore, plasma methods can be easily introduced into large scale industrial processes.

P5-1:3 Efficient Use of Resources in Energy Converting Systems

Nadine Jacobs, Alexander Dyck, Marco Zobel

NEXT ENERGY EWE-Forschungszentrum für Energietechnologie e. V., Germany

The use of μ -CHP (combined heat and power)-devices will become more and more popular as a decentralised energy supply from heat and power for the future. It is one of the most efficient principals for utilization of energy content of fuels, whether fossil or renewable. There are a lot of advantages for μ CHP-systems like high overall efficiency, possible grid independency, and flexibility in the supply on demand. In any case, some research aspects must be taken into account, such as the complex gas purification, gas humidification, and the low temperature gradient for the heat exchangers in a heating system. To overcome the disadvantages in μ -CHP-systems we are developing a new generation of μ -CHP-systems based on PEM (proton exchange membrane) fuel cell (FC) stack technology. Different high temperature (HT)- and low temperature (LT)-PEM FC are already under investigation in different research projects. Both of them have some principle advantages and disadvantages. For the low temperature range, there are the increasing poisoning and the reduced activity of the catalyst with decreasing temperatures as limiting factors. For high temperature range the start-up procedure is energy consuming, it takes duration for the customer and the destructive water formation on the

cathode part is observed and must be avoided. To overcome these hurdles we will optimize the MEA (membrane electrode assembly), bipolar plates and gaskets as well as the design of the FC for the middle temperature (MT) range, which is intended operation range is between 90 and 120 °C. This includes the development of a catalyst with lower platinum load and leads to the reduction of cost and resource intensive platinum. As a research result, we expect a μ -CHP- System – including reformer – that is able to operate with an electrical efficiency of above 40% and reach an overall efficiency of more than 90%.

P5-1:4 Evaluation of Cathode Gas Composition and Temperature Influences on Alkaline Anion Exchange Membrane Fuel Cell (AAEMFC) Performance

Leyla Topal, Carolina Nunes Kirchner, Wiebke Germer, Zobel Marco, Dyck Alexander

NEXT ENERGY EWE-Forschungszentrum für Energietechnologie e. V., Germany

Global energy demand is increasing day by day because of increasing population, expanding economies and technologies. These growing energy requirements, combined with fuel flexibility, usage of renewable energy sources, reduction of CO₂ emission and wide range of application areas from portable usage to power plants are the key drivers behind the commercial and governmental attention in the fuel cell market. Proton exchange membrane fuel cell (PEMFC) is the most investigated and well developed type. However, some hurdles such as dependency on precious metal Pt and expensive electrolyte membrane material limit its commercialization. AAEMFCs enhance their presence due to their promising advantages compared to PEMFC including possibility of non-precious metal catalyst usage and enhanced kinetics for oxygen reduction reaction thanks to alkaline environment. One of the main challenges is the development of a fuel cell type that can work a wide range of fuel alternatives. Pure hydrogen and pure oxygen have been used to evaluate fuel cell performances. However, the use of pure gases is limited only to some special applications e.g. submarines. For reasonable application fuel cell researchers evaluate the utilization of hydrogen direct from renewable sources or from

reformed natural gas and atmospheric air for oxygen supply to be qualified in fuel cells. In this approach, performance of an AAEMFC with the anion exchange membrane (AEM) in hydroxide-form was analyzed via application of various cathode gas compositions from pure O₂ and synthetic air to different concentrations of CO₂ at varied temperatures.

P5-1:5 Meteorological forecasts for the benefit of the operation of domestic hot water systems using electrical auxiliary heaters in weak grids – an example from Brazil

Hans Georg Beyer (1), Manfred Georg Kratzenberg (2)

1: Universitetet i Agder, Norway; 2: Universidade federal des Santa Caterina, Florianopolis, Brazil

In countries where the auxiliary heating of solar domestic hot water systems (SDHW) is mostly done electrically - as e.g. in Brazil - the influence of these systems on the load characteristics in the distribution systems – especially in weak feeder lines - in not to be neglected. Sharp load peaks may occur during hours of augmented hot water consumption. This is economically critical for both, the grid operator and the consumers, given that the consumption tariffs are time dependent. As - due to storage of the SDHW system – the operation of the auxiliary heater is not strictly coupled to the time hot water consumption a smart control may shift the electricity consumption to less critical periods. This however, requires forecast capabilities for solar irradiance and ambient temperature to avoid the dispelling of solar energy. The set up of a smart control based on forecast information on irradiance and temperature model is discussed for the example of SDHWS's in Florianopolis, Brazil. Basic forecast information are taken from a numerical weather prediction model (ARPS) run by the Brazilian weather forecast center CPTEC. The ARPS output is subject t a site specific post-processing using artificial neural net-

work techniques trained with on on-site measurements. Using the characteristics of a typical one family thermosiphon-SDHWS (1.7 m² collector area, 100l storage) the benefits of the use of a forecast-driven controller for the avoidance of consumption during peak periods are inspected. Conflicts with other figures of merit for the system operation will be discussed.

P5-1:6 Spatial modeling of a sustainable gas supply chain by matching supply and demand

Jan Bekkering, Wim Van Gemert

Hanze University of Applied Sciences, Netherlands

Biogas production from co-digestion can have a significant contribution to a sustainable gas supply when this gas is upgraded to natural gas specifications and injected into the gas grid. In this study we analyzed such a gas supply chain in a Dutch situation. A model was developed with which several relevant aspects of such a supply chain were analyzed: the cost price ($\text{€}/\text{m}_n^3$, based on a net present value calculation), as a function of scale level (m_n^3/hr), the effect of scale level on energy use and transport movements, and the influence of seasonal variations in gas demand on the cost price. The model includes practical sustainability criteria. To model the seasonal gas demand, gas demand data of a gas grid company were used which comprise the gas demand of five gas receiving stations (GRS) during a year on an hourly basis. Of each GRS the dominant types of users of the gas are known. For each GRS, the influence of variable biogas production by a digester, use of a gas storage facility in the supply chain, and a big and a smaller digester on cost price were analyzed. Results show that flexible production is cheaper than gas storage for small gas demand following capacities. When gas demand has to be followed for a longer period, gas storage is

cheaper. Moreover, the cost price decreasing effect seems to be more significant when the gas delivery area mainly consists of households than when it consists of large companies. This might influence the optimal locations for digesters and thus locations for biomass production. The consequences of this are currently investigated in further research.

06 Energy Policy and Economics

Oral Presentations

Time Tue, 2 October 2012, 14:00 pm – 17.00 pm

Location A14 - Room 112

Session Chair **Juan Roberto Paredes**, Inter-American Development Bank,
United States of America
Wolfgang Pfaffenberger, Jacobs University Bremen, Germany

Presentations

- **Hans-Peter Igor Waldl**, Overspeed GmbH & Co. KG, Germany:
The New Energy Economy - Renewables and historic energy systems
growing together by advanced use of information
- **Wolfgang Pfaffenberger**, Jacobs University Bremen, Germany:
Promotion of Renewables in the European Union
- **Santiago Sanchez**, ENERPRO, Ecuador:
National Energy Efficiency Plan for the Residential, Public and Industry
Sectors of Ecuador, Period 2013 -2020
- **Dwipen Boruah**, IT Power, India:
Developing Solar Cities in India

O6-1:1 The New Energy Economy - Renewables and historic energy systems growing together by advanced use of information

Hans-Peter Igor Waldl, Thomas Pahlke

Overspeed GmbH & Co. KG, Germany

Since some years, driven by high penetration rates of wind energy, and, in a growing number of cases, also solar power production, the energy system in many countries is changing significantly. From the idea of “alternative”, “additional” energies which must be integrated into the existing grid, we changed rapidly to a phase of developing and building a new energy system with renewables in the focus. This holds with regard to technical issues as well as with respect to energy economy. We will present an overview of the current challenges on the

technical, economic and regulatory level including market issues, and we will present examples in which way state-of-the-art on-line system modeling, software systems, and information infrastructure do and will contribute to tackle these challenges. A focus will be laid on wind and solar power predictions, energy markets, storage integration and optimization, and requirements for future information generation and data flows as components of a energy supply system which is stable under technical and market aspects.

O6-1:2 Promotion of Renewables in the European Union

Wolfgang Pfaffenberger (1), Roland Menges (2)

1: Jacobs University Bremen, Germany; 2: TU Clausthal , Germany

In the current debate on how to most effectively mitigate climate change, renewable energy sources are posted to play a prominent role. The use of renewable energy sources for electricity generation may either be directly amplified by means of regulation such as paying subsidies for green electricity generation, for example in terms of feed-in tariffs as in Germany, or more indirectly by stimulating endogenous market-driven green electricity activities. The European Union (EU) has set country specific targets for the share of renewable energy in final energy consumption as part of the climate and energy policy mix. On the other hand the EU has stated that countries are free to choose the instruments for promoting renewables. Evaluating the efficiency as well as the effectiveness of existing renewable energy policies from an economic perspective basically depends on the question, whether renewable energies should be treated as a mean or as a goal of environmental and energy policy. Moreover, as it is the primary objective of environmental policy instruments to transform collective goals into individual behavior, the question has to be discussed, to what extent existing policy instruments are covered by the preferences of individual

households when acting as voters or taxpayers on the political market place and as consumers on energy markets. This paper in the first part describes and compares the instruments used in different EU countries. It then discusses the following questions: Is the present mix of instruments compatible with the European internal market and the market rules for the electricity and natural gas market? Is the present mix of instruments economically efficient? Does the present policy mix lead the way to a sustainable energy path for the EU, reducing import dependence and greenhouse gas emissions in an efficient way? What alternatives exist to improve the present policy mix?

O6-2:1 National Energy Efficiency Plan for the Residential, Public and Industry Sectors of Ecuador, Period 2013 -2020

Santiago Sanchez, José Luis Palacios

ENERPRO, Ecuador

The Ministry of Electricity and Renewable Energy of Ecuador contracted in 2011 with the Ecuadorian company EnerPro, in consortium with the Spanish consultancy, CREA, the consultancy for the National Energy Efficiency Plan for the Residential, Public and Industry Sectors of Ecuador, for the Period 2013 - 2020. The scope of the study comprised seven phases: planning and organization of work, information and data gathering, data analysis, identification of energy efficiency measures, forecast of scenarios, implementation plan, and final report. Relevant aspects that determine the energy usage in Ecuador were defined, including: population growth, economic indicators, human development index, climate conditions, etc. The information about the characterization of demand of energy usage, both thermal and electrical, of household appliances, office and industrial equipment were gathered by means of direct surveys performed in the largest cities of Ecuador. As a mean to weight the suitable energy efficiency measures, three aspects were taken into account: total energy savings, reduction of carbon dioxide emissions and economic savings. A total of thirty two energy efficiency

measures were considered, and ordered according to different ranking parameters: largest energy savings, lowest initial investment and higher reduction of CO2 emissions. Action plans for every measure were prepared. The top ranked thirteen priority measures accounted for approximately 80% of the savings of the total energy saved in the period of the plan. As a final result, the total amount of energy saved was estimated to reach 5% of the final energy consumption during the eight years of the plan.

O6-2:2 Developing Solar Cities in India

Dwipen Boruah

IT Power, India

The Ministry of New and Renewable Energy (MNRE), Govt. of India has launched a program on “Development of Solar Cities” under which a total of 60 cities will be supported for development as “Solar/ Green Cities”. The program aims at minimum 10% reduction in projected demand of conventional energy through energy efficiency measures and enhancing supply from renewable energy sources. As a Renewable Energy consultant, I have the opportunity to take lead in preparing Master Plans for 12 cities to develop them as “solar city”. The Master Plan provides total and sector-wise projections for energy demand and supply for next 10 years. Further, it provides a complete sector-wise base line on energy utilization and GHG emissions in the city. Year-wise targets for energy conservation, renewable energy addition and GHG abatement along with the action plan for implementation has been clearly brought out in the master plan. Potential sources of funding from respective organizations (both public and private) for providing financial support have been identified. As an integral part of the Master Plan of a guidebook has been prepared indicates appropriate RE systems and En-

ergy Efficient devices for urban context, Financial Schemes & supportive finance, Business models, Implementation strategy and Risk Analysis for developing solar cities. In my presentation, I intend to share my experience in preparing Master Plans for developing solar cities in India in terms of approach & methodology, Summary of baseline energy consumption & GHG emission in different cities, Renewable Energy and Energy Efficiency Strategy to reduce 10% conventional energy consumption in these cities, Economic viability, Payback, Physical target, Budget, cost of energy savings per MU energy savings, cost of per capita energy savings etc. I propose to share my experience and results from the extensive work in preparing Master Plans for developing 12 Indian Solar Cities.

P6 Energy Policy and Economics

Poster Presentations

Time Tue, 2 October 2012, 15:15 am – 15.45 am

Location A14 - Foyer

Presentations

- **Juan Roberto Paredes**, Inter-American Development Bank, USA:
Greening energy matrices in Latin America: What for?
- **Dana Chirvase**, Intermediary Body for Energy, Romanian Ministry of Economy, Commerce and Business Environment:
Development of renewable energy in Romania: potential, state of the art and prospects
- **Sunil Prasad Lohani**, Sustainable Energy Systems Laboratory, Department of Mechanical Engineering, Kathmandu University, Nepal:
Household Energy Planning for Low Carbon Emission in Nepal – Vision 2030
- **Burak Turker**, NEXT ENERGY - EWE Research Center, Germany:
Importance of Utilizing Local Energy Resources for Electricity Generation

P6-1:1 Greening energy matrices in Latin America: What for?

Juan Roberto Paredes

Inter-American Development Bank, United States of America

The presentation will describe the activities, usefulness, impacts and challenges encountered by the Inter-American Development Bank, the largest multilateral funding source in Latin America, associated with the introduction of renewable energy technologies into energy matrices of several countries in the region. A brief description on the general energy situation will initially provide clear insight into sustainability issues, such as climate change, vulnerability, dependence on fossil fuels, regulatory frameworks, existing market distortions and long term outlook. Activities carried out under the Climate Change and Sustainable Energy Initiative (SECCI) launched in 2007 will be presented as well as specific projects and financing schemes aimed at increasing the participation and investment opportunities of non-conventional renewable resources in the electricity market. In addition, a detailed overview of existing international financing sources will be provided. As a former PPRE graduate I have led the Renewable Energy pillar of the SECCI initiative since its inception in 2008. Now working for the energy division at the IDB I am responsible for developing innovative fields of work in the clean energy sector such as marine energies and smart grids, which could

also constitute a real future alternative to the region in a moment where energy demand is increasing, large investments in new infrastructure are urgently needed and climate change impacts are already affecting energy supply.

P6-1:2 Development of renewable energy in Romania: potential, state of the art and prospects

Dana Chirvase

Intermediary Body for Energy, Romanian Ministry of Economy, Commerce and Business Environment

The promotion of renewable energy technologies stands as one of the Government priorities for fulfilling the targets assumed by Romania towards European Union i.e. electricity/energy from renewable energy sources will be 33% (2010), 35% (2015), 38% (2020) of the final gross electricity consumption and 24% (2020) of the final gross energy consumption respectively, the last target being explicitly stipulated in the Directive 2009/28/EC on the promotion of the use of energy from renewable sources. Romania has an important renewable energy potential, the main source used so far being hydro energy. Electricity produced by hydroelectric power plants reaches a share in the total energy of the country between 26-33%, depending on the meteorological conditions of the specific year. Although renewable energy sources had in the past an insignificant contribution (except hydro energy), a change of this trend has been noticed in the last years, namely the diversification and development of other resources as for example wind energy, cogeneration based on biomass and geothermal, the last one being mainly used for district heating systems. The article aims at analyzing the renewable energy potential as well as the barriers and limitations which still impede the implementation on large scale of renewable energy

projects. There are discussed the promotion mechanism in the operation phase of renewable energy projects (energy quota and green certificate system), financing opportunities based on structural funds from European Regional Development Fund as well as integration into the electricity grid of electricity generation units from renewable energy sources.

P6-1:3 Household Energy Planning for Low Carbon Emission in Nepal – Vision 2030

Sunil Prasad Lohani, Jhalak Adhikari, Ram Lama

Sustainable Energy Systems Laboratory, Department of Mechanical Engineering, Kathmandu University, Nepal

“Although Nepal has very low per capita emissions as well as total emissions and still needs to meet basic development needs like education, healthcare, and the like, it has moral obligation to opt for low carbon development pathway. In this analysis the base case scenario and the low carbon emission scenario has been compared for the emission and cost factors. This paper deals with energy planning for low carbon emission scenario at household energy consumption sector till 2030. The base case scenario of energy mix and technological option are changed with low carbon content energy mix such as renewable energy, and increase use of modern and efficient technology. The low carbon emission energy planning is done using an energy planning software Long-Range Energy Alternatives Planning System (LEAP). This software provides long range emission projection for different scenario, which can be used as a reference for future energy planning of the country. The result of this analysis shows that the carbon dioxide (CO₂) emission in base case scenario is higher than that of low carbon development pathway. A comparative result indicates that for base case scenario in 2030, CO₂ emission is 44690 tons whereas for low carbon development pathway, the CO₂ emission is about 23100 tons. However, energy cost per capita surge up with low emission scenario and is about

8951 USD / capita / year in contrast with 3282 USD / capita /year in base case scenario. Nevertheless, the increased energy cost in low emission development pathway can be compensated through international financial assistance: direct financial assistance, technological transfer or carbon trading mechanism like CDM and economical benefits through better environment and less health associated cost. Thus LCS will be very beneficial for sustainable development and CO₂ stabilization.”

P6-1:4 Importance of Utilizing Local Energy Resources for Electricity Generation

Burak Turker

NEXT ENERGY - EWE Research Center, Germany

Electricity generation by utilizing imported resources is an unavoidable situation in countries where the amount of local natural resources is limited. Especially imported coal and natural gas play a huge role in electricity generation all over the world. While they are affordable commodities for strong economies, these high value imports with often volatile prices might become an economic burden for economically weaker or developing countries. Furthermore, relying on high shares of imported resources makes a country dependent on other nations for its crucial energy needs. This is a rather unwanted situation due to the importance of energy independence in international politics and economics which can sometimes get quite fragile. On the basis of the information and the reasons stated

above, utilizing local energy resources for electricity generation should be one of the top energy policy related priorities of a nation in order to maintain a healthy economy and achieve a certain level of energy independence. Only after exploiting the local resources to a certain extent, the high value resource imports should come into question. In this talk, importance of local energy resources and negative effects of energy related imports on economy will be evaluated around the example of Turkey which relies on imported natural gas for more than 50% of its electricity generation.

07 Energy and Development

Oral Presentations

Time Tue, 2 October 2012, 14:00 pm – 17.00 pm

Location A14 - Room 113

Session Chair **Tania Parveen Urme**, Murdoch University, Australia
Ekkehart Naumann, Self-Employment, Austria

Presentations

- **Mohammad Shahriar Chowdhury**, United International University, Bangladesh:
Performance of Solar Home Systems in Bangladesh: A Technical Appraisal
- **Ekkehart Naumann**, Self-Employment, Austria:
From “Development Aid” to Public Private Partnership and Commercialization
- **Hamadou Tchiemogo**, Programme d’Accès aux Services Energetiques (PASE)
- Commune Rurale de Safo, Niger:
Presentation Of PASE (Programme d’Accès au Services Energetiques PASE- Safo)
- **Valter Monteiro-Oliveira**, Universität Bonn, Germany:
Electrification of Isolated Communities in the Brazilian Amazon with
Renewable Energy: Social, Economical, and Environmental Factors in the
Performance of Installed Systems

07-1:1 Performance of Solar Home Systems in Bangladesh: A Technical Appraisal

Mohammad Shahriar Chowdhury

United International University, Bangladesh

Solar Home System (SHS) based rural electrification has experienced a considerable growth in Bangladesh since the start of the Rural Electrification and Renewable Energy Development Project (REREDP) in 2003. The project is funded by World Bank, Global Environment Facility (GEF), GIZ, KfW, Asian Development Bank and Islamic Development Bank in the form of soft loans and grants. The initial target of 50,000 SHS installations in off-grid areas was achieved within 2.5 years, 3 years ahead of schedule and US \$ 2.0 million below estimated project cost. After that a new target of 1 million SHS installations by 2012 was set. The target has already achieved and till March, 2012 about 1.4 million systems has already been installed. At present monthly average installation is over 40,000. The size of the SHS market and its impact on the regeneration of the rural economy make it necessary to investigate the quality and reliability of the installed SHSs, if the continued success of the initiative is to be maintained. This paper reports on the findings from a technical appraisal of SHS in Bangladesh. Two hundred geographically dispersed installation sites were visited as well as the SHS components were collected from the suppliers and manufacturer's production line to assess the technical quality.

Physical characteristics of the SHSs and their system components were tested in the field and also in the lab to ascertain compliance with and deviations from the approved specifications. Despite the overwhelming success of the project, the study revealed various shortcomings. Notable among these are: incompatible and sub-optimal component configurations, faulty installations and a lack of effective quality assurance mechanism. The findings highlight the need for a more effective quality assurance mechanism to protect consumer investment and rights. The paper also suggests for the necessary modification of the technical standard for SHS in Bangladesh.

07-1:2 From “Development Aid” to Public Private Partnership and Commercialization

Ekkehart Naumann

Self-Employment, Austria

Since the 80s of the last century until now, the donor agency supported sustainable development changed from “demonstration projects” and RE programs, financed by grants, to commercially viable sustainable development national programs including the private sector. The gap between “profitable” and “affordable” was bridged by Public Private Partnership [PPP], (cross) subsidizing energy service for low income groups by tapping added value of the commercial sector by such service for these subsidies. The author was active in this field of sustainable development by providing energy service through RET since 1996 until now, focusing on both, energy service for re-

mote rural areas and grid connected electricity generation. Experience of success stories as well as fall backs will be presented based on projects in South Africa, Nepal, Pakistan and Afghanistan.

07-2:1 Presentation Of PASE (Programme d'Accès au Services Energetiques PASE- Safo)

Hamadou Tchiemogo

Programme d'Accès aux Services Energetiques (PASE) - Commune Rurale de Safo, Niger

The Program of Access to Energy Services for the rural Municipality of Safo: PASE- Safo is a pilot project on the scale of a rural town of 72,000 inhabitants distributed into 54 villages. The PASE project will provide energy services within 4 years to: 11 health centers, 30 schools and one college, 7 new water supply systems, 7 municipal infrastructures, 350 farms, 5 multi-functional platforms, 800 income generating activities; 8 new villages electrified through grid extension, 1600 households electrified through solar photovoltaic and 500 households with modern combustion. It is co-financed by the European Union at 75% and UNDP Niger to 25% forming a total amount of € 3.2 million. The overall goal is poverty reduction and economic and social development of the rural population, the guideline being formed by the Millennium Develop-

ment Goals (MDGs) to be achieved by 2015. The project of PASE is a program that gradually covers the entire country. In order to carry out this project an Implementation Body composed of engineers in energy was settled down. The action includes four main activities described as follow: Constitution of three Energy Territories, identification and selection of two or three Delegate Service Operators (Opérateurs de Services Délégués OSD) required to provide energy services and infrastructure to develop the market for energy services on the perimeter of each Energy Territory, Construction, commissioning and monitoring of equipments providing energy services: Operation and maintenance of such equipments and Support of all stakeholders, especially the OSD, throughout the action.

07-2:2 Uptake of off-grid solar systems: modelling social, economical and environmental factors and their influence on electrification projects in the Brazilian Amazon region

Valter Monteiro-Oliveira, Florian Höfer

Universität Bonn, Germany

The success of electrification with off-grid systems in isolated communities depends on their uptake and acceptance. Therefore, estimating the potential uptake is necessary in order to design suitable systems and establish practical regulations for maintaining the systems. Approximating future usage and uptake, however, has proved challenging to policymakers and engineers. As a first contribution toward managing

this dilemma, this work models social, economic and environmental phenomena and their influences on uptake and usage in three off-grid projects. These were projects making use of photovoltaic energy in isolated riverside communities in the Brazilian Amazon region (one project with 103 solar home systems and two projects with 9 mini-grids, each serving an average of 20 households).

P7 Energy and Development – Poster Presentations

Time

Tue, 2 October 2012, 15:15 am – 15.45 am

Location

A14 - Foyer

Presentations

- **Sandra Laura Chavez**, Self Employment: Synergy, Energy for Development
- **Ali Al-Alawi**, Petroleum Development Oman LLC, Oman:
A Feasibility Study to use Solar Photovoltaic Pumping system for Water Supply in Health centre Sultanate of Oman.
- **Claudia Braden**, Universität Oldenburg, Germany:
Solar Energy and Rural Development - an exploration into end-users' impact evaluation
- **Sebastian Groh**, Postgraduate School Microenergy Systems, Germany:
The Energy Poverty Penalty: Residential and micro-business energy modeling for the case of Arequipa (Peru)
- **Alessandro Bezerra Trindade**, Self-Employed, Brazil: RE Tools to Assess Rural Electrification at the North Region of Brazil
- **Andreas Michel**, GIZ, Germany: Universal Energy Access for all - lessons learnt from the Energy Access program EnDev

P7-1:1 Synergy, Energy for Development

Sandra Laura Chavez (1), Isabela Aroeira de Almeida (2), Danilo de Brito Lima (3)

1: Water Capital, Mexico; 2: WayCarbon, Brazil; 3: Tecnometal, Brazil

Synergy is an association of students and graduates interested in working on rural energy projects with the aim of promoting rural development. To achieve this goal, energy experts are joined together during workshops with the purpose of analyzing a specific situation and creating suitable and sustainable solutions. Two objectives can be accomplished with such workshop: an immediate one being the solution of the analyzed energy problem in rural community and the second being the formation of a worldwide network energy professionals united in one common goal. For the first workshop, which took place between March 26th and 28th at the University of Oldenburg, the subject is the Mafora Mission, situated in Mozambique. Mafora Mission is a volunteers association, located deep in rural areas of central Mozambique, in charge of taking care of nearly 100 Mozambican orphans between the ages of 0 and 18. Activities of the Mission include teaching, feeding, providing a place to sleep, and giving assistance to the children. Currently, the Mission suffers from critical funding problems. One idea is to search for ways to create businesses to supply the Mission with a sustainable income by us-

ing a small stream that flows within the Mission's grounds. Studies showed that there is potential to use the stream to generate either electrical or mechanical power for income producing activities and one suitable application is grain milling. On the other hand, the water from the stream could also be used for irrigation, allowing the Mission to cultivate its fields for selling or own-consumption. Examining the two aforementioned applications – grain milling and irrigation – both technically and economically, but also analyzing another option – energy efficiency – the workshop was able to propose several measures the Mission can undertake to generate a sustainable income, which could help improve the Mission's situation.

P7-1:2 A Feasibility Study to use Solar Photovoltaic Pumping system for Water Supply in Health centre Sultanate of Oman.

Ali Al-Alawi

Petroleum Development Oman LLC, Oman

Photovoltaic pumping system has many possible applications in the sultanate of Oman and one of these applications is supplying clean water for health centre to maintain a safe and comfortable environment for patients and staffs, and for treatment at all levels of clinical and surgical area. In this paper a feasibility study is made to use Photovoltaic pumping system in one of the health Center in Sultanate

of Oman. The simulation of the proposed system using existing software will be carried out and the system will be economically evaluated for both external and internal cost. Conclusions based on the study are listed in this paper

P7-1:3 Solar Energy and Rural Development - an exploration into end-users' impact evaluation

Claudia Braden

Carl von Ossietzky Universität Oldenburg, Germany

In which way does solar energy impact rural development in off-grid areas? This question was posed by the Solar Energy Foundation, which provides people in Asian and African off-grid areas with the opportunity of social development and economic prosperity by using solar energy. As an approach to answer the introductory question, a field study was conducted in the village Rema in Amhara region, Ethiopia, which utilizes solar home systems for lighting, phone charging, radio, TV and fridges. An answering approach towards the question was developed with the special focus on obtaining end-user defined impacts from solar use: According to the Indian economist Amartya Kumar Sen, development can be defined as increasing people's choices in life, referred to as capabilities. The capabilities have to be defined by the people themselves, in order to make them agents of their own lives. Therefore, a survey using qualitative methods was conducted in Rema, asking for the impacts experienced by the end users. The impacts found were the capabilities made available by solar home systems. Those were economical improvements, health, education, self-determined time use, changes in gender relations, social interaction, information, communication, entertainment, se-

curity, wellbeing and changes in the people's state-of-mind. The interdisciplinary survey results in the conclusion, that the use of solar home system increases the variety of user's choices in Rema. This increase takes place for basic choices like education, health and living standard as well, as for user's inner attitudes towards their ability to make changes in their lives.

P7-1:4 Energy poverty penalty and energy demand modelling for the case ' of Arequipa (Peru)

Sebastian Groh

Postgraduate School Microenergy Systems, Germany

Is there such a phenomenon like an energy poverty penalty? And if so, can it be empirically proven? By building a robust energy demand model, this paper develops a framework of methodologies to assess energy poverty and to investigate ability and willingness to pay for energy on the micro-level. The results are consistent with views of researchers and practitioners, proofing the existence of an energy poverty penalty, which postulates that the poor pay more for energy relative

to their total income and obtain worse solutions compared to people with higher incomes. Data was collected from 342 households and micro-businesses in the rural area of Arequipa, Peru. Mobile phone coverage was partly identified as a viable proxy for remoteness criteria and used to build the data strata, thus facilitating model replication for different geographical areas. Results give viable insights for potential microfinanced energy supply interventions.

P7-1:5 RE Tools to Assess Rural Electrification at the North Region of Brazil

Alessandro Bezerra Trindade

Self-Employed, Brazil

Despite the fact that nowadays Brazil is the 6th richest country in the world, it has a lot of inequalities. In the last 8 years was created a policy called “Light to Everyone” by the Federal Government and is intended to universalize the supply of energy to all families in the country until 2015. But the North region, specifically the region around the Amazon River, who is off grid, and with a lot challenges, including lack of roadies and airports, the difficulties is even bigger. Some villages take more of 20 days to be reached by boat. So there is a goal but there is a lack of information about past initiatives for rural electrification in order to decide the best alternative to a given village. So the idea was to create some tools to make possible evaluate past RE initiatives placed at the North region of Brazil, comparing to diesel generators

and making possible to decide the best pick. All the RE are possible, and a trade-off about installation costs, generation costs, and O&M costs must be evaluated. The tools covered a collect of data about the past 10 years, the costs had to be converted to US dollar and suffered a monetary correction based in annual rates, after that was did a regression analysis in order to modeling equations to be used at the tools (spreadsheet). The final product is a tool where you input the power desired to the village and the tool bring a comparing table about the costs of photovoltaic, biomass, hybrid, hydroelectric, biodiesel and diesel power plants. This study was financed by IICA – Inter-American Institute for Cooperation on Agriculture and had the support of Eletrobras Amazonas Energy and take place for 6 months since October of 2011.

P7-1:6 Universal Energy Access for all - lessons learnt from the Energy Access program EnDev

Andreas Michel

GIZ - Deutsche Gesellschaft für Internationale Zusammenarbeit, Germany

UN has set ambitious targets: by 2030 all people should have access to modern energy. But what does this mean? How much electricity is needed and how much thermal energy for cooking? GIZ together with other organizations is working on indicators to define a range for minimum full access. This will be brought to discussion. Since 2005 GIZ implements the Energising Development

Program. More than 8 Mio people in more than 20 countries have been provided with access to modern energy be it electricity or thermal energy. The technologies promoted, the approaches applied, the factors for success but also the challenges will be presented.

O8 Higher Education and Capacity Building

Oral Presentations

Time Tue, 2 October 2012, 14:00 pm – 17.00 pm

Location A14 - Room 111

Session Chair **Mouldi Miled**, DESERTEC University Network, Tunisia
Doty Dewi Risanti, Institut Teknologi Sepuluh Nopember, Indonesia

Presentations

- **Hester Bijl**, Delft University of Technology, Netherlands:
Delft Energy Initiative: driving force behind TU Delft as the international hub for energy talent and innovation
- **Doty Dewi Risanti**, Institut Teknologi Sepuluh Nopember, Indonesia:
Renewable Energy Education in Indonesia: Challenges, issues involved and course structure for a sustainable future
- **Moses Kaern**, ForWind / Universität Oldenburg, Germany:
Study Wind Energy at the University of Oldenburg
- **André Bisevic**, Fraunhofer IWES, Germany:
Capacity building in the field of Wind Energy Systems- Online and in Learning Alliances with Industry

08-1:1 Delft Energy Initiative: driving force behind TU Delft as the international hub for energy talent and innovation

Hester Bijl

Delft University of Technology, Netherlands

Delft Energy Initiative Energy is one of the major research and education themes at Delft University of Technology in the Netherlands. Research and education programmes as well as campus activities to save energy and stimulate the use of renewable energy are all traditionally organised in faculties and service departments. The Delft Energy Initiative is the driving force behind strengthening TU Delft's position as a strong international hub for energy talent, knowledge and innovation. The initiative does this by connecting people and disciplines from within the university borders with government, industry and knowledge partners outside. Our joint aim? Really contribute to the energy transition. Energy education Educating the energy engineers who will realise the energy transition is perhaps TU Delft's most important contribution. Today there are multiple bachelor, master and postdoctoral education programmes operating in parallel. As the chair of the Delft Energy Initiative I believe the energy transition requires a more coordinated effort. That's why I am working with the faculty staff on streamlining the energy education programmes, zooming on three aspects: Multidisciplinarity and societal relevance Stimulating entrepreneurship and clean tech start-ups Strengthen-

ing TU Delft as international hub for top talent and innovation In my presentation I will focus on how the Delft Energy Initiative is strengthening TU Delft's position as an international hub for top talent and innovation on the area of energy.

08-1:2 Renewable Energy Education in Indonesia: Challenges, issues involved and course structure for a sustainable future

Aulia Siti Aisjah, Doty Dewi Risanti

Institut Teknologi Sepuluh Nopember, Indonesia

In 2030 Indonesia is estimated to be a net energy importer since the domestic energy productions could no longer meet domestic consumption with transportation and industrial sectors being expected to be the largest energy consumer of about 73% of total energy consumption. Indonesia's crude oil production is expected to decline with an average 6.6% per year from 346 million barrels in 2009 to 82 million barrels in 2030. Even the crude oil exports will be stopped in 2016. The similar condition may apply for natural gas.

Indonesia possesses a variety of renewable energy resources, including geothermal, solar, micro-hydro, wind and bioenergy. Indeed, Indonesia has more geothermal energy potential than any other country which could meet some 40 percent of national electricity demand. Yet currently Indonesia only uses 4.2 percent of that potential. At present, renewable energy production (hydropower, geothermal and biomass) makes use of only 3.4 percent of total potential reserves. This low figure is partly because shifting the country's energy portfolio to renewables would require massive investment, the lack of policy in order to promote the use of renewable energy and demand of expertise and the technological know how in order to exploit the renewable energy effectively.

Engineering Physics Department at Institut Teknologi Sepuluh Nopember located in Surabaya offers master program in instrumentation engineering and renewable energy. The renewable energy curriculum prepare based on analysis of stakeholder, the availability of facilities, infrastructure in universities, and harmonization with partner universities curriculums of the Oldenburg University. In general the master program curriculum in Engineering Physics consists of the core courses and specialization courses. The study is designed in 4 semesters. Each semester consists of 18 weeks of lectures. The thesis is taken on the semester 4. Various researches in exploiting the potential of renewable energy resources were undertaken, particularly in rural areas.

08-2:1 Study Wind Energy at the University of Oldenburg

Detlev Heinemann, Moses Kaern, Martin Kuehn, Joachim Peinke, Kathleen Poland

ForWind / Carl von Ossietzky Universität Oldenburg, Germany

Wind energy has long been one of the main research areas in renewable energies at the University of Oldenburg and has led to the foundation of ForWind, the Center for Wind Energy Research. As far as teaching is concerned, the newly developed concept of “Wind Physics” accounts for these developments and the improving research landscape in Oldenburg. It combines the fields of energy meteorology, statistical and turbulence physics, with a systems approach of modeling and measuring wind flow as well as response of wind turbines and wind farms. In view of this development, education in full-time programmes, like the Postgraduate Programme Renewable Energies (PPRE), Engineering Physics, and Physics, is currently reorganized. A comprehensive set of wind energy courses is offered for the different study programmes in an integrated manner. They range from introductory and applied courses on wind energy engineering, e.g. in PPRE, to a full specialization in “Wind Physics” with a strong research focus in the Master of Physics or the European Wind Energy Master (EWEM). EWEM is a new programme, starting fall 2012, and is jointly offered by the consortium of TU Delft (Netherlands), Risø/DTU (Denmark), NTNU Trondheim (Norway), and the University

of Oldenburg, in order to build the leading European wind energy programme – with “Wind Physics” being one out of four scientific tracks. The European Commission has awarded EWEM with funding through the Erasmus Mundus scheme. ForWind and the University of Oldenburg have also developed innovative concepts for part-time education and life-long learning: the Continuing Studies Programme Wind Energy Technology and Management, which is in its sixth year of operation, and the Continuing Studies Programme Offshore Wind Energy, which starts fall 2012. The presentation will give a description of the concepts of the full-time and part-time education in wind energy at the University of Oldenburg.

08-2:2 Capacity building in the field of Wind Energy Systems- Online and in Learning Alliances with Industry

André Bisevic, Telsche Nielsen-Lange

Fraunhofer IWES, Germany

The research activities of the Fraunhofer Institute for Wind Energy and Energy System Technology (IWES) cover wind energy and the integration of renewable energies into energy supply structures. The rapidly growing sector of renewable energies (RE) and the challenges of the energy transition require highly trained professionals and executives. That is why the Fraunhofer IWES conducted worldwide training programs and seminars with a specific focus on different technical aspects of Renewable Energy. The existing learning alliances between institute and industry are an ideal foundation to share application oriented knowledge in the fields of Wind-, Solar- and Bioenergy and energy system engineering. The target groups are engineers, technicians and scientists who wish to extend and upgrade their acquired knowledge beside their job. In addition, scientists from the Fraunhofer IWES are involved in the implementation of various Master's programs in the field of RE. Noteworthy are the European Master for Renewable Energy (EUREC), the German-Arabic Master program REMENA and the German Master program Regenerative Energien und Energieeffizienz (RE²). This range of on campus programs will now be complemented by an Online-M.Sc. Windenergysystems. This program is

designed by the Fraunhofer IWES again in cooperation with the Kassel University. One goal is to open up the academic training in wind energy for career changers worldwide. Using the knowledge and experience with our on campus courses, within the conference we would like to discuss the added-value of Online-Master programs for capacity building in wind energy in the future "2030" renewable energy sector. This conference contribution contains two questions:

- What is the benefit of a time-and-independent design of the learning process?
- Which kind of quality standards must be respected for quality assurance and sustainable capacity building in the academic field of RE?

P8 Higher Education and Capacity Building

Poster Presentations

Time Tue, 2 October 2012, 15:15 am – 15.45 am

Location A14 - Foyer

Presentations

- **Andreas Michel**, Energypedia gUG:
Energypedia - connecting knowledge about RE
- **Michael Golba**, Universität Oldenburg, Germany:
Renewable Energy Careers
- **Evelyn Brudler**, Universität Oldenburg, Germany:
Energy Education in Oldenburg
- **Tanja Behrendt**, Universität Oldenburg, Germany:
Blended Learning Renewable Energy Master Course
- **Andreas Günther**, Universität Oldenburg, Germany:
Bi-national PhD Program Renewable Energy
- **Rosa García Sánchez**, BIBA Bremer Institut für Produktion und Logistik GmbH, German:
Prospects of the qualification in the wind energy industry - Challenges and opportunities of modern skills training on-site and off-site
- **Lars Broman**, Strömstad akademi, Sweden:
On the Importance of Public Understanding of Renewable Energy
- **Kristian Boedecker**, GUNT Gerätebau, Germany:
Equipment for technical education in the field of Renewable Energies

P8-1:1 Energypedia - connecting knowledge about RE

Andreas Michel

Energypedia gUG

Energypedia is an internet platform similar to Wikipedia. It provides articles and databases about renewable energies technologies and services and experiences in the context of development cooperation. The articles are and will be updated continuously by energy experts from all over the world. The authors are combining their knowledge by sharing it on Energypedia (collective intelligence). Unlike conventional web-platforms Energypedia allows its users to make their contributions. Providing and revising knowledge (in terms of wiki articles about RE) is not organized in responsibilities or hierarchies. All Energypedia users are equal, everyone has the right to create content. The result is a web-based knowledge platform which provides relevant content concerning renewable energy in the context of development cooperation and beyond. The information is continuously revised and hence always up to date.

Energypedia was started by the GIZ program Energising Development for internal knowledge management within the program. Soon the demand from outside the program grew, so first it was opened to other GIZ programs. Demand from outside GIZ was strong, so in autumn 2011 Energypedia was made available public. Since March 2012 Energypedia was taken out of GIZ and is run now by the independent non-profit Energypedia gUG from Germany.

P8-1:2 Renewable Energy Careers

Michael Golba, Edu Knagge

Carl von Ossietzky Universität Oldenburg, Germany

Over the last 25 years the options to start a career in the Renewable Energy (RE) field have increased significantly. This can particularly be observed for the graduates of the Postgraduate Programme Renewable Energy (PPRE) at Oldenburg University. Back in the late eighties and early nineties the RE sector was only a niche market and finding regular and well-paid employment was almost impossible. Graduates from this field started their own business, joined one of the few RE research institutions around then, returned to their previous engagements or found regular jobs in adjacent or even less related fields. And, if involved in RE, one was supposed to be a generalist, i.e. knowing almost everything in the straightforward RE field. The situation changed drastically within only some years, when the RE industry slowly in the beginning and then vigorously started to boom in the late nineties. Along with the growing number of jobs and options available, many new educational and research programmes were introduced worldwide and finding a proper engagement in the RE field was no longer a dream for most PPRE-alumni. A recent study shows that currently about 95% of PPRE alumni find an appropriate employment in the RE field. Along with the increasing number of opportunities positions offered in the RE field become more and more specific over the years.

For many positions the entrance requirements ask for more specialised competencies in particular RE fields and only to a lesser extent for generalists. The poster shows some examples of career paths of alumni in the Renewable Energy field and highlights the development of careers in the field over the last two decades. The data stem from the detailed PPRE-alumni data base and from a recent survey of 44 German postgraduate programmes.

P8-1:3 Energy Education in Oldenburg

Evelyn Brudler, Michael Golba

Carl von Ossietzky Universität Oldenburg, Germany

After many years of niche existence Renewable Energy (RE) has definitely reached the main stream. This applies to the implementation of RE technology, a differentiated research setting and – finally – also to Higher Education: Renewable Energy lectures, seminars, laboratory education, and excursions, and – not least - fully-fledged study programmes. These are preferable in postgraduate format, covering various technical topics, and also addressing different perspectives of the renewables in other non-technical disciplines, such as economy, informatics or politics are becoming ever more popular: Currently, there is hardly any German university which doesn't offer at least some lectures in this field. It also follows that RE has to cope with similar developments and dramatic changes as in other areas of Higher Education. As a consequence of these changes the universities - more than ever before - have additional freedom and options but at the same time more need and have to take more risks – and maybe more courage - to establish new study programmes with unique profiles. This applies also for the students, when deciding on their study profiles. Both, the organisation (in this case the university) and the person (in this case the student) are constantly required to make decisions. In order to take as much infor-

mation as possible into consideration the universities have to provide its applicants and students with valid information; in particular the career developments of its graduates. The poster gives an overview about Oldenburg Universities' pursuits to coordinate and conceptualise a transparent setting of RE related lectures and programmes with interlinked options for pursuing individual study profiles for students and graduates. This will comprise bachelor, master and PhD level as well as life-long-learning options. From the universities point of view emphasis is put on constant evaluation as well as following-up as to whether students have attained adequate professional positions.

P8-1:4 Blended Learning Renewable Energy Master Course

Tanja Behrendt, Larissa Krekeler, Michael Golba

Carl von Ossietzky Universität Oldenburg, Germany

A new master course will be developed at Oldenburg University, especially for the needs of employed people who would like to study renewable energies in addition to their job. It will be realised within a blended learning concept - a mixture of online and face-to-face learning. It is designed for those who cannot join face-to-face PPRE, EUREC or similar RE-Master programmes (for job-related or personal reason), which means them being away from their work place and family for 3 semesters. This concept allows high flexible learning, relative independent of time and space. A few compact face-to-face periods will provide the opportunity for hands-on experience (laboratory course) and to meet fellow students in person. Additionally online and face-to-face preparation modules will be offered to enhance harmonisation of competencies before starting the course. Overall the course will take 24 month (incl. master thesis) if studied full time. Within a joint project with the universities of Kassel, Hagen and Stuttgart as well as the Fraunhofer-Gesellschaft, Next-Energy, ForWind and Center for Lifelong Learning in Oldenburg different online courses will be developed. New learning methods with different tools and materials will be researched within this project and used for successful implementation of the Blended Learning Renewable En-

ergy Master. The complete course will be finished by 2017. The poster will give an overview of the planned course structure and first insights into pilot preparation modules and lectures which will be tested this summer and winter term respectively.

P8-1:5 Bi-national PhD Program Renewable Energy

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The DAAD (German Academic Exchange Service) funded Bi-national PhD Program Renewable Energy started in 2011. With the structured PhD Program Renewable Energy, in conjunction with Faculty V's Graduate School Science and Technology, our goal is to improve RE education at PhD level, meet international standards and offer a structure to follow on after the Master Degree Renewable Energy.

Research Areas

The research profile of the doctoral program:

1. Conversion and Storage of Renewable Energy Sources
This research area is based on the scientific methods of physics, chemistry and engineering sciences including: Wind Energy Systems, Thin Film Photovoltaic, and Energy Storage Technologies
2. System Integration and Management Research here is mainly based on modeling and characterization methods, computer science, meteorology and nonlinear dynamics (physics). The focus is on: Smart Grid and Demand Side Management, and Resource Assessment and Modeling
3. Societal Acceptance and Political-Economical Framework
This research area addresses the important and sensitive economical, political and environmental dimensions, when

it comes to RE. In particular it emphasizes the need for an interdisciplinary approach, including various techniques from economics or qualitative social research.

Bi-national PhD Program 'Renewable Energy'

With the bi-national PhD Program, both the University of Oldenburg and the University of Victoria, Canada, intend to create a forum for questions regarding the transformation of energy supply systems. Both universities have long-standing research and teaching experience in the area of RE. Program Aims and Features Innovative subject-related research projects Research in interdisciplinary and transdisciplinary contexts Structured doctoral training program Internationalization of the education Research stays of students at partner university Annual summer school (alternately in Oldenburg / Victoria) Since our start at the end of 2011 we have sent four students from Oldenburg to Victoria, British Columbia and three students from Victoria have been to Oldenburg.

P8-1:6 Prospects of the qualification in the wind energy industry - Challenges and opportunities of modern skills training on-site and off-site

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New technical possibilities for capturing wind energy have reinstalled the use of wind energy as energy resource within the European Community, as the increase from 17,315 MW[1] in 2001 to 89,670 MW 2011 in EU-15[2] prove. It is a booming industry with expected job increase of 250000 during the next decade[3]. Thus there is a need for well educated engineers and technicians for installing, maintaining and planning off-and on-shore windmills. In many cases, employees need to update their technical knowledge on windmills, grid integration, construction, installation, maintenance, etc. Also managerial topics are relevant since wind energy professionals are working worldwide and need knowledge on legislation as well as cooperation, flexibility, adaptability and team spirit skills. Maintenance is carried out on-site often by small teams off-shore. Due to different development status of the mills and continuous technological innovation, vocational training and on-site advice via tele-systems complete the qualification requirements. While basic knowledge can be gained in courses offered by universities and vocational training providers, the peculiarities of each windmill require experience and therefore accompanying qualification actions. The challenge is that the employee off-shore needs information on how to repair a part or how to handle a problem, eventually to ask

a more experienced colleague without leaving. For this he need to get access to a system in which he find training materials and guidelines for problem solving without leaving his workplace. A suitable mobile system might also allow direct online communication with experts and trainers. A virtual training room with access to a knowledge base, a risk free training environment, e.g. serious games and to web2.0 applications for all employees could support the qualification of personnel independently of location. This article will discuss challenges and opportunities for virtual training environments to be used for staff qualification.

[1] http://www.gwec.net/fileadmin/images/Publications/GWEC_annual_market_update_2010_-_2nd_edition_April_2011.pdf

[2] http://www.ewea.org/fileadmin/ewea_documents/documents/publications/statistics/Stats_2011.pdf

[3] http://www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/Jobs_pamphlet_lr.pdf

P8-1:7 On the Importance of Public Understanding of Renewable Energy

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Public understanding of science PUS is a well-known concept among science communicators. Public understanding of renewable energy PURE is proposed as an important sub-concept of PUS. The aim of my presentation is to invite renewable energy scientists to join a PURE research project. I will be happy to, at least initially, coordinate the project. We can identify four separate important questions for such a project to answer:

(A) Is PURE important? (B) How to achieve PURE? (C) Which issues of PURE are the most important ones, according to renewable energy scientists? (D) What understanding of renewable energy has the general public today, worldwide?

A. An overwhelming majority of scientists in relevant fields of science agree that (1) carbon dioxide is a greenhouse gas, (2) human activities, primarily combustion of fossil fuels, increase the level of CO₂ in the air, (3) Fossil fuels for production of useful energy must be replaced by renewable energy sources. (Whether nuclear energy can be part of the solution is questionable.) In order to facilitate a historically fast transition from fossil fuels to renewable sources of energy, these have to be accept-

ed by the general public. Therefore, the answer to question A is in my view that PURE is important.

B. Increasing PURE is done using a multitude of means, among them schools, TV, journals, social (Internet based) media, and science centres. Important components of achieving PURE might be informal learning, interactivity and hands-on experience.

C. Which kind of renewable energy knowledge is the most important for different target groups - consumers, producers, decision makers, city people, farmers, etc.?

D. To know where to start, we have to find out, what kind of understanding people have, and what is missing.

P8-1:8 Equipment for technical education in the field of Renewable Energies

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GUNT Gerätebau is a leading supplier of technical equipment for engineering education. Since several years the 2E division of GUNT, concentrates on didactic equipment for the field of energy and environment. The objective of 2E is to integrate the principles of sustainability into the field of technical training, and to develop a carefully thought out spectrum of teaching and research equipment for the energy and environmental sectors that meets high didactic demands. This conference paper focuses on basic principles for new 2E devices and will give overview of the didactic concept that follows the 2E curriculum. As an example the modular 2E training system for solar thermal energy HL320 will be explained in more detail. This system demonstrates the main practical components for solar heating. Additional modules enable extensions with storage tanks, different heat consumers and a modern heat pump. The system concept deals with didactic training aspects from practice and theory, ranging from the correct filling process with a heat transfer medium through to the calculation and optimization of effective power. Effective use of modern hard- and software for energy metering supports the proposed range of experiments. The contribution will conclude with an outlook on running and upcoming 2E-projects.

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Publisher

Postgraduate Programme Renewable Energy (PPRE)

Editorial Team

Claudia Braden, Andreas Günther, Michael Golba

Layout

Per Ruppel, Oldenburg

Translation

Julia Rudman

Printing

Flyerheaven, Oldenburg

September 2012

DAAD



Bundesministerium für
wirtschaftliche Zusammenarbeit
und Entwicklung



Auswärtiges Amt



Niedersächsisches Ministerium
für Wissenschaft und Kultur



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