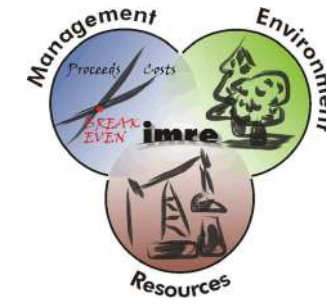
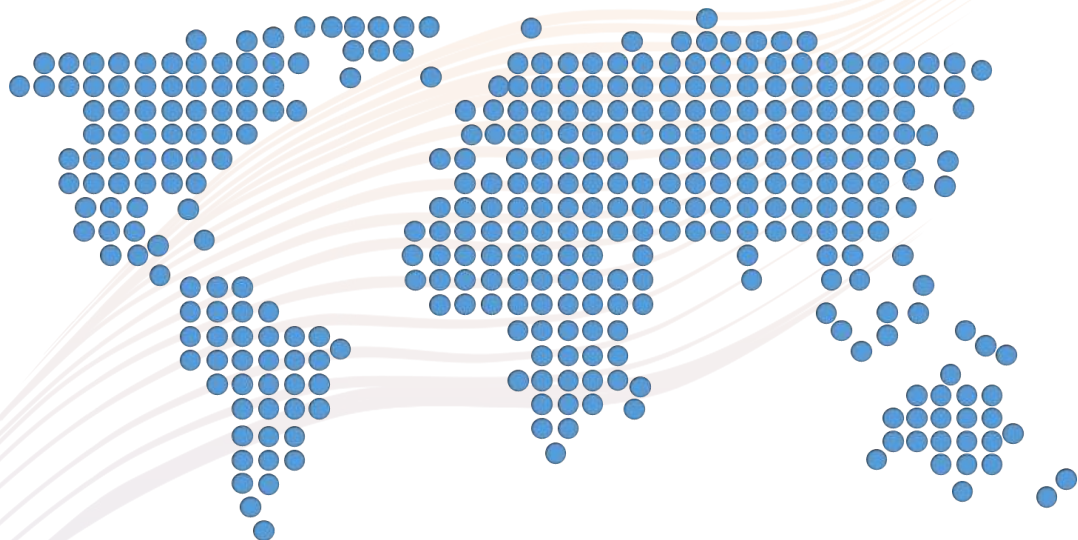


# MANAGEMENT OF ENVIRONMENT AND RESOURCES

## Annual Report 2017



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After retirement of JCB on April 1, 2017, all responsibility for the MBA IMRE Study Programme has passed on to Prof. Magnus Fröhling. As a result, lecturing within the IMRE Programme has come to an end and more time is available for international projects and for research. The format of this annual report has therefore also changed.

## URM TEAM

### Head of the Chair of Environment and Resources Management (URM)

Prof. Jan C. Bongaerts



### Research Associate

Dr. Jiangxue Liu



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M. Sc. Katharina Rosin



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## CEMEREM Project



In April 2016 a new project entitled “Development of a Centre of Excellence for Mining, Environmental Engineering and Resource Management (CEMEREM) started up. It is a joint project of Taita Taveta University (TTU), Voi, Kenya, the University of Applied Sciences Dresden (HTWD) and TU Bergakademie Freiberg. The purpose is to develop CEMEREM at TTU in the next five years. CEMEREM has four main objectives:

- Education and training of students and staff of TTU and of members of stakeholder organisations of CEMEREM
- Promotion of research
- Development and operation of

specific laboratories for issues of the natural resources sector

- Community outreach

The project also aims to foster scientific and cultural exchange between the project partners, industrial and governmental institutions in Kenya and Germany. Until the end of 2017, the financing of the project is secured by the Ministry of foreign affairs of the Federal Republic of Germany through DAAD. The government of Kenya spends a considerable sum of money on the construction of a new CEMEREM building on TTU’s campus.



*DAAD’s Film Team Underway for CEMEREM*

## Brainstorming Workshop at TU Bergakademie Freiberg

**15th May 2017:** a brainstorming workshop took place at TU Bergakademie Freiberg. 27 participants comprising researchers, industry experts and students were in attendance. Prof. Hamadi Boga of TTU explicitly travelled from Kenya for the strategic session. The purpose of the brainstorming workshop was to raise and collect innovative ideas for continuation of the CEMEREM project for the years 2018 – 2020. A so called “Metaplan” - a well-known procedure for collecting and processing ideas as well as a decision-making method, was used to generate topics. All participants were

sub-divided into working groups consisting of 3 to 4 members. Each group was required to contribute topics and associated measures they thought were important for the development of the Centre. In total, 78 topics were generated. Next, the participants identified their preferred topics and assigned different levels of priority to each topic. The 78 topics were sorted into nine categories. The most preferred category was ‘Teaching and professional training’. Many topics generated from the workshop have been used as input in the CEMEREM II proposal.



*Brainstorming Workshop at TU Bergakademie Freiberg*

## CEMEREM Opening Ceremony

**6 April 2017:** The official opening ceremony of the new CEMEREM Centre took place at the main campus of Taita Taveta University in Voi. The new DAAD Centre of African Excellence will be hosted in the CEMEREM building with lecture and seminar rooms and laboratories for academic education, professional training and continuous education, research and services to stakeholders and communities.

The ceremony was honored by the presence of John Mruttu, Taita Taveta County Governor, John Mruttu and Jutta Frascher, Ambassador of

the Federal Republic of Germany. TU Bergakademie Freiberg representatives were Prof. Dr. Jan C. Bongaerts, Prof. Dr. Carsten Drebenstedt and Dr. Jiangxue Liu. HTW Dresden was represented by Prof. Dr. Knut Schmidtke, Vice Rector and Prof. Dr. Ulrike Feistel. The German Industry and Commerce Delegation in Kenya was headed by Country Director Maren Diale-Schellschmidt. Representatives of all other DAAD Centers of African Excellence were also present to take part in the annual meeting of the Centres which coincided with the CEMEREM opening ceremony.



*CEMEREM Opening Ceremony at TTU: Family Photo with Dignitaries*

Prof. Dr. Hamadi Boga, the vice chancellor of TTU, placed emphasis on the new Centre as “a dream come true” for TTU. He praised the strong, determined partnership of the three participating universities which were able to demonstrate remarkable successes in the first year of the center’s operation. Ambassador Frascher shared an overview of the activities of the Federal Republic of Germany in Kenya in the field of education. Governor Mruttu explained that the Taita Taveta county and region would give rise to special development opportunities with the presence of the TTU, the potential of which is strengthened by CEMEREM.

A panel discussion was then conducted with representatives from the



*Prof. Dr. Hamadi Boga*

universities as well as the business community. All participants unanimously concluded that CEMEREM is a fundamental step in the right direction for its novel opportunities in students’ education and training for the various roles needed in Kenya’s growing raw material sector.



*Left: Freiberg Delegation with Prof. Hamadi Boga, Middle: Official CEMEREM Opening Ceremony at TTU, Right: Presenting a Letter by Rektor Prof. Barbknecht of TU Bergakademie Freiberg*

## The First CEMEREM Summer School in Germany

**9th - 16th July 2017** The first CEMEREM summer school took place at HTW Dresden and TU Bergakademie Freiberg. The participants comprised 18 students and staff selected by TTU. They were conducted through a dense program comprised of various lectures and visits to Dresden, Welzow and Freiberg.

The program started with a lecture session given by Prof Grischek, Prof. Bongaerts, Prof. Feistel, Dr. Jiangxue Liu and Nashon Adero. Topics covered included Post-mining water issues, Financing related to Mining Projects, Climate Change and Renewable energy potential in Kenya. Par-

ticipants then presented their research work and results in the poster session.

In Dresden, visits were made to DREWAG power (Combined Heat and Power) station at Nossener Brücke. The group were given an insight into electricity generation and heat recovery technologies with an overall efficiency of close to 90%. The power generator's business model was also explained to showcase the optimal cash flow generation. A visit to the Hosterwitz Waterworks revealed the general concept of treating bank filtrate to provide drinking water.



*CEMEREM Summer School at HTWD*

A visit to Welzow-Süd opencast lignite mine and its post-mining rehabilitation site gave participants an overview of the technical, economic and ecological aspects of current lignite mining in Germany, including the legal framework for mine closure, land reclamation and re-cultivation.

In Freiberg, beside visits to the laboratory in the Institute of Thermal Engineering and Thermodynamics and the laboratory in the mining institute at TU Bergakademie, participants toured the underground mine at "Reiche Zeche". They descended 145 meters underground following the traces of the miners of the 16<sup>th</sup> to 19<sup>th</sup> century. The geology of the silver deposits, the mineralogy of the actual veins, as well as the development of mine

technology was covered. A visit to Agrargenossenschaft in Clausnitz provided the opportunity to practically observe energy production from biogas. The farm co-operative operates a unique natural resources cyclical management concept growing its own fuel sources for use in machinery, generating electricity with PV panels, windmills and biogas plants. Heat from the power stations is used on-site and in the village housing units while sludge output is recycled on agricultural land.

The last day of the seminar was devoted to closing remarks, handing out awards for the best posters and a discussion about the overall evaluation of the seminar in view of similar future events.



*Visits to Welzow Open Pit Mine, TU Bergakademie Freiberg, Agrargenossenschaft Clausnitz*

## Administrators Training

**9th - 16th July 2017** The administrators training took place parallel to the Summer school. Two staff of TTU, Prof. Arap Too and Mr. Habib Mruttu travelled to Germany for a training week at HTWD Hochschule Zittau/Görlitz (HSZG) and TU Bergakademie Freiberg with a special focus on administrative frameworks, arrangements and procedures of university management at the German Partner Universities.

In Dresden, they were welcomed by Prof. Stenzel, Rector of HTWD. After the official opening of administrators training and the Summer School, the delegates had meetings with staffs of HTWD. Mr. Prautzsch, head of the Financial Department of HTWD, introduced the responsibilities and activities of his department and he explained the financial procedures of HTWD, including third party funding and its administration. Mr. Ifland and Mr. Schuster from HTWD's Procurement Department briefed the delegation on HTWD's procurement framework and procedures.

Together with Summer School participants, the delegates visited the Welzow-Süd opencast lignite mine



*Administrators Training at HTWD*

and its post-mining rehabilitation site.

In Zittau, the delegates had a meeting with Prof. Schoenherr, Head of iTN Research Institute and his staff. After an introduction into iTN's current research, Dr. Clemens Schneider gave an overview of the work of the Institute of Process Technology, Process Automation and Measuring Technology (IPM).



*Visits to Welzow Open Pit Mine*

After the visit to the Power Plant Simulation Laboratory and the Physics and Chemistry Basics Education Laboratories, the delegates also met with Prof. Heidger, Prorektor for Academic and International Affairs and with Prof. Fuchs, Dean of the Natural and Environmental Science Faculty. As an analogy to the meetings at HTWD, they received a briefing from Dipl.-Jur. Hollstein, HSZG's Administration Head, on administrative frameworks, procedures and approaches at TTU and HSZG.

In Freiberg, the delegates were received by Ms. Ingrid Lange, Head of the International University Centre for a meeting about TU Bergakademie's international activities, both for incoming and outgoing students and staff. Dr. Wopat of GraFa, the University's PhD Administration and Counselling Centre, explained the procedures for PhD students and she highlighted the various educational offers and support activities available for PhD students in order to improve their research efforts and productivity. Ms. Cindy Wolf of the International Admission Office showed the administrative procedures for the acceptance of international applications, the registration of accepted international applicants, the docu-



*Administrators Training at HSZG*

mentation and monitoring of their academic records, the finalization of their graduate certificates and the repository of archives. Both administrators were also given an exclusive workshop by Dr. Rocco Haustein and his assistant of SAXEED, the University's Consultancy for spin-off company creation. During their workshop, they showed how they train, assist and empower students and staff to set up their own business based on study results and knowledge inputs experienced in their university careers. As a result of that workshop, SAXEED representatives plan to spend a week at TTU for similar workshops at TTU's main campus and at the campus of SAEES in late November 2017.

## The first CEMEREM Conference

In order to bring together academia, government and industry to discuss education and applied research in mining the natural resource sectors, CEMEREM organized its 1<sup>st</sup> international CEMEREM conference on Mining and Mining Education in Africa. The conference was held in Nairobi on 15th and 16th November at Sarova Panafric Hotel.

Representatives from the three partner universities, Taita Taveta University (TTU), University of Applied Sciences Dresden (HTWD), TU Bergakademie Freiberg as well as experts from Kenya, Germany, Ghana, Namibia, South Africa and Zambia attended. DAAD was represented by its Regional Office Nairobi Director Dr. Blumbach.

Prof. Hamadi Boga, Vice Chancellor of TTU, expressed his delight about the establishment and the development of CEMEREM since the start-up of the project. CEMEREM Team Leader Prof. Ulrike Feistel (HTWD) gave an overview of the main objectives of the CEMEREM project, its history, its first achievements and the activities of CEMEREM II in the coming years 2018 to 2020. She also highlighted a future perspective of



CEMEREM in 2030 within the context of the Kenya Vision 2030. Dr Helmut Blumbach took the opportunity to present the plan for a German-East Africa University of Applied Sciences. He also announced that DAAD funding of CEMEREM Phase 2 for the time period of 2018 to 2020 is now confirmed.

Participants were briefed on education for mining by representatives of the University of Zambia, Namibia University of Science and Technology, University of Mining and Technology, Ghana and Nairobi University. Speakers highlighted the importance of establishing links between universities and industry as a crucial prerequisite for education.

Prof. Jan C. Bongaerts explained the role of mineral resource education, especially within the CEMEREM project, to avoid the so-called Resource Curse and to move towards a sustainable wealth creation in resource-rich countries, in particular in Africa. Colin Forbes, (the Kwale Mineral Sands Project), gave a lively overview of approaches and instruments of his

company to ensure a sustainable community development and stakeholder management.

Other presentations highlighted current practices in education, including vocational training, for mining, minerals process engineering and resources management in various African countries. A special session was devoted to young scientists presenting their recent research. Participating students were encouraged to ask questions and present their remarks to highly qualified and experienced panelists.

All in all, organizers and attendants considered this event to be successful, expressing their desires to have similar conferences in the future.



*Participants to The 1<sup>st</sup> International CEMEREM Conference on Mining and Mining Education in Africa*

## ERASMUS Project

Teachers of Novi Sad University from Serbia visit TU Bergakademie Freiberg in the framework of the ERASMUS Plus Programme of URM. From 16 to 21 October, a delegation of Novi Sad University visited TU Bergakademie Freiberg. The exchange visit took place in the framework of an ERASMUS Plus Project of URM - IMRE. The members were briefed on the activities of the International University Centre, the PhD Centre (Graduierten- und Forschungsakademie – GraFa) and the International Student Office. They also visited several laboratories, including the underground mine and they had individual bilateral meetings with scientists of TU Bergakademie Freiberg. They also had an excursion of the agricultural research campus of Hochschule für Technik und Wirtschaft Dresden ((University of Applied Sciences) and to Agrargenossenschaft Bergland in Clausnitz to have a hands-on contact with the farm's renewable energy projects. They also had a meeting with students of TU Bergakademie Freiberg to examine possibilities for bilateral student exchanges.

Prof. Dr. Hermann Heilmeyer of the Institute of Bio-Sciences had a fruitful meeting with with one member from Novi Sad, saying: „It was a good op-

portunity to meet this colleague. We have found common interests with a perspective for scientific co-operation. As a result, I have concluded to accept an invitation for a conference at Novi Sad from 9 to 12 June of next year for a presentation of my work and establishing new contacts.”

Dr. Jasna Grabić was also very happy: „Our expectations were fulfilled. We have been able to collect valuable and useful information. We had meetings, visits to laboratories, we did excursions and we learned how TU Bergakademie manages teaching, research and administrative matters. We are quite impressed. Going home, we will explore further options for bilateral exchange of staff and students of our universities.“



*Members of Novi Sad University Visiting the Mine of TU Bergakademie Freiberg*

## DAAD Centres of African Excellence meeting in South Africa – Cape Town, 26 – 30 November

Organized by the South-African Centre for Development Research and Ruhr University Bochum, this event gathered around eighty participants, many of whom have graduated from one of the DAAD African Excellence. As such, it was also a “DAAD Alumni meeting”. The conference was devoted to the topic of Inter-African and International Migration out of Africa to other continents, whether out of political, economic, voluntary and other motivations. The topic is important for Germany's international policy-making for Africa. By far the largest migration takes place within Africa and movement to Europe only count for comparatively small numbers. There is also no clear distinction among the motivations.

Each DAAD Centre represented at

the Conference was invited to describe its contribution to the topic. Prof. Jan C. Bongaerts, acting on behalf of CEMEREM, noticed that mining always implies mobility, since miners (and others) move to where mining happens. As a matter of fact, such a movement gave also rise to the city of Freiberg in the middle of the 12<sup>th</sup> century. He added that it will become a task for CEMEREM to ensure that, especially in Africa, mining with its inevitable mobility enables sustainability as an activity allowing for value creation and, possibly, community development after mine operations close down. He also used the occasion for contacts with other participants within the framework of the DAAD Centres of African Excellence Network.



*DAAD Alumni Meeting in Cape Town, South Africa*



### InnoCrush

Since 2016, scientists at TU Bergakademie Freiberg have initiated a Research Project entitled "InnoCrush" with the intention to develop and optimize a technology for high selectivity in mining and for pre-processing. This project is financially supported by the European Union (European Social Fund) and the Saxonian Government (Grant No. 100270113). The technology to be developed must be highly-automated as a "Smart Mining Technology" – SMT – and it must integrate all relevant issues and knowledge related to mineralogy, geotechnics, mining engineering, remote sensing and automation and, finally, minerals processing. This technology would be used especially for the extraction of minerals from vein deposits with following benefits:

- Reduction of ore losses and avoiding dilution,
- Unlocking a feasible extraction of previously non-economical deposits or parts of deposits,
- Reduction of the effort of separating gangue rock,
- Reduction of the environmental impact,
- Reduction of energy and materials consumption.

In order to establish SMT, already at the stage of emergence, it is important to identify and assess its eco-



nomically, its technological and environmental impacts and its impacts on stakeholders. In order to achieve this task, an integrated economic-techno-enviro-socio evaluation model must be developed in order to evaluate four dimensions, both in separate and integrated ways. The ultimate results of the research enable the establishment of SMT in overall optimized conditions.

The major objectives of the research work to be performed by Katharina Rosin and Dr. Jiangxue Liu can be defined as follows: (1) developing a method to estimate mining and processing costs of SMT, (2) developing a method for estimating the benefit of SMT regarding technological, ecological and social aspects, (3) providing a basis for decision-making on the adoption of SMT in comparison to the previous drill and blast method. The expected outcome is an integrated evaluation model with consideration of economic, technological, environmental and social aspects needs to be developed. First results were presented at the International Conference for Young Scientists in Saint Petersburg (see Page 16).

### Resource – Efficient Production and Provision of Products

The PhD project of Nicoleta Gurita has the aim to design incentive-based approaches to sustainable and resource-efficient delivery of small electronic products and a recovery of strategic and critical metals from electronic waste. She has now developed a mathematical model to measure the stocks and the monetary value of strategic and critical metals stocks in selected electronic equipment. She has also explored the current German Waste Electrical and Electronic Equipment (WEEE) Management System for

mobile phone and smartphone waste streams with the goal of identifying the potential of closing the resources loop. She has set up a cost benefit analysis for the end-of-life management of mobile phones and smartphones to find out that there are significant potential revenues from recycling these products. This leads to the design of Product Service Systems (PSS) to achieve a closed loop supply chain for strategic and precious metals in small electronic products.

### Selecting “green” construction products generated in mining operations as a complex issue of decision-making

Selecting “green” construction products as a complex issue of decision-making: this PhD project of Mariia Rochikashvili addresses any relevant information, awareness, various sets of criteria, materials properties, regulatory affairs etc., which all have impacts on minerals and non-minerals as construction products for decision-makers within and around the con-

struction industry and its supply chains.

The focus is on a deep analysis and understanding of this decision-making process and how it can be modelled and modified for bringing more “green” construction products within the scope of the decision-makers.”

### Energy from renewable sources for the mining and minerals sector

The PhD project of Kateryna Zharan deals with an analysis of possibilities to implement energy from renewable sources in mining industry. Applications to mining projects in RSA are of complementary importance. The project includes an investigation of technological approaches and an evaluation of economic and environmental

perspectives. An important part of the work relates to the study of real-world cases in important mining countries around the world, notably Australia and the Republic of South Africa. It is expected that appropriate business models and their “enviro-socio-economic” valuation can be established.

### Economic and technical utilization of Associated Petroleum Gas – Case study Yemen

The PhD project of Arfan Obaid aims to find a solution of the existing flaring practice of the associated petroleum gas, taking Yemen as a case study. The research joins the forces for more sustainable business in the field of utilizing the Associated Petroleum Gas (APG). The main objective is to decrease the CO2 emission by finding alternatives to flaring, except for safety reasons. APG is the gas, that along with water, accompanied the crude oil production which is found either

dissolved in the oil or as a free “gas cap” above the oil in the reservoir. Despite the existence of vast number of possible applications of the associated gas, the most widely applied approach is Gas Flaring; such approach is broadly used due to its simplicity and feasibility. The goal is to develop a decision-making model to sustainably utilize the Associated Petroleum Gas, taking into consideration the available utilization options.

### Innovation and implementation of KPIs in Environmental Management

The PhD of Maslar Naser is dealing with innovative appropriate KPIs for performance measurement system

concerning concrete case studies related to growing industrial sectors and new production technologies.

### International Forum of young scientists at the National Mineral Resources University (Gornyi), Saint Petersburg

This famous annual conference attracts students and young researcher many countries. This year, they came from Canada, Chile, China, many European countries, India, Mongolia, Pakistan, Thailand and Vietnam. Nine working groups were arranged for presentations on the entire natural resource development value chain from prospecting, exploration, preparation, construction, production, energy generation and use to mine closure and rehabilitation. Attention was also paid to environmental protection, geo-information systems, nano technologies and economic instruments for innovations.

TU Bergakademie Freiberg delivered 18 contributions in eight working groups. It should be noticed that the Freiberg delegation itself was very international. Traditionally, the presentations take part in competitive contests for students and PhD researchers for each working group. The winners are announced in the final ceremonial session in the grand auditorium of the historical campus. The Freiberg delegation took home more than 15 awards. Katharina Rosin, URM staff member and researcher within the



*International Forum of Young Scientists in Saint Petersburg © Pressefoto "Gorny" Universität*

InnoCruh project, was awarded with a First Prize in the working group on economic instruments with her paper on an integrative method for a comprehensive evaluation of new mining technologies.



*Katharina Rosin Awarded the First Prize,*

## Contribution to the 68<sup>th</sup> Freiberg Research Forum – economically attractive, innovative and sustainable - Photovoltaics has reached the market June 15, 2017

Every two years, the Freiberg Silicium Days take place in June. Around 200 experts from around the world come to listen to papers and discuss issue on photovoltaics, such as sawing, material recycling, silicon deposition, nanostructures, crystallizations and etching and cleaning. This year, an opening session on the economics of photovoltaic electricity in mature markets was organized by URM.

The four speakers included Prof. Jan C. Bongaerts with an overview of the recent development of investments in photovoltaic (PV) plants, generation of PV electricity, and future trends of



costs and electricity prices, PhD candidate Florian Unger presenting an interesting scenario about the City of Frankfurt's strategy to become fully dependent on energy from renewable sources, PhD candidate Kateryna Zharan about renewable energy in mining and Meng-Chun Lee about PV as an economically viable option to avoid CO2 emissions in public buildings (See also below.)

## Fourth MOTA Conference

Prof. Jan C. Bongaerts participated in the Fourth MOTA Conference (Mining On Top in Africa) as Invited Speaker. The conference was attended by leaders and government officials of several African Mining countries and by members of mining associations, mining companies, mining equipment suppliers and geology and mining technology consultants. His presentation was on education for mining in Africa with CEMEREM as an innovative example.



## Chemnitz Project

The project which was started up several years ago, continued in 2017. It enables students to participate in research activities and gain first-hand experience on climate change and energy policy of the City of Chemnitz. In 2017, the Master's Thesis project of Meng-Chun Lee was presented in a colloquium. The purpose of the project was to calculate the costs of avoiding carbon dioxide emissions using renewable energy technologies in city buildings. All 35 buildings with such technologies were investigated in detail in order to determine the current climate policy gap between intended and current reductions and current. From there, the costs of electricity generation (so-called LCOE) and the marginal abatements costs (MAC) of (in comparison with specific reference cases) were estimated for each building. On that basis, investments for the city of Chemnitz to meet the climate mitigation policy targets (= closing the gap) were estimate for various technology scenarios.

The next project dealt with the estimation of carbon dioxide emissions by industry and trade within the city limits. This subject suffered largely from the unavailability of data and the origi-



nal research design had to be modified. It resulted in the compilation of guidelines for the city administration and its industrial and trade partners to develop a policy for the assessment and the reduction of carbon dioxide emissions.

The third project constituted a novelty for the city's climate policy. It has been criticized because it does not include topics, such as the life-style of citizens, the climate foot print of their every-day consumer behaviour, their awareness of vegetarian/vegan diets, the purchase of long-lasting products, re-use and recycling, bans of plastic bags, mobility and free time activities. Hence, 11 cities (Gothenburg in Sweden, Frankfurt in Germany, Sendai in Japan, Bologna in Italy, Manchester in England, Barcelona in Spain, Ljubljana in Slovenia, Akron in the USA, Taiyuan in China, Terrassa in Spain and Uppsala in Sweden) were selected for an investigation of these issues and how they are integrated in their climate policies.



## Chemnitz Project

The methodology had three components:

- collecting the data from the internet
- detailed analysis of the climate change programmes of the cities
- sending questionnaires to the cities about their climate change programmes

As it turned out, due to the availability of data and received answers, it was

possible to deal with four cities in detail: Gothenburg, Frankfurt, Manchester and Sendai. Even with this limitation, a wealth of information was obtained about activities and measures taken by these four cities. It can serve as a source of inspiration for a review of some of Chemnitz' climate policy priorities.

## A novel approach towards stakeholder management: complete flexibility for the assessment of stakeholders and their interests and concerns - A project initiated by JCB

Stakeholder management is an important issue in mine planning and mining operations. The purpose of this paper is to present a new way of stakeholder assessment going beyond standard approaches, such as the Gardner Model and the Saliency Model of Mitchell, Agle and Wood. The new approach is based on the Advanced Hierarchy Process (AHP) method. Its main advantage consists in the fact that, in comparison with existing approaches towards of stakeholder management with their predeter-

mined categories of stakeholders, it allows for a complete flexibility in stakeholder assessment and evaluation. This flexibility also enables a practical approach towards the evaluation and assessment of the interests and concerns of stakeholders. In consequence, companies applying the method are placed in a position to design and implement their own stakeholder management without any reference to models presented in the literature.

## Publications

**Rochikashvili, M., Bongaerts, J.C., 2016.** *Multi-criteria Decision-making for Sustainable Wall Paints and Coatings Using Analytic Hierarchy Process.* Energy Procedia, Volume 96, September 2016, Pages 923–933

**Rochikashvili, M., Bongaerts, J.C., 2017.** *Prediction of User Behaviour on the Basis of Key Determinants of Sustainability for Wall Paints Used in Construction with the Help of the Analytic Hierarchy Process.* *Journal of Environmental Accounting and Management*, 5(2), 2017, pp. 77-86

**Zharan, K., and J. C. Bongaerts. 2017.** "Decision-making on the integration of renewable energy in the mining industry: A case studies analysis, a cost analysis and a SWOT analysis." *Journal of Sustainable Mining (Elsevier)* 1-9. doi: 10.1016/j.jsm.2017.11.004.

**Rochikashvili, M., Bongaerts, J.C. 2017.** *Prediction of User Behaviour on the Basis of Key Determinants of Sustainability for Wall Paints Used in Construction with the Help of the Analytic Hierarchy Process.* *Journal of Environmental Accounting and Management*, 5(2), 2017, pp. 77-86

**Gurita, N., Bongaerts, J.C., Fröhling, M. 2017.** *Forthcoming.* "Assessing Potentials for Mobile/Smartphone Reuse/Remanufacture and Recycling in Germany for a Closed Loop of Secondary Precious and Critical Metals." submitted to *Journal of Remanufacturing*, accepted for publication

**Gurita, N., Bongaerts, J.C., 2017.** *Cost-benefit analysis of WEEE recycling in Germany.* As in Christian Ludwig, Cecila Matasci (Eds.), (2017): *Boosting Resource Productivity by Adopting the Circular Economy.* A world Resources Forum Production Printed by Paul Scherrer Institute Villigen PSI-October 2017. ISBN 9783952140970

**Rosin, K., Liu, J.X., Bongaerts, J.C. 2017.** : *Development of an integrated model for sustainability assessment of an new "Smart Mining Technology, Proceedings of the International Forum of young scientists at the National Mineral Resources University (Gornyi) in in Saint Petersburg, 19 – 21 April 2017*

CIRP Spring School on Industrial Product/Service System (IPSS) - Optional Course in PhD Studies at Department of Mechanical Engineering Technical University of Denmark  
Participant: Nicoleta Gurita

68. BHT – Freiburger Universitätsforum 2017, Freiberg Silicon Days/2nd PhD Conference, 7 – 8 June 2017, Freiberg, Germany  
Participants: Prof. Jan C. Bongaerts, Mengchun Li, Florian Unger, Kateryna Zharan

Solar World Congress 2017, 28 Oct - 2 Nov 2017. Abu Dhabi, UAE.  
Participant: Kateryna Zharan

The 1st Conference on Mining and Mining Education in Africa, 15 - 16 November 2017. Nairobi, Kenya  
Participants: Prof. Jan C. Bongaerts, Kateryna Zharan

ENVIREE Krakow Summer School on Rare Earth Elements recovery and environmental issues, 26 – 28 April 2017, AGH – University of Science and Technology, Krakow, Poland  
Participant: Kateryna Zharan

Advancing Energy Policy Summer School, 19-23 June 2017 ENTRE Lyon, France  
Participant: Kateryna Zharan

PhD researcher internship: ENERWATER project setting a standard method and online tool for assessing and improving the energy efficiency of waste water treatment plants (H2020-EE-2014-3-MarketUptake), 20 Nov – 4 Dec 2017, University of Santiago de Compostela, Spain  
Participant: Kateryna Zharan

World Resources Forum 2017, 24-25 October 2017, Geneva  
Participant: Mariia Rochikashvili, (Katharina Rosin, Jiangxue Liu Poster)

International Forum of young scientists at the National Mineral Resources University (Gornyi) in Saint Petersburg, 19 – 21 April 2017  
Participants: Katharina Rosin, Prof. Jan C. Bongaerts

International Raw Materials Career Days in Krakow  
Participants: Katharina Rosin

5th International Colloquium of Non-Blasting Rock Destruction  
Participant: Katharina Rosin, Jiangxue Liu

Eric Dalke	Analyse, Bewertung und Einführung eines geeigneten Gefahrstoffmanagements für das Unternehmen IHI Charging Systems International am Beispiel des Standortes Ichttershausen
Mostofa Akm Golan	Techno-Economic Feasibility Study for Coal Mining Project: Case Study - Northern Part of Barapukuria Coal Field, Bangla Desh
Ali Alp	Evaluation of Investment Opportunities in Renewable Energy Sector and Investment for Wind Power in Turkey
Meng-Chun Lee	Cost of avoidance of CO <sub>2</sub> emissions from renewable energy sources in public buildings of the city of Chemnitz
Ritika Srivastava	The contribution of industry, small-scale industries, trade and services in the context of energy targets of the European Union. The Federal Republic of Germany and the Role of the City of Chemnitz
Ana Munguina	Case study on the application of the Analytical Hierarchy Process: Evaluation of local opportunities for CEMEREM
Agarwal Varun	Institutional Alternatives for Piped Water Supply: A Critique of the Dominant Discourse and an Effort towards a Framework for Decision-Making
Alla Zhuzha	Complex Decision Making on a New Innovative Product with Respect to Quality, Cost and Human Resources Requirements in a Make-or By Setting -- with a Case Study on Witthinrich GmbH
Gloria Auma Njagah	Analysis of Factors Determining Industrial Solid Waste Management in Kenya
Esuola Abolade Oladipuo	Migrating from perennial energy crisis to a sustainable renewable energy resource via integrated solutions: Nigeria's case
Sandra Viviana Calderon Franco	Impact of distributed energy generation on the electricity market and the emergence of new business models in developing countries: Colombia as a case study
Timo Herrmann	Auswirkungen der Mantelverordnung auf die Verwertung von Bauabfällen in Bayern
Jonas Beer	Selective Diamond Nucleation on Silicon Substrates with an Iron Thin Film

## Smart Biogas: An efficient system for sustainable and decentralized organic waste management

Nagaro GmbH is a German renewable energy company dedicated to provide a cost effective organic waste processing system through the generation of biogas in the form of portable smart biogas plants. They can be used in decentralized applications ranging from households to semi-commercial level. Nagaro's prefabricated and portable Smart Biogas plant consists of a digester tank and a biogas storage chamber. It was developed and built by Azim Khan Niazi, IMRE Alumnus in close co-operation with Erik Ferchau, researcher on biogas at Institut für Wärme- und Gastechnische Anlagen of TU Bergakademie Freiberg. It was tested for several months under various conditions of weather and with a large variety of feedstocks at Agrargenossenschaft „Bergland“ Clausnitz e.G. , a co-operative farm with a lot of experience in the generation and the use of renewable energy from different technologies.

The digester tank is made out a (used) High Density Poly Ethylene (HDPE) IBC container. Waste parts from cars such as an electric motor can be re-used. Its attractive design and its portability are unique features. It is easy to manufacture and to operate, with a manually or electrically driven rotor for the con-

tinuous stirred tank reactor (CSTR). Tests, depending on various feedstocks, have revealed production amounts of 2 cubic meter biogas per day, allowing a single stove burning up to up to 10 hours. Feedstocks are manifold: animal manure, organic waste from food, starchy material, used frying oil, coffee waste etc. mixed with water. Applications can be cooking, heating, fruits drying etc. The main products of the Smart Plant are methane with a composition ranging from 55 – 68% and an effluent with excellent properties as fertilizer for organic farming in fields and gardens and as soil conditioner. It also helps to reduce GHG emission by replacing fossil fuels. Nagaro has developed a strong network in Kenya, Indonesia, Nepal and Pakistan with support from Prof. Jan C. Bongaerts and MBA IMRE Alumni.



*Muhammad Azim Niazi Khan and Erik Ferchau showing theirs Smart Biogas Plant in front of a “big brother”*

In 2017, with the help of Annisa Rahmawati, IMRE Alumna, Nagaro has installed two Smart Biogas Units in Indonesia with five other units to be shipped to Indonesia in January - February 2018. The first Smart Biogas Unit is operated by Ms. Yayuk, a small organic farm holder near Nganjuk City on Java. The second Unit was installed at Bumi Langit Institute Yogyakarta, founded by Iskander Waworuntu. Bumi Langit is described as “a living place where people witness and learn about the importance of mutual living between man and nature”. Nagaro has signed MoUs with Hardic Associates Pvt. Ltd Nepal and with Adikarya Agribusiness Indonesia, Inti Surya Engineering Indonesia and the State Polytechnic Institute Malang (POLINEMA) Indonesia.



*Azim Khan and Annisa Rahmawati at Bumi Langit, Yogyakarta, Indonesia*

Nagaro is also involved in technical support for education and training within CEMEREM. As of January 2018, four Smart Biogas Units will be opera-

tional at TTU's main campus in Voi and at its agricultural campus in Ngerenyi. The intention is to expand the project beyond the university in co-operation with the local farming communities.

As a part of the CEMEREM Smart Biogas Project, Joshua Holland, an IMRE student of TU Bergakademie Freiberg went as an exchange student to Kenya in November 2017 for a project on establishing Smart Biogas plant in the Taita Hills region.

He did a survey about potentials for introducing a smart biogas plant, developed by an IMRE Alumni in co-operation with the Institute of Heat Technology and Thermodynamics of TU Bergakademie Freiberg (see also below). He developed a questionnaire for administration to the local population around TTU's agricultural campus in the Taita and Taveta regions. The outcomes will be presented in his Master's Study project.



*Joshual Holland in the Taita Hills region*

## Ghana Student founder of new NGO

Elvis Owusu Acheampong from Accra, Ghana's capital, is an IMRE student since 2014. He has founded an NGO for the improvement of the living conditions of marginalized people in Ghana. His new NGO named „Sustain Lives International“ has the intention to transfer information and knowledge for sustainable work and living conditions. These include an awareness of environmental problems.

His first project aims at improving the „work conditions“ at Accra's Agbogbloshie landfill where electric and electronic waste is treated and dismantled with devastating impacts of health and the environment. The NGO wants to stop plastics insulations of cables being burnt and replace this

unhealthy practice by appropriate cutting technologies.

As a geologist, prior to his arrival in Freiberg, he witnessed the environmental and health problems in gold mining. That experience has helped him to set up his new NGO. At the Afrolynk conference in Berlin, held on 1 September, he was interviewed by Deutsche Welle, the German international radio station. Since December 1, „Sustain Lives International“ receives a grant from the Nord-Süd-Brücken Foundation. This Foundation has its roots in the Solidarity Fund of former Communist Germany. His total budget stands a 12 550 Euro with 75 % coming from Nord-Süd-Brücken, 10 % being contributed by Gesellschaft für Entwicklung International Sachsen e.V., another NGO and the remaining 15 % to be generated by his own fund raising.



*Sustain Lives International Group*

## Vimukthi - a member various projects developed by NGO in his native Sri Lanka

**mAgri project VISION 2020** – This is a global initiative of the Dialog Foundation for the elimination of avoidable blindness by 2020. Dialog runs eye camps in remote locations/rural areas, where patients are being screened by experienced optometrists. Patients with serious eye issues will be directed to the nearest hospital for further treatments and the rest will receive a custom made spectacle for free. In 2017, the project team completed 15 eye camps in 9 districts of Sri Lanka which saw nearly 7,000 patients and distributed 5,000+ Spectacles.

**DEWN Disaster Emergency Warning Network** is an early warning platform established after the 2004 Tsunami. Partnering with the Ministry of Disaster Management, Microimage ( a software company), R&D Division of Moratuwa University and Dialog, DEWN developed a platform to disseminate early warning messages during a disaster.

**SSF Senehe Siyapatha Foundation** is a housing project for the victims of 2016 and 2017 landslides and floods. SSF constructed 35 houses (Project SSF1) for Aranayaka landslide victims with public donations extended by Dialog

contributions: for every 1 Euro, Dialog contributed 2 Euros. Currently, SSF2 for the construction of 37 houses is in progress.

Development of a community app to fight and eliminate vector borne diseases. Currently the focus is on fighting the dengue epidemic in Sri Lanka. Through the app users have the ability to report suspected or confirmed dengue cases in their communities. People who live near to the reported case will be notified about the number of Dengue cases and they will be encouraged to take dengue prevention activities such as cleaning their surroundings, be alert on symptoms. Public Breeding grounds can be reported through the app. The back end logins have been given to relevant government authorities to monitor the dengue cases and disseminate necessary medical resources to relevant locations effectively and take necessary actions.



### DAAD Alumni Seminar: PV Technologies and Projects – Focus on mature and developing markets

Unlike the “German Energiewende”, energy systems in many developing countries are heavily dependent on fossil fuels (with the exception of large hydro). There are not enough generation capacity and grid connections, many power cuts, expensive back-up systems, monopoly structures and a lack of private investors. However, governments in many of these countries change their energy policies to

- i) encourage private investors
- ii) create energy markets
- iii) promote renewable energy technologies.

In this seminar, experts meet with DAAD German Alumni to adapt lessons to be learnt from “German Energiewende” to developing countries. In order to increase the benefits of the International Alumni from the seminar and the visit to Intersolar Europe München 2018, the focus will be especially on Solar Power Systems (Photovoltaics).

#### Objectives of this seminar

- Become briefed on current developments in Germany’s Energiewende: Policy and legal developments, current status of the renewable energy industry, position of renewable en-



ergy in the energy markets, players in renewable industry, future outlook

- Learn about research efforts and outcomes related to PV technologies of the Host University (TU Bergakademie Freiberg) and affiliated partners, especially Fraunhofer THM (Technologiezentrum Halbleiter Materialien)
- Give an opportunity to Alumni to present their projects on renewable energy, especially PV
- Experience visits of laboratories, companies and projects with personal communication
- Enable networking with partners from government, government organizations, industry organizations (e.g. Chamber of Commerce), enterprises, project developers ... for new contacts, new types of co-operation and, possibly, new projects

### DAAD Alumni Project: Sino - German Co-operation for a Low Carbon Economy

It may be not well-known that co-operation on issues of Climate Action between Germany and China already has a tradition. Through BMUB, the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety and the Chinese National Development and Reform Commission (NDRC), several projects have been completed and are running since 2008 within the framework of the International Climate Initiative (ICI).

In 2018, this cooperation will have its ten years anniversary and this context, the present proposal for the Alumni Seminar should be placed.

The Seminar is characterized by its inter-disciplinarity. Experts with a variety of backgrounds will be invited to give presentations about subjects referring to the following disciplines of research and development:

- Climate Protection and Climate Action Policy Making
- Low-Carbon Innovative Technology
- Valuation Algorithms for Energy Technologies and Low-Carbon Projects
- “Triple” Integrative Life Cycle Assessment

- Investment and Finance for a Low-Carbon Economy

The Seminar is also characterized by an active input from the participants. Alumni will be requested to prepare a scientific poster before the Seminar and present their work during a poster session. Given the plurality of their backgrounds and professional experiences, the following topics are given:

- Greenhouse Gas Accountancy
- Low-Carbon Technologies
- Business Models for Low Carbon Economies
- Life Cycle Assessment
- Scenario Analysis
- Investment and Finance

