Topic 1 - Energy is crucial for achieving the Sustainable Development Goals

(10 lectures + 9 posters, 23 October, late morning and afternoon)

keynote speech 1

10:35 **Youssouf Ouédraogo**

For a sustainable energy supply for Africa: What can be done to address the major challenges?

former Prime Minister of Burkina Faso (1992 – 1994), Special Adviser to the President of the African Development Bank, former Ambassador to BE, NL, UK, LUX and European Union, leading economist, professor at the University of Ouagadougou

ABSTRACT

Flowing with the definition of sustainable development, sustainable energy is energy that is capable of meeting the needs of present generations without compromising the ability of future generations to meet their own energy needs. Witching this context, the concept of sustainable energy encompasses the principles of sustainable and equitable use for inter-generational equity. According to this broad view, we can agree with the World Energy Assessment (WEA), which defines sustainable energy as “energy which is produced and used in ways that support human development over the long term, in all its social and economic and environmental dimensions".

This approach is relevant. Indeed, since the Earth Summit in Rio de Janeiro in 1992, Humanity has not ceased to realize that beyond the questions linked to their long-term sustainability, the excessive use of fossil resources in the industrialization along the last two centuries has led to a historic stage where man is not only capable of self-destructing as a species, but also of destroying his planet. Hence, the urgent need to act individually and collectively to ensure the protection and safeguarding of the environment, in order to ward off for the present and future generations the adverse effects of climate change.

Africa, as we know, has enormous energy resources, hydroelectric, wind, gas, oil, geothermal, etc. However, its electrification rates are the lowest in the world. Nearly 80% of the world's population without electricity in the world live in Africa, especially in sub-Saharan Africa where average per capita rural consumption hardly exceeds 124 kW per year. Moreover, for good reason! Only less than 10% of Africa's hydroelectric potential is mined. In addition, while the African continent has the highest solar irradiation in the world, the use of solar energy remains insignificant.

Yet, access to sustainable energy is vital to achieving Africa's economic and social sustainable development. Although Africa accounts for less than 4% of greenhouse gas emissions, it is particularly vulnerable to climate change. The desert is advancing, while marine and forest resources are decreasing. For example, an average global warming of 2 degrees induces 3 or even 4 degrees for the Sahel. The continent's ecological footprint has increased by 250% over the past fifty years. In addition, the African population is rapidly growing rapidly, with the result that there are daunting prospects in terms of food availability, poverty alleviation and climate migrations. Finally, African adaptation to climate change is central to global mitigation efforts, as it will contribute to the resilience of a large part of the world.

Over the past fifteen years, African economies have shown unprecedented growth, despite the perverse effects of the global economic and financial crisis. They have had average annual growth rates of more than 5%. However, this growth has proved inadequate to address the continent's concerns in the short, medium and long term, including education, health, job creation and poverty reduction. The non-sufficiently inclusive nature of growth and the persistent backwardness of production structures are the main causes. Largely, the Africa’s good growth results remained dependent on a few landlocked sectors, such as hydrocarbons, minerals and agricultural commodities, contributing for more than 67%. In most African countries, the contribution of manufactured goods to GDP does not exceed 12%, while in the emerging countries of Asia it is more than 30%. This backwardness explains that Africa only contributes 3.5% to world trade, while Asia, for example, reaches 31.5%. In addition, the benefits of such growth are limited to narrow segments of the society, generating strong social inequalities.

The key challenge for Africa is therefore to leverage its current growth momentum to generate the jobs that people, especially young people need, and reduce significantly poverty and social inequalities. To successfully meet such a challenge, Africa must resolutely and urgently address the issue of the contribution of its manufactured products to its GDP. This transition to the structural transformation stage will enable African productions, because they are more valued by industrialization, to generate more added values and thus more jobs. Like the emerging economies of South-East Asia, which Economist Thomas Piketty describes as examples of success in economic "catching up" through industrialization, Africa must reach this higher stage if it wants to permanently raise the challenge of poverty reduction and to overcome its structural dependence on other regions of the world.

From this point of view, ensuring a sustainable energy supply is imperative for Africa. The achievement of this strategic ambition nevertheless requires prerequisites. Beyond the behavioral changes, it will require on the part of the African populations, it will also require African leaders to have a new and determined political leadership, in order to place this ambition at the heart of the top priorities from the continent. In this regard, African governments will have to set an uncompromising course, consisting of bold energy policies and consistent reforms at national, regional and continental levels. Such a step towards realizing the enormous and multifaceted energy potential of the continent should be at the center of partnerships between African countries and their Regional Economic Communities with their partners, bilateral or multilateral, including the private sector, whose contributions have become unavoidable.

In addition, experience has shown that, as well as in the energy sector and several others, the enthusiasm that has always benefited Africa is mainly dictated by the raw material needs of the major powers, whether traditional or emerging. By adopting a paradigm shift based on a more structural

transformation of its economies, Africa could get rid of this structural dependence and finally cease to be the privileged ground for the expression of the geostrategic stakes of these great powers.

keynote 2

10:55 **John F. May**, Population Reference Bureau in Washington, DC, Visiting Scholar, report "*The Demography of Africa: Impacts on Economy, Energy, and Governance*"

ABSTRACT

The population of Africa, and particularly of sub-Saharan Africa (SSA), is growing rapidly. The continent has already a population of 1.2 billion people and is expected to have a population of 2.5 billion persons in 2050. Should the demographic trajectory of Africa follow current assumptions of a rather slow fertility decline, the total population of the continent could be 4.4 billion at the end of the century. At that time, the population of SSA alone could be close to 4 billion—a quadrupling of the SSA population in 2016.

This huge population increase in Africa will have far reaching consequences on many development sectors. First and foremost, African population will migrate and urbanize rapidly, fueling the current megacities and their slums. The formation of human capital (education and health) will be another major challenge. Last but not least, SSA will need to create during the next quarter century 18 million new jobs every year—this is about the current population of Burkina Faso.

Three dimensions will need particular attention. First, should fertility decline more rapidly, active people would become relatively more numerous than their dependents and this could generate a production surplus (i.e., a first demographic dividend). Second, the rapid population growth will have a major impact on the energy needs of the continent, and countries will need to accelerate their energy transition. Last but not least, in order to capture a demographic dividend and to plan for their energy requirements, SSA countries will need to improve their governance. This will be a sine-qua-non condition for countries to be able to charter the way forward and seize the potential opportunities.

Lecture 1

Prof. Dr. EL Tayeb Mustafa and Prof. Dr. El Tayeb Idris Eisa

11:15 **Sustainable energy mix for African and MENA region countries**

Prof. Dr. El Tayeb Mustafa, President of The Future University, Sudan, Former Director at UNESCO, RAOS member, and Prof. Dr. El Tayeb Idris Eisa

ABSTRACT

This paper reviews the current applications of energy mix of renewables, fossil fuels and nuclear energy in specific countries in the African and MENA region. The analysis indicates that Africa is rich in energy resources but poor in energy availability, supply as most of the energy resources are not yet fully utilized.

This severe energy poverty and extreme supply shortages hampers the economic development of the countries in the region.

North-African, Gulf Countries and South Africa are major exceptions with significiant higher levels of electrification and overall energy consumption. Meeting the current and future energy demand is the major challenge to all African and some MENA region Countries.

The paper addresses also the impacts of the applications of the technologies of renewable energy, fossil fuels, and nuclear energy (in specific countries) on; energy supply, costs, effects on environment and the benefits and the left constraints. Also, the paper highlighted some of the successful stories in the region.

The last chapter also focuses on the necessary policy, strategies and the transformations needed in the institutional energy structures, legal framework, and financial challenges facing the implement optimal and sustainable energy mix program in the selected countries.

Lecture 2

Dr. Emmanuel Kofi ACKOM

11:35 **Energy for sustainable development in Africa: Successes, challenges and possible way forward**

Dr. Emmanuel Kofi ACKOM, E.K., Haselip, J.A and Mackenzie, G.A., UNEP, DTU Partnership (UDP), Technical University Denmark (DTU), Copenhagen

ABSTRACT

In this paper, we present some of our experience based on 25 years of UNEP DTU Partnership's (UDP) work on energy for sustainable development in the African continent. Modern energy is an enabler for economic growth, poverty alleviation and sustainable development, yet approximately 70% of the population in sub Saharan Africa (SSA) are without access to this very essential service. The rather low access to modern energy in Africa could be attributed to a myriad of factors including but not limited to geopolitical, governance, institutional, policy, cultural, finance and human capacity. Working with government departments, key institutions and scholars in Africa, through a combination of technical assistance, capacity building, and academic and field research, and facilitating a South-South knowledge network, UDP has gained some very rich experience in sub-Saharan countries. Our paper will focus on the mechanisms employed by UDP, the extent to which, and how, our work in the continent has been able to influence change in climate-friendly energy policies and energy planning in the participating African countries. The challenges encountered in the implementation of our work and how we were able to overcome some of them will be highlighted. Finally, but not least, our paper provides recommendations for a possible way forward in surmounting some remaining barriers that hinder increased energy security and diversification of supply using cleaner energy options.

Lecture 3

Prof. Wail Benjelloun

11:55 **African universities and science diplomacy in favour of alternative sources of energy (based on exchanges with 100 universities during COP22 in Marrakesh)** Prof. Wail Benjelloun, President Mediterranean Universities Union (UNIMED), Former president of the Conference of the University Presidents of Morocco

ABSTRACT

During the climate change conference in Marrakesh (COP22), close to a hundred university presidents and directors of research academies met at the invitation of the Moroccan Conference of University Presidents and the Hassan II Academy for Science and Technology. The event was sponsored by UNIMED along with several other international organizations. Most of the participants were from Africa, with several presidents from other continents. The objective was to convey to COP22 negotiators scientific information concerning climate change in Africa and to lobby for political and policy support for the adoption of mitigation measures.

The meeting also considered the role of universities in addressing climate change, with reference to education, training, research and social responsibility and the setting of a climate research agenda for Africa. The second day was devoted to mitigation, adaptation and resilience to climate change in Africa: Role of science, technology and continental cooperation.

It became clear from the discussions that African countries must prioritize adaptation and mitigation strategies if current growth is to be sustained. In 2012 70% of major global droughts occured in Africa, affecting more than 16 million people. The fact that Africa relies so heavily on rain-dependent subsistence agriculture means that rainfall variability (drought or flooding) can seriously hamper GDP growth. Africa must thus work to make its voice heard in international fora, adopt mitigation measures to decrease deforestation and opt for alternative sources of energy (the Moroccan wind and solar program was commended). It must also empower the poor through the adoption of appropriate social safety nets.

At the end of their deliberations, participants in this summit adopted a Joint Official Declaration of African Academies of Science and Presidents-Rectors of African Universities recommending actions to be undertaken in the academic and scientific areas to face the challenges of climate change in Africa. The Declaration insisted on the necessity for the United Nations, decision makers in the developed world and international organizations to set up a special fund to financially support initiatives that need to be implemented in Africa, including support for research.

The Marrakesh proclamation, adopted by the heads of state and of government at tthe end of COP22 included these recommendations, calling for an increase in funding, in mobility and in access, together with an improvement in technological capacity building for Africa as well as the transfer of technology from developed to developing countries.

Lecture 4

Bruno BENSASSON

14:00 **Centralized and decentralized energy solutions for Africa: cutting edge technologies supported by and co-developed with the African actors**

Bruno BENSASSON, ENGIE, Africa Business Unit, CEO, Paris

ABSTRACT

The development of a balanced portfolio of activities which delivers an acceptable growth while taking into account risks is a necessary approach for any international company wishing to do business in Africa. None of the African countries are coming with a low risk profile, we have to understand those risks and above all make the right decisions on the development of an energy infrastructure which is in line with the Continent's needs.

Africa will need both centralized and decentralized energy solutions. As baseload is required, the mix of solutions will much depend on the progress of storage systems.

Installation of centralized power will have to provide the competitive, low carbon, solutions, Africa needs for its economic growth. We also see a role for the growth of natural gas in Africa, in large LNG-to-power projects, but also small scale LNG and gas distribution. The African economies need energy services that will make their businesses more competitive, thanks to expert externalization. Development of decentralized innovative solutions will bring power – and beyond power, many applications : water, mobility, etc. – to rural Africa. As the access to power in rural Africa progresses, there will be a real need to also help larger cities tackle the challenges of a sustainable growth through the deployment of cutting edge technology.

This whole process and evolution has to be supported by and co-developed with the African actors, authorities and regulators, off-takers, industrial clients and potential partners.

Africa will write its own energy story, capitalizing on innovating technologies and taking advantage of the know-how and experience of both international companies and local players.

lecture 5

Dr. Koffi Ekouevi

14:20 **Making Access to Energy Services the Engine of Sustainable Development in Sub-Saharan Africa**

Dr. Koffi Ekouevi, Senior Economist, The World Bank

ABSTRACT

Science and technological innovations have tremendously transformed human life over the twentieth century. Advancement in the management of energy systems has supported and fuelled economic growth by enhancing productivity and thereby contributing to increase living standards. At the dawn of the twenty first century, this positive trend is continuing with expectation of further breakthroughs yet to be experienced.

At the same time that many communities around the world are benefitting from such a remarkable social and economic transformation, there are also communities where human life have not changed much as compared to the beginning of the twentieth century. Many of these communities are found in Sub-Saharan Africa and in South Asia. One of the missing links preventing these communities to join modern life with its promise, facilities and conveniences, is access to modern energy services. Indeed, without access to modern energy services, it is difficult for example, to escape the trap of poverty, to prevent the occurrence of chronic diseases, to gain access to modern education, water and sanitation facilities, to increase productivity in agriculture, and to engage in industrial activities.

The post-2015 Sustainable Development Agenda with its thrust to deliver an inclusive and shared prosperity to mankind is an opportunity to engage differently with communities that are being left out. The 17 Sustainable Development Goals (SDGs) that are crystalizing this thrust offer a compass to guide action to effectively transform life within these communities. In particular, the Sustainable Development Goal 7 aiming to ensure access to affordable, reliable, sustainable and modern energy for all, is a necessary pre-requisite to the achievement of the remaining SDGs.

The objective of this presentation is to highlight the catalytic role that modern energy services as defined by SDG7 ought to play in ensuring that the remaining SDGs are achieved by 2030. It would focus on the specific context of Sub-Saharan Africa to first present the current status and trends of energy access, to secondly outline the challenges preventing the development of adequate energy systems despite an exceptionally rich energy resources endowment, to thirdly discuss a complementary set of transformative bottom-up and top-down approaches to develop energy access initiatives, and to fourthly provide insights towards recommendations for a sustained engagement of public and private partnerships to address the energy access gap in the region; this bearing in mind the importance to account for local contexts and constraints.

Lecture 6

Ed Brown

14:40 **Governing decentralised energy provision: exploring the role of local governance in articulating nexus approaches to energy transitions**

Ed Brown, Jon Cloke, John Harrison and Richard Sieff (all at Department of Geography, Loughborough University, UK)

Presenter: Ed Brown, National Co-Coordinator, UK Low Carbon Energy for Development Network and Senior Lecturer in Human Geography, Loughborough Univ.

ABSTRACT

Nexus thinking, increasingly advocated as an integrative approach to building synergies and reducing trade-offs across the water, food and energy sectors (e.g. Hoff, 2011), has coincided with a period of dramatic transformations in the political and energy contexts of the Global South. Widespread political decentralisation has taken place, while the global prominence of debates surrounding energy access and decentralised energy provision has risen substantially.

These changes prompt the question of what role decentralised governance structures could take in realising nexus approaches to decentralised energy transitions, yet existing literature in this field has been critiqued for a lack of attention to the crucial part played by local governance and changing national-local political relationships (Stevens & Gallagher, 2015). This is of particular surprise given the extensive nature of many current political decentralisation drives in developing countries.

This paper aims to bridge the gap between the literatures on political decentralisation and nexus approaches to decentralised energy, which have hitherto largely been discussed as separate entities. Drawing on work conducted for a recent EPSRC/DFID/DECC-funded research project which focused on Renewable Energy and Political Decentralization and ongoing work on local energy governance in Kenya and Malawi the paper combines a more conceptual consideration of how best to cross-fertilise insights from these literatures with a more practical focus on what the **future local governance of energy** might look like as the drive towards rapid electrification across Africa continues to take form. Focussing predominantly on Kenya, site of one of "the most rapid and ambitious devolution processes in the world" (World Bank, 2015), this discussion attempts to better understand the role of local governance in implementing a more harmonised nexus and how political decentralisation might facilitate and enhance this process.

A range of issues within this context will be explored including:

- How the various scales of governance interact within the energy, water and food sectors
- How they might be most effectively coordinated and
- How institutional disconnect, power imbalances and the increasing complexity of greater cross-sector integration might be resolved?

lecture 7

Prof Emanuela Colombo

15:00 **Performance and Impact Assessment Model: energy planning methodology to orient strategies for scaling up access to energy**

Politecnico di Milano, Italy, Prof Emanuela Colombo, UNESCO Chair in Energy for Sustainable Development, Francesco Romeo, and Lorenzo Mattarolo, Department of Energy; and Mariano Morazzo, Enel Foundation

ABSTRACT

Over the last decades, the interest of the international community for sustainable development and the multiple interconnections among energy, environment and society has widely increased. This holistic approach of sustainable development has been clearly remarked in the 2030 Agenda. The centrality of energy within sustainable development (with special reference to GOAL7) is definitely marked: energy has started to be considered as a key means for unleashing development, supporting local enterprises and creating new jobs, improving health and education, in addition to assure sustainable and equitable access to basic needs. Despite the relevance of energy in the development framework, 1.3 billion people today still do not have access to electricity, 2.7 billion depend on traditional biomass for their own domestic use and around a billion do not have access to a reliable electricity grid. These numbers are not likely to change significantly in the near future, even under the most optimistic scenarios.

Given this framework, a proper e**valuation metric able to assess the effects of energy projects on the changes of community livelihoods and the positive effects on social, economic and environmental levels is strongly needed to assess future strategies and policies**
Relying on the most recognized and utilized evaluation frameworks, as the DAC-OECD criteria (Relevance, Efficiency, Effectiveness, Sustainability and Impact), the Results Chain, this study proposes a Performance and Impact Assessment Model (PIA). **This model provides information and quantitative results** for comparative analyses among projects and feedback for decision making, in order to orient policies and strategies. **It is structured in two phases**:

1) *an internal, **project-based step**, which assesses projects in terms of performance*

In the first phase, four DAC-OECD criteria are calculated with a common metric, adopting exergy-based technique and recent Life Cycle extensions. In this way, exergy becomes a 'proxy' of the primary resources total consumption undertaken during the project.
This homogeneous unit measures the different input flows, all expressed in terms of resource consumption, leading to a quantification of four criteria through dimensionless indexes. The application of this analysis to several projects allows the creation of a benchmark useful for comparing the results from different projects – especially in terms of resources consumption – and identifying the most effective strategies.

2) *an external one, **people-based**, which assesses the project impact on the beneficiary communities hifting the attention from the project itself to the local context*

The second phase is dedicated to the fifth criterion, the impact, which aims at measuring the effects that the project has on the local livelihoods, assessed in terms of target community's five capitals: natural, physical, human, social and financial. The model is an original re-elaboration of the "Sustainable Livelihoods Framework". A schematization of the proposed methodology for the impact assessment requires: (i) an application procedure structured into three steps, customization, development and results analysis, (ii) an evaluation hierarchy, made of five capitals, representing community livelihoods, and dimensions where dimensions and indicators are provided.

This PIA Model takes its rationale from the literature, results obtained are suitable for comparisons among projects and its framework may divulgate results to donors or stakeholders and indications to address future interventions and strategies.

Application has been conducted on real case studies by private players, public institution and NGOs in Malawi, Ethiopia and Chile. Currently POLIMI is working with ESMAP (World Bank) and Enel Foundation to evaluate synergies between PIA and the Multitier framework

lecture 8

André Bouffioux

15:50 **Industrial Strategy to identify priorities in energy mix policies in Africa as a result of joint discussions about local needs and resources**

André Bouffioux, CEO, Siemens Belgium-Luxembourg (also responsible for the assigned countries: Algeria, Morocco, Tunisia and West-Central Africa)

ABSTRACT

Not available yet.

Lecture 9

Valérie Quiniou

16:10 **Integrating Climate into Strategy for an Oil & Gas Company: focus on Africa**
Valérie Quiniou, Vice-President, Climate - Strategy - Innovation, TOTAL S.A., Paris

ABSTRACT

not available yet.

Lecture 10

Dr. Mannava V.K. Sivakumar

16:30 **Challenges of Climate Change with respect to Energy Policy in Africa**

Dr. Mannava V.K. Sivakumar, Editor-in-Chief, *Weather and Climate Extremes* (Elsevier), Acting Secretary of *Intergovernmental Panel on Climate Change* in WMO, corresponding member of the Royal Academy for Overseas Sciences of Belgium

ABSTRACT

The threads connecting energy, climate and development are more evident in Africa than in any other continent in the world. Africa's energy systems are underpowered, inefficient and unequal. Climate change poses complex challenges to the energy production and supply in Africa because of progressively higher rises in temperature, variability in precipitation patterns and the increasing magnitude and frequency of extreme events. Energy-sector bottlenecks and power shortages cost the region 2-4 per cent of GDP annually, undermining sustainable economic growth, jobs and investment. They also reinforce poverty, especially for women and people in rural areas.

Africa experiences a wide variety of climate regimes, in which its location, size, and shape play key roles. Rainfall amount, duration and seasonality are the most important factors in differentiating the African climate regimes. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) identified Africa as the region at greatest risk from global warming. Decadal analyses of temperatures strongly point to an increased warming trend across Africa over the last 50 to 100 years. Land-use changes (such as deforestation, desertification, and urbanization) also increase the atmospheric temperature. These land use changes remove the vegetative cover that absorbs the shortwave radiation, thereby, leading to global warming. African ecosystems are already being affected by climate change, and future impacts are expected to be substantial. Impacts from recent climate-related extremes, such as heat waves, droughts, floods, cyclones, and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability. Hydro-electric power generation has been negatively affected by droughts and floods and increased climate variability and change can also impact the functioning of key energy infrastructures (e.g. refineries, rigs, hydro-electric plants) within countries.

Various studies have shown that the future climate change would hit Africa hard, but with different degrees over different parts of the continent. The IPCC provided a broad assessment of changes expected to 2100 in Africa for all climate scenarios, and the main message is that the entire African continent is very likely to warm during the 21st century. The warming is very likely to be above the global average in all seasons, with drier subtropical regions warming more than the moister tropics. In addition, the annual rainfall is likely to decrease in Mediterranean Africa, Northern Sahara, Southern Africa, but increase in East Africa.

More than five hundred million people in sub-Saharan Africa have no access to electricity and about 80% of African households use biomass fuels (e.g. wood and vegetation) for cooking and water heating. Unsustainable harvesting of forests coupled with climate change and variability threatens biomass users with dwindling supplies. Meeting the energy needs for development while addressing climate change issues are now the major issues to be addressed by governments. Confronting the climate change challenges is a complex task and requires an innovative integrated approach to energy policy in Africa. This includes renewable energy power generation through its vast solar, biomass and wind resources; geothermal energy; flexible financing mechanisms through funding instruments that exist under the area of climate change; performance standards; and awareness-raising campaigns among potential investors and consumers. The challenge is to embrace a judicious, dynamic energy mix in which renewable sources will gradually replace fossil fuels. Shifting towards low-carbon energy systems can avert climate catastrophe while creating new opportunities for investment, growth and job creation.

POSTER PRESENTATIONS (35 in total under Topics 1, 2 and 3)

(poster 1)

Our goal: 600 million connected Africans connected to electricity by the year 2025

Smaïla Camara, ENA/Dauphine and HEC Paris Business School, Special Advisor to Jean-Louis Borloo, President of "Energies for Africa" (Ministre d'État, ministre de l'Écologie, 2007 – 2010, France)

ABSTRACT

The facts

Each year, 10 additional million Africans do not have access to energy.

Energy is a prerequisite to any development. Yes, Africa witnesses a fast 5% growth per year, but it's not the case throughout the entire continent. Development through electrification certainly isn't a new idea, though it never went through. But the urgency is here: 650 million people today do not have access to electricity on the continent, and this number is susceptible to significantly grow considering the African population will double by 2050.

The urgency to act

We are obviously facing a social urgency. For kids to be able to do their homework at night, for women to stop giving birth in the dark, for medicines to be preserved in fridges, for the African youth to consider a proper future on their own continent, we need to generalize the access to electricity. We are also facing an economic emergency. The development of electrification will offer new perspectives to African companies, therefore benefiting European and worldwide economies. Let's keep in mind that if the growth of African countries raises from 5% to a double digit per year, it will raise ours of 2%. Africa represents an incredible perspective of growth, especially for Europe.

The launch of Energies for Africa (Energies pour l'Afrique)

It is in this perspective that we are advocating for the creation of an Energy access instrument, with the ambition to gather all initiatives and international investments in favour of developing access to electricity, and to promote those projects matching technical, institutional, legal, or financial African needs.

The current situation is not a fatality. A real opportunity does exist to bright light to a continent that will host 40% of the world's population at the end of the century. And this instrument will be the key to such development. We created Energies for Africa to accompany all common interest actions promoting the access to energy for Africans, and especially to electricity, starting with the creation of this instrument led by Africans in partnership with Europe and all mains contributors.

The goals

Our main goal: 600 million Africans connected to electricity by the year 2025. Electricity is a prerequisite to agriculture, health, access to water, to economic, cultural, social and democratic development. Obscurity calls for obscurantism, when light calls for Enlightenment. Today, Africa and the world take action for the whole continent to have access to electricity.

(poster 3)

AGORIA's views and technology contributions for energy and sustainability in emerging countries (in particular, Africa)

Christian DIERICK, Advisor, Agoria ("Development through technology"), Multisector Federation of the Technological Industry, Brussels

Abstract : not available yet.

(poster 4)

Development of advanced energy technologies in Africa: success stories obtained and challenges left from both technological and managerial points of view

Peter Koninckx, Director Power Generation & Transmission Systems, Siemens

Abstract : not available yet.

(poster 5)

Modern energy strategy implementation in Africa: success stories and challenges left in terms of central & decentralised power generation, integration of renewable energies, power systems interconnection and optimum planning between centralized grid and decentralized micro-grids

Joseph Dubois, Product Director of Tractebel

Abstract : not available yet.

(poster 6)

Generic lessons from EUROMED Research-to-Innovation projects in the field of Renewable Energy & Energy Efficiency: Innovation, Co-development, Capacity building

Claude Ayache, Senior Advisor, KIC InnoEnergy, Societas Europaea (SE), Business Development & European Affairs, Brussels

Abstract : not available yet.

(poster 7)

Collaboration between Northern and Southern organizations with the aim to facilitate and analyse technology impact on society

Jean-Pierre Raskin (Université Catholique de Louvain) and Stéphanie Merle (Louvain Coopération)

ABSTRACT

Higher education is the time for many students to focus on the complex functioning of our society and to reflect on social inequalities and environmental issues it generates. In science and technology, initiatives are emerging to integrate these questions to training. Many universities and colleges are motivated to develop the teaching of social and environmental complexity linked to the technical choices, to develop critical thinking with students against models of society conveyed by technology... We are talking about scientific citizenship, ethics applied to engineering, socio-technical integration, political technology assessment, ...
Higher education is fully active in sustainable development and can help to promote more equitable and sustainable societies in forming the European civil society of tomorrow with alliances and synergies.

The purpose of this seminar is to share current practices for developing a civic education of science and technology to students. The reflection will also focus on possible partnerships between NGOs and universities to introduce the themes of sustainable development and social issues in the curriculum, the role of the multidisciplinary and the need to address issues with a multi-stakeholder approach. With the objective to strengthen partnerships and to demonstrate that scientific citizenship is an inseparable element of a European active, aware and informed citizenship multiple causalities of the human development process.

(poster 8)

Growth, energy and climate: squaring the circle

Philippe Charlez, Mining Engineer, Senior Technical Advisor specialist of Unconventional Resources, former Rock Mechanics Expert in the Oil & Gas industry

ABSTRACT

The human being has never been able to build a growth society by the strength of his muscles. It is by transforming the magic power of fire into mechanical energy and then into electricity thanks to the steam engine and the electric generator that Watt and Faraday invented economic growth in the early nineteenth century. Today our growth society only gravitates around steam engines or generators a little more sophisticated. The engine of cars, the aircraft reactors or the gas turbines of the power plants are in fact only their great-grandchildren. Also, if technology is the endogenous catalyst of growth, energy is the exogenous food. For if the fire that feeds them should fail, the brilliant inventions of Watt and Faraday would become nothing but cold and immobile museum pieces.

Since the beginning of the Industrial Revolution, economic growth has relied heavily on energy, and more particularly on fossil fuels, which today account for 82% of the world's energy mix. But, through this fossil energy consumption, economic growth is also a hazardous process that irreversibly transforms finite natural resources into dangerous waste. The latter are a source of alteration of the ecosystem and represent in the medium term a major environmental risk. This is the case for anthropogenic CO_2, which is the main cause of climate change.

Modern society would thus be confronted with contradictory objectives: to satisfy an increasing demand for energy to ensure economic growth to 10 billion people while reducing GHG emissions to solve the problem of climate change. Growth, energy and climate: can the energy transition solve the squaring of the circle?

Philippe Charlez's approach is both historical and scientific and based on unquestionable figures. It proposes original and pragmatic solutions to promote renewable energy more rapidly and reduce coal consumption. Rather than a global transition the author proposes to develop regional solutions that would significantly reduce the energy intensity of emerging countries. Finally, the he advocates on behaviors one of the main levers of energy saving.

As the main challenge of the 21st century, energy transition must address itself in a dispassionate and rational way. Nothing is impossible but everything is not possible. Complex, transverse, involving multiple technological, economic and societal components, it deserves better than an ideological debate conveyed by accepted ideas. It must be treated and felt as a positive voluntary evolution and not as a revolution undergone.

(poster 9)

Science and diplomacy in Central and Western Africa : remarkable achievements and challenges

César KAPSEU, Ambassador of science, University of Ngaoundere (Cameroun) and Liliane D. T. ATOUKAM, Humanities and Social Sciences (same university)

ABSTRACT

Cameroon is the interface between the regions of Central and Western Africa. To this end, it can play a role in scientific diplomacy. One of the assets of this Africa in miniature also concerns the languages: English and French are two official languages. Cameroon borders with 5 countries (Nigeria, Chad, Central African Republic (CAR), Congo and Equatorial Guinea). Two neighbors have insecurity problems (Nigeria and CAR).

The objective of this article is to identify cases related to science and diplomacy to our knowledge in Central and Western Africa. Indeed, Cameroonian teachers have formed critical masses in Chad, Congo and the Democratic Republic of Congo (DRC). The lessons have given hope to young people in difficult situations and post-conflict situations. The partners that support these courses are the “Agence Universitaire de la Francophonie (AUF)” and the Association of African Universities.

Joint projects between researchers from Cameroon, Chad, Congo and DRC have resulted in the revitalization of laboratories and the promotion of research in both grade change and publications. Indeed, several Congolese and Chadian teacher-researchers have gone from Assistants to Masters of Conferences. A teacher researcher from Burkina Faso who attended a conference in Cameroon became a Minister in his country.

The 10 regional and international conferences organized played a major role in mutual understanding and trained young researchers. These events strengthened science and diplomacy capacities in the central and western regions and promoted multidisciplinarity. Regional functions as representative of the African Network for Solar Energy, the African Committee for the Future of the Earth, the Francophone Network of Process Engineering Researchers in Agro-Food (GP3A) Francophony and the network of innovation researchers have strengthened the bonds of solidarity between scientists.

Collective books at the end of congresses on topical subjects such as renewable energies, biodiversity, climate change, waste recycling and innovation, in collaboration with the French and German Embassies in Cameroon, of Belgium in the DRC and development partners such as AUF (Canada), the Research Institute for Development (France) and the World Academy of Sciences (Italy) have given weight to the interface between science and technology. Diplomacy.

Keywords: science, diplomacy, central and western Africa, network, research, teaching, conference, project

Topic 2 - Energy mix: towards robust, equitable and socially acceptable energy systems (20 lectures + 14 posters, 24 and 25 October)

(lecture 1)

Dr Aymen Chaouachi

09:00 **On Power System Paradigm: Opportunities and Challenges**

Aymen Chaouachi, PhD, EGI (Elia Grid International, Brussels), Power System Operations & Security

ABSTRACT

The electric power system is facing increasing stress due to fundamental changes impacting both supply and demand dimensions. On the supply side, a sustained shift from large synchronous generators to scattered smaller distributed energy resources, increasing penetration of non-synchronous power injection (HVDC or power park modules) and variable uncontrollable resources (wind and solar farms). To meet the demand needs, the EIA's 2016 Energy Outlook projects that the total electricity generation will have to increase by 69 % through 2040 (predominately in non-OECD countries). Furthermore, new concerns in term of environmental impact marks the needs to integrate higher shares of Renewable Energy Sources (RES), which are yet still presenting major challenges in term of investment, operational costs as well as well as their controllability.

Against this background, resources both in financial and technologic innovation terms would present further obstacles to cope adequately with such expected paradigm. Entities engaged in the power sector's extensive value chain ranging from utilities, generation, transmission & distribution and regulating authorities are facing increasing challenges to manage such evolution in the medium and long term without compromising the system security, securing the necessary investment funds and the affordability of the electricity supply.

The EU identified three main pillars to address the forthcoming challenges namely: Sustainability, Competitiveness and Security of Supply, it is clear however, that from a systemic perspective, sustainability in its broader definition implicitly covers the two later pillars. In this presentation, we will highlight Elia Grid International experience and vision for electricity sector challenges prospects and the strategy to leverage sustainable opportunities.

(lecture 2)

Prof Anthony Papavasiliou

09:20 **Sustainable Energy Transition: An Operations Research Perspective**

Anthony Papavasiliou, ENGIE Chair at UCL in Energy Economics and Energy Risk Management and Center for Operations Research and Econometrics (CORE)

ABSTRACT

As an interdisciplinary domain that is positioned at the interface of engineering, mathematics and economics, operations research offers a ubiquitous set of methodologies for comprehensively addressing the engineering, institutional and economic challenges that result from the transition to sustainable energy systems. With its unique renewable energy potential, Africa is ideally positioned for a sustainable energy transition, and can be expected to be confronted with an array of challenges that have already emerged in numerous US and European systems. In this talk we will focus on how operations research can be used for addressing a number of these challenges, with specific case studies from California and Europe: (i) mitigating the variability of large-scale renewable energy integration in day-ahead scheduling; (ii) coordinating the operations of neighboring zones in order to absorb the renewable energy fluctuations of neighboring regions; (iii) designing markets that can maintain the economic viability of flexible technologies that can be used for balancing renewable energy resources.

(lecture 3)

Prof. Ndaye Nkanka Bernard

09:40 **Prospective Énergétique de la République Démocratique du Congo dans un Scénario "Business As Usual" à l'Horizon 2050**

Prof. Ndaye Nkanka Bernard, Institut Supérieur de Techniques Appliquées, Kinshasa

RESUME

Dans une problématique énergétique mondiale marquée par des contraintes d'ordre social, économique, environnemental et de disponibilité des ressources primaires toujours croissantes, la principale préoccupation pour chaque pays reste la satisfaction de ces contraintes sur le long terme tout en pensant aux générations futures. Le domaine scientifique qui permet d'étudier en profondeur ces contraintes et de proposer aux décideurs les options politiques à suivre est « la Planification Énergétique », outil d'analyse chiffrée de l'avenir énergétique d'un pays et base scientifique des orientations à suivre. Les modèles de prospective énergétique constituent alors des supports précieux à l'analyse chiffrée de différents scénarios de développement énergétique des pays. Cependant, tous les modèles de prospective énergétique qui existent actuellement sur le marché mondial ne s'appliquent pas facilement dans la plupart des pays en développement où généralement une base de données riche, désagrégée et structurée fait défaut.

Dans cet article, nous présentons un modèle de prospective énergétique que nous avons développé et nommé « RDCONGO », pouvant s'adapter aux réalités des pays en développement. Il s'agit d'un modèle de prospective énergétique sur le long terme, permettant l'élaboration de plusieurs scénarios énergétiques et d'en évaluer les coûts et les effets sur l'environnement. De quoi rendre le choix des scénarios allant dans le sens souhaité plus facile.

Son application au cas du système énergétique de la République Démocratique du Congo (RDC), pays en développement, dont l'évolution économique, démographique et sociale pourrait déjouer les pronostics actuels et nécessiter un apport énergétique important, nous a permis, dans un scénario de référence (Business As Usual – BAU), d'avoir des résultats qui démontrent que le modèle énergétique actuel de la RDC n'est ni acceptable ni durable sur le long terme. Le scénario BAU, considéré comme « Scénario Éclaireur » pourrait donc être utilisé pour faciliter l'élaboration d'autres scénarios dans l'objectif d'orienter le système énergétique de la RDC dans le sens voulu. Ce qui constitue avec le modèle lui-même, la valeur scientifique de notre démarche.

(lecture 4)

Prof Samuele Furfari

10:00 **Energy poverty in Africa: focus on challenges and solutions related to electric power and to energy for cooking**

Prof Samuele Furfari, Geopolitics of Energy, ULB, École polytechnique

ABSTRACT

We consume too much energy! It's a well-known familiar refrain. We seem to forget that the

quality of life in our Western countries - and has no equal in the history of mankind – is the result of this energy consumption. Without energy, there would be no health care, no health, no hospitals, no home comforts, no leisure, etc. But the reality is globally different ... A part of Humanity is suffering from "energy poverty". The situation is particularly dramatic in Africa.

There is in the world 1.3 billion people who have no access to electricity. Despite exact statistics, it is estimated that 2.5 - 3 billion have intermittent access. Few hours a day of electricity is infinitely better than those who have none at all. The average rate of access to electricity of Sub-Saharan Africa is 35%. In South Sudan, only 5% of the population has access to electricity, in Burundi 7%. In DRC it is 16% while hydropower that could be produced on the Inga River would suffice for much of Africa.

But there is worse than the lack of electricity! After all, if we want to do without comfort we can do without electricity. But we cannot go without food. Cooking is therefore a necessity.

There are 2.7 billion humans who eat meals prepared with renewable energy only (wood, green wood cut by women and children, dried dung), sometimes with plastic bottles. This causes severe respiratory disease and premature death that are largely documented by WHO. Should Burundi deforestation continue at the current rate in order to obtain the necessary energy, its forests will disappear in 24 years.

These countries must grow and get out of this extremely precarious energy situation. It is

therefore urgent that as citizens, academics and policy makers are aware of this injustice and act quickly to end the scourge of fuel poverty in Africa. If there is a humanitarian and moral urgency for rich countries, there is also for them major economic concerns, geostrategic and credibility.

There is no doubt that some leaders of countries lacking modern energy will not follow the

solutions recommended or imposed by NGOs, in particular in relying on China already funding and building infrastructure using fossil fuels and hydroelectric dams they need.

In this vibrant plea in favour of the poorest people in Africa, the speaker proposes a series of pragmatic solutions reconciling economic development and environment, rich and developing countries, economic interests and human development.

(lecture 5)

Carl De Maré

10:50 **Steel: a key resource for a sustainable and circular economy in emerging countries**

Carl De Maré, Vice-President ArcelorMittal, Group CTO, Head of Technology Strategy

ABSTRACT

Steel was 2 centuries ago at the start of the industrial revolution and has become an unavoidable resource for development of the world. However, the model of steel comes more and more under pressure due to its environmental footprint. The presentation will address the question on how much steel will be required in the 21th century to develop all regions and how can this be done in a sustainable way with respect with the environment.

The key drivers for the use of steel will be explained, together with the major technologies to produce steel (primary steel from iron ore and secondary steel from scrap). These insights enable to predict the long-term steel use and production in the different regions world-wide. During the next 50 years, the growth of steel will come from recycling steel scrap. However also steel production from iron ore will still be required during a long period and carbon will be required to reduce iron ore to fresh primary steel.

Although steel is one of the most GHG friendly man-made materials, it requires carbon to reduce the iron ore and is contributing to the Climate Change problem. The strategy of ArcelorMittal however is not to leave Carbon, but to create new options to re-use the carbon in a much more circular way, as is already done today with the steel itself.

A portfolio of options has been studied and developed as use low caloric value BF gas to reheat steel before rolling, filter CO2 out of the waste gas with only waste heat, reform CO2 with cokes gas and renewable power. The most innovative breakthrough technology however is the use of microbes to convert the waste carbon of the Blast Furnace into bio-ethanol. This innovation allows to create how valuable transport fuels and avoid the use of fossil oil.

ArcelorMittal with his partner Lanzatech has worked years in order to scale up the technology upto the level that is can convert a significant part of the waste carbon of a steel plant. Currently ArcelorMittal is building a first large scale demonstration plant in its steel plant in Gent, Belgium, where it will produce 80 million litre of bio-fuel.

This use of bio-technology open a new field. It allows to store renewable energy over a long period, but also it creates a stock feed made out of waste carbon which can be used to produce plastics, paints and even food.

The steel plant of the future will more than ever be a corner stone to further develop the real circular economy. Steel has showed it is able to re-use a lot of the waste materials generated in the society.

ArcelorMittal is now also showing it can generate other stock feeds for other high value add business development. For this reason, ArcelorMittal is convinced that Steel will become the material of choice of the 21th Century.

(lecture 6)

Prof Jean-Pierre Tshibangu

11:10 **Towards a global partnership regarding mineral resources and energy production: contribution to sustainable development with focus on Africa**

Prof Jean-Pierre Tshibangu, UMons, Faculty of Engineering, Dpt of Mining Eng., RAOS member

ABSTRACT

The global demand of mineral resources and its impact on economy is growing at high rate since about two decades (http://minerals.usgs.gov/minerals/pubs/mcs). Ensuring industrial production needs the development of facilities to produce energy in such an amount to comply with the level of activity. Different definitions have been used for the development, the most recent being the "emerging" one.

The development of African countries relies mostly on the production of raw materials from natural resources: agriculture or mining. Specifically, the production of mineral resources and their transformation implies the use of great amount of energy (e.g. use of furnaces or electro-winning in metallurgy). The mining sector has to face different challenges: the increase of World population and demand ; the limited high grade resources (producing one tonne of metal will then need more energy); the variability of prices on the global market ; the development of activities in protected areas (example of Natura 2000 zones in Europe); the pollution of surface and underground water, etc.

The most recent boom in mineral commodities prices showed a big development of artisanal mining in Africa (2 to 3 million people in DRC) to supply industrial companies in the World. This situation is favoured by poverty and low technological level in Africa, and it can be shown that these operations do not improve the life conditions of local populations. In artisanal operations, people use to exploit very rich areas in deposits leading to their general premature economical depletion. Mineral resources are considered as "Earth heritage", their exploitation must then be conducted in such a way to ensure sustainability for future generations.

Another big issue is the perception of development model in Africa as can be illustrated currently by migration of young people trying to reach Europe. In terms of energy consumption, American people have been and are still the biggest consumer per inhabitant. With the recent boom of the mining sector in Africa, one can see that current reference for standard of life seems to be the Western one (South Africa, D.R. Congo,…). The resources of the earth in terms of mining commodities and energy resources (mostly petroleum) will not be enough to sustain such a standard for the growing global population.

How can Africa meet SDG 12 (Sustainable consumption and production) and 13 (Strengthen the means of implementation and revitalize the global partnership for sustainable development) in the global competitive market?

Statistics show that Africa has a huge potential in mineral resources both for mining and energy (coal in South Africa), but developing those resources to comply with SDG 12 and 13 will need an overall

approach to deal with workforce (so improving education), technology (develop research) and capital (improve the level of economic risk and avoid capital evasion towards other continents). All these items are linked to the governance of African countries in order to improve the lifestyle of populations eco-friendly. Currently Africa produces mostly raw material. Mining products exported towards all over the World are reimported with big margins, so giving an unbalanced trade.

There is then a need for a new partnership between rich countries and Africa to develop a fair business that can be profitable for both parties.

In its current H2020 research program, European Union expressed three ways to address the new policy for the mineral commodities (https://ec.europa.eu/growth/tools-databases/eip-raw-materials). International cooperation is one the pillars of the European Innovation Partnership; it is intended to implement new technologies in exploration and modern mining through cooperation with international players, among which African countries. This pillar is aimed at developing ore metallurgy and processing techniques in an innovative way to increase metal recovery, decreasing energy consumption and improving the by-products recovery; engaging EU's partners in a dialogue on recycling technologies with the aim to improve the environmental performance of end-of-life products. It is important for Africa to develop such a cooperation with a clear view to what can be the target at the horizon of 2030 to comply with the United Nations objectives. The partnership to be developed by Africa can also be extended to other continents; some ideas will be developed in this presentation.

(lecture 7)

Dr Ir Pépin Tchouate Heteu

11:30 **Renewable energy deployment in Africa : opportunities, challenges and perspectives**

Pépin Tchouate Heteu, Ph.D. in applied sciences from UCL, managing Director of DEECC Consulting (Energy, Environment, Climate change mitigation)

ABSTRACT

Sub-saharan Africa (SSA) is the world's region with the lowest access rate to electricity, only 35% in average, with a stark disparity between urban (69%) and rural areas (15%). This is due to the electrification strategy, adopted by SSA countries for the past 60 years, based on centralized grid extension and a monopolistic electricity supply system. Paradoxically, majority of SSA countries are endowed with untapped renewable energy resources which are beeing seriously considered since the UN launched the Sustainable Energy For All (SE4ALL) Initiative. In fact, achieving universal access to electricity by 2030 will demand to strategically increase renewable energy generation to supply both on- and off-grid population, businesses and industries.

This communication will address:

- Update of electrification status in SSA
- Overview of the SE4ALL objectives in selected countries, with emphasis on access and renewables share in the electricity mix
- Overview of Renewable Energy resources in Africa
- Benefits and Challenges associated with Renewable electricity development in Africa including green minigrids, regulatory and tariff issues as well as economic, health and environmental impacts.
- Perspectives and way forward.

(lecture 8)

Paul FRIX

14:00 **EU - Africa cooperation in the field of energy: what needs to be done to boost regional power trade ? (challenges and opportunities of Power Pools)**

Paul FRIX, Senior Economist, DG Honoraire Coopération belge et CDE/CDI, Conseiller CBL-ACP, Manager de PROPADEV SPRL

ABSTRACT

Not available yet.

(lecture 9)

Henri Boyé

14:20 **Hydro-electricity in Africa : remaining economically exploitable capacity and impact assessment study (including social acceptance)**

Henri Boyé, USAID Electrification Advisor / Electricity Sector Reform Project, and Michel de Vivo, General Secretary of International Commission on Large Dams

RESUME

L'acceptabilité sociale et environnementale des barrages

Notre planète Terre a de plus en plus besoin d'eau et d'énergie, du fait de la croissance de la population et des consommations, surtout dans les pays en développement. Les ressources en énergie fossiles émettrices de CO2, hydrocarbures, gaz naturel, pétrole, charbon, sont consommées à un rythme croissant, et les réserves sont inévitablement en voie d'épuisement, au détriment des générations à venir. Après la COP 21, le recours accru aux énergies renouvelables est une nécessité renforcée par l'Accord de Paris. Parmi toutes les énergies renouvelables, c'est l'hydroélectricité qui est la plus économique, car compétitive sans subventions couteuses, et sans problème d'intermittence ni de stockage pour les gestionnaires des réseaux électriques. Elle offre de plus des avantages uniques pour la gestion du réseau électrique (réglage de la fréquence et de la tension).

Par ailleurs les besoins en eau douce, en eau potable et en irrigation, vont aussi beaucoup augmenter, avec le changement climatique annoncé. Sans eau, il n'y a pas de vie sur notre planète. Les ressources en eau douce sont limitées et mal réparties. Il existe des régions où la fourniture d'eau conditionne toute amélioration du niveau de vie, actuellement trop bas, et même la survie des communautés existantes, ainsi que la satisfaction de la demande toujours croissante résultant de l'accroissement rapide de leur population. Dans ces régions, on ne saurait se passer de la contribution des barrages-réservoirs pour l'utilisation des ressources en eau. Il faudra beaucoup augmenter nos ressources en eau et construire de nouveaux barrages.

Les infrastructures de stockage d'eau sont considérées comme des outils indispensables à la fois pour le développement durable et pour l'adaptation au changement climatique.

Pourtant le développement des barrages est controversé, au Nord comme au Sud, du fait des impacts potentiels, et les projets nouveaux se heurtent souvent à des oppositions parfois fortes.

L'acceptabilité sociale des barrages est donc une question très importante, et le présent article s'efforce d'apporter quelques réponses et réflexions, en matière de prise de conscience sur les questions d'environnement et de démocratie, avec des exemples d'actions dans les pays en développement.

(lecture 10)

François Misser

14:40 **Grand Inga, le plus grand complexe hydroélectrique du monde : ambition nécessaire mais à mûrir**

François Misser, diplômé de l'École supérieure de journalisme de Lille, chercheur indépendant, spécialiste des relations entre pouvoir et ressources naturelles en Afrique

ABSTRACT

La plus grande richesse du Congo, outre ses hommes, c'est le fleuve dont le pays tire le nom, et son bassin, l'eau qui lui apporte un potentiel agricole, forestier et énergétique considérable. Mais la mise en valeur de ce potentiel, notamment hydroélectrique est laborieuse. L'article entend rappeler l'enjeu de d'Inga 3, première étape du projet Grand Inga, qui vise à faire du site, le plus grand complexe hydroélectrique mondial. C'est un projet dont l'envergure est telle *(+ou- 40 GW* qu'à lui seul, il représente près de la moitié du nouvel en énergie hydroélectrique qu'il faudrait développer à côté d'autres sources d'énergie, pour atteindre l'objectif de **l'énergie pour tous à l'horizon 2030**.

Bien conçu, l'aménagement du site peut conférer au pays et à la région, grâce à l'énergie la moins chère du monde, une compétitivité dont ils manquent cruellement, rendre des services environnementaux considérables, en générant une énergie propre, alternative aux centrales thermiques d'Afrique australe et fournir une alternative à la destruction des forêts congolaises, sans compter les services rendus à des secteurs comme l'agriculture et la santé.

Dans un deuxième temps, sera examiné l'état d'avancement du projet de construction de ce troisième barrage, dont le démarrage, annoncé pour octobre 2015 par le gouvernement congolais, n'aura lieu au plus tôt qu'en 2017. Les causes des retards dans la mise en œuvre, qui tiennent à sa taille, défi à la fois géologique, hydrologique, technologique et financier seront examinées.

Nous nous pencherons enfin sur la finalité de ce projet extraverti, largement configuré selon des critères de solvabilité de la clientèle de l'électricité produite par le barrage et de sa capacité à garantir la bancabilité du projet. Le traité international signé entre le Congo et l'Afrique du Sud en 2013 fait passer les besoins de la société sud-africaine ESKOM et de l'industrie minière du Katanga, avant ceux du reste du Congo. La société civile congolaise s'exprime de plus en plus à ce propos. La question est maintenant de savoir comment sera gérée cette attente et si dans les étapes à suivre du développement d'Inga les aspirations des Congolais seront davantage prises en compte par l'État congolais et ses partenaires.

(lecture 11)

Prof. Patrick Hendrick

15:00 **Using small low cost, robust and easily maintained decentralized hydraulic power stations in Central Africa**

Prof. Patrick Hendrick, ULB, École polytechnique

ABSTRACT

Central Africa suffers from a recurrent lack of electrical energy. That prohibits its locally-based industrial development but also its daily life through, for example, the education of the children and students but also the working condition of women.

Though the hydro-electric potential is, in most of these countries, huge but has been and is still poorly or non-adequately exploited.

One of the reasons has been the uncorrect use of a too heavily centralized hydraulic power generation and another one is the use of too expensive, too delicate and too difficult and expensive to maintain small power generation units.

Two solutions that bring new technical and maintenance features will be presented here.

One is the old Archimedes screw specifically designed for and used in turbine mode. This application will be described for rivers that have been monitored in the Katanga province of the RD Congo.

The other solution proposed is using the very robust cross-flow turbine concept and it is analyzed for an application in the Kayanza province in Burundi.

(lecture 12)

Prof. Dr. Ir. Jozef Poortmans

15:20 **The potential and challenges related to photovoltaic electricity generation and local (DC) microgrids**

Prof. Dr. Ir. Jozef Poortmans, Scientific Director PV@imec, Director R&D strategy@EnergyVille and Part-time Professor at KULeuven and Univ. Hasselt

ABSTRACT

The presentation will review the technological and cost challenges related to the deployment of photovoltaic electricity generation. Thanks to the rapid price decline of PV-generation the present levelized cost of electricity from PV-source would be in the range of 4-7 Eurocent/kWh making PV economically perfecly conceivable. The presentation will also highlight the challenges related to the reliability of this electricity generation taking into account the specific climate over the African continent. From this it will become clear that reliability ensuring lifetimes > 20 years will require specific solutions for the tropical regions as compared to the subtropical regions.

However, even with all the solutions becoming affordable, large-scale deployment will also require the development of nano- and microgrids including local storage as to deal with the intermittency of solar electricity generation. These nano- and microgrids could be based on DC-solutions rather than pure AC as this could reduce the investment costs by 10-20%. Such development is to be taken seriously as at least 2-thirds of the generation/lead would be essentially DC-based (PV, batteries, LED-illumination, ICT-systems, ...)

(lecture 13)

Marcel Bial

16:10 **The value of concentrated solar power for developing countries: another look on energy transitions**

Marcel Bial, Secretary General of the European Solar Thermal Electricity Association

ABSTRACT

The main priority for any society is to trigger growth, creating jobs and improve living standards.

Growth is at the beginning of the 21th century to a large extent achievable as "green growth", based on an energy supply model designed as the most efficient combination of renewable sources. This will deliver reliability and affordability of a system, in which a centralized bulk energy supply to energy intensive industries will coexist with decentralized generation serving mostly local demand and "circular" or "participative" economy sectors.

The energy transition towards renewables that started in Europe is an irreversible process, even if the pace of this transition will vary from country to country. It might of course just be accelerated or delayed by price swings on raw materials and fossil fuels or any major accident...

Energy investments need time from any decision to implementation,

- effects on the system (re-balancing a generation portfolio) until the effects on technology costs get real (effects of scale and bankability of innovation) and until the behaviour and interest of users (prosumers/consumers), also as voters change.

The time metrics for this process is at least a decade, which means that longer-term planning is key and that opinion-drivers and decision-makers understand the value of an energy transition in its various dimensions.

The value of any energy transition is 3-fold:

- business (cost/return ratio) value leading to concepts such as primary affordability,
- macro-economic value (GDP metrics, up into "social welfare" understood as the well-being of the entire society, including the quality of life, quality of the environment (air, soil, water), availability of essential social services, even religious and spiritual aspects of life.
- both together means a political value: The energy transition is already now an instrument for policy makers to offer their voters an active role in modelling their own future: the citizen has suddenly a "real say" about how and when his energy needs shall be covered

The key issue is system responsibility. But which one?

- Although energy policy remains in most countries (including EU!!) a national competence, even if progress is being made towards integration of the power systems: soon, power systems will constitute larger physical entities (more than a single market) where any structural unbalance or

any abrupt supply disruption in a given country impacts all participating countries in the system. Herein lies the importance of a robust „grid integration“ of VARIABLE renewable energy sources such as PV and wind.

- Countries in Europe claiming they can manage penetration levels of intermittent generation “of nearly 100%” are either exporting system stability issues to their neighbours or manage such situations over short periods (sunny or windy weekends).
- This means that the reliability of a power system will soon no longer be managed at national level

The good things ahead of us:

- In this context, the supra regional system responsibility (i.e. the task of real-time balancing generation and demand) in todays power systems is to stay as the core task of TSOs.
- In order to manage intermittency of more generation sources, it will need to be increasingly coordinated with DSOs and new agents (independent power producers, “prosumers”, etc..).

But someone MUST take responsibility..

Both for the system operation and the market design, correcting what no market will deliver a full-value approach of investments that leads to a better balanced ratio between generation investments in intermittent and non-intermittent sources.

The less good things…

- Energy regulators are said to defend the interests of consumers. Doing so, they have been following mainly a “technology-neutral”, “market-fits-all-issues” policy.
- However, energy markets that are today largely financial markets cannot (by essence) and will not cover all value aspects.
- Current market mechanisms alone do not ensure that generators in the power system are remunerated for their effective contribution to system responsibility, do not take into account externalized societal costs such as industrialization effects, business opportunities, health effects, dismantling costs, etc...
- It tackles only the short-term affordability and completely misses the strategic and political values of the energy transition.

We have the choice between 3 scenarii:

- Either to end with a system with approx. 30% of renewables that a still fossil-fuel based system can more or less cope with, without incentive to go further. coal, oil and gas industries will come back on stage and …citizens will pay also with their health.
- Or both the system operators and the demand side will sooner or later call for a new clean and cost efficient balance between intermittent and non-intermittent generation sources. At that moment, dispatchable generation will reach extreme price peaks due to not timely investments and the resulting scarcity; the energy transition will come to a hold – possibly inverting the energy transition back into fossil fuels.

The better scenario, the better choice is to use CSP as soon as possible – as Morocco has impressively demonstrated

- A smooth energy transition built on a balanced technology mix building on non-intermittent generation technologies incorporating commercially proven bulk storage solutions is of course possible

- However, these should be built now so to be available in larger volumes and at much lower costs demonstrating thus to the world the complementarity of technologies for a common objective: full decarbonization. Natural gas may be to a certain extent further used to increase firmness of deliveries.

(lecture 14)

Prof Dr Ir Eric PIRARD

16:30 **Development of solar energy in Africa : A challenge in terms of resource availability and recycling**

Prof Dr Ir Eric PIRARD, RAOS member, and Dr Sandra BELBOOM, Ulg

ABSTRACT

Africa is a booming continent in terms of population, GDP or electricity consumption. From 2000 to 2014, population has been multiplied by 1.42 to reach 1155.8 million people, GDP by 1.9 and electricity consumption by 1.6 (International Energy Agency 2012). Based on these facts, increasing their electricity production using their local resources is mandatory to be able to increase their energy security supply and to continue their economic development.

Focusing on Africa, sun is a renewable resource, free of charge, without any dependency of supply from other countries but implying technologies to transform this resource into electricity. Photovoltaic panels are dedicated to this goal and present several advantages as the free cost of the fuel and no emissions during the production of electricity. These advantages are counterbalanced by the high amount of mineral resources needed, the lifetime of installations, the decreasing yield during operation years and the very limited recycling potential.

Based on published literature, this study will highlight environmental considerations of the use of PV panels in using the Life Cycle Assessment methodology (International Organization for Standardization (ISO) 2006b; International Organization for Standardization (ISO) 2006a). This study will consider polycrystalline-silicon panels and highlight the advantages and drawbacks of PV as well as limitations in the environmental evaluation of PV electricity production. Boundaries of the system will begin with the production of the panel with the raw material extraction and will end with the end-of-life. A special focus will be put on the recycling of the panels and the depletion of the mineral resources. Production of silicon used in the photovoltaic panels is assumed to be produced from an inexhaustible source (silica sand), but only a very limited part of this resource is adapted to produce solar silicon.

As the amount of PV panels is increasing through years, and their lifetime is about 30 years, some recycling routes should be implemented and should influence the design of panels to avoid a landfill at the end of their life.

(lecture 15)

Prof. Peter Baeten

16:50 **The development of Small Modular Reactor (SMRs) for emerging nuclear countries in Africa**

Prof. Peter Baeten, SCK•CEN & VUB Kernenergie, and Prof. Hamid Aït Abderrahim, Deputy Director-General International Affairs SCK•CEN & UCL

ABSTRACT

Not available yet.

(lecture 16)

Prof Willy Verstraete

09:00 **The bio-tech road towards sustainable energy – a possible frame for Africa**

Prof Willy Verstraete (Ugent), Center for Microbial Ecology and Technology (CMET), Faculty of Bioscience Engineering at Ghent University

ABSTRACT

Biotechnology has raised a lot of perspectives in the domain of sustainable energy for industrialized and developing countries as well. There are routes such as producing crops rich in biodegradable or combustible biomass. These crops can be higher plants but also algae. The concepts of bio-diesel and bio-ethanol are well known; the technologies to incinerate respectively gasify energy rich biomass are also quite well documented. All of these possibilities have so far to the best of our knowledge not been of major application to Africa.

Of particular interest is the route of anaerobic digestion. The technology is readily available at various levels of complexity. Effective breakthroughs such as up-flow anaerobic sludge bed reactor technology originate from South African research some 25 years ago. Yet, although biogas production fits the concept of energy recovery from wastes coupled to efficient environmental clean-up technology, it has as yet not really been widely applied in the African context, as judged from literature and lectures at international congresses. It is very much of value to examine how one could increase the implementation of such worldwide useful technology on the African continent.

A quite important aspect is the duality normally existing between food crops versus energy crops. In this regard, a new approach is merging in which the arable land is used to grow low-fertilizer demanding energy crops, while the need for protein can to a considerable extend be provided by the production of single cell microbial protein based on aerobic fermentation. This new approach will be discussed and the potential barriers and opportunities for Africa will be critically explored.

(lecture 17)

Dr Rainer Janssen

09:20 **Overview of bioenergy policies for sustainable development in Africa**

Rainer Janssen, PhD, Head of the Biomass Department at WIP Renewable Energies (WIP = "Wirtschaft und Infrastruktur GmbH & Co Planungs-KG"), Munich, Germany

ABSTRACT

The agricultural sector in most Sub-Saharan African countries is currently dominated by subsistence farming with very low investment levels and yields. The development of modern biofuel projects offers opportunities for investment and infrastructure improvements with the promise to diversify agricultural production and thus to stimulate socio-economic development, including an increase of yield levels and value creation within subsistence farming schemes.

Primary drivers for modern bioenergy promotion in Africa include security of energy supply, a reduction of the foreign exchange burden of oil importing countries, as well as environmental benefits such as the restoration of degraded land, reduced land abandonment, and the mitigation of greenhouse gas emissions.

On the other hand, concerns exist that biofuel expansion in African countries may have severe negative impacts on biodiversity and the use of natural resources through increasing competition over land and water resources. Rising prices of agricultural commodities may negatively affect food security of the poor in developing countries and the implementation of large-scale biofuel projects may cause negative social impacts such as conflicts over land ownership and displacement of rural communities.

It is widely acknowledged that sound legal and regulatory frameworks for biofuels are needed in African countries to ensure environmentally, economically and socially sustainable production, promotion and use of biofuels.

In order to minimise risks and maximise benefits, in recent years several African countries have launched initiatives to establish sound policy frameworks for bioenergy in order to ensure environmentally, economically and socially sustainable production, promotion and use of biofuels. Significant progress has been achieved in Mozambique with the National Biofuels Policy and Strategy (NBPS) published in May 2009 and the Biofuel Sustainability Framework in its final stages of development.

This paper presents current policy initiatives for sustainable biomass in several Southeast African countries (i.e. Mozambique, Malawi, South Africa, Tanzania) and discusses conclusions of the "Workshop on Sustainable Biomass Production in Southeast Africa" which was organised by WIP Renewable Energies on behalf of Netherlands Enterprise Agency in Maputo, Mozambique in 2013.

(lecture 18)

09:20 **Wood energy trends and challenges in Africa: What future for African populations energy needs?**

Jean Noël Marien, Régis Peltier and Emilien Dubiez, Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), Unité de Recherche « Forêts et Sociétés » – Montpellier, France

ABSTRACT

Wood-energy in Africa (including charcoal) mainly meets domestic energy needs as there are no specific wood cultivation projects dedicated to supplying industrial energy plants. We shall describe how this informal but highly organized sector operates, covering the entire process moving from the standing tree to the kitchen oven. We also shall present some basic data showing the significance of increasing needs and consumption, especially in urban areas, with regard to rapidly depleting natural resources.

Some examples of contrasting situations in Africa will highlight the diverse issues raised by wood energy. An analysis of the situation in 16 African towns will show different solutions to the pressures generated by domestic energy needs. Other examples will present two pathways of natural resource degradation (in Guinea and DRC) induced by the supply of wood energy to large cities.

In most African countries, the use of wood for domestic energy involves multiple, interacting issues.The wood mainly comes from degraded natural forests (e.g. shifting cultivation) and is generally produced within traditional agricultural systems. The demand grows continuously, due to ever increasing populations domestic needs. We will address the relations between wood energy and environmental and social issues, and examine the economic weight of the sector. Finally, we shall indicate some institutional and governance means to address (or not) the populations' domestic energy needs.

The sustainable management of wood-energy resources is possible and is one of the keys for the future. We shall present some results of the Makala project, an EU funded programme in DRC and Congo Brazzaville, from 2008 to 2014 (1). The project has developed on a large scale various operational tools for a sustainable wood resource management. These range from simplified, but efficient, management planning for rural communities, to various methods to create or regenerate a large area producing wood resources through the natural regeneration of degraded forests, agroforestry systems, or the plantation of fast-growing species. Achieving a more efficient carbonization process is another important issue. The feasibility of improved stoves also will be discussed.

Given that urban population growth will in many cases lead to an increase in household energy requirements which will surpass what can be provided by tree formations, the authors argue that planners should consider the development of energy mixes that combine the sustainable production of wood-energy with a partial transition to other energy sources (fossil, hydro-electricity, solar or

biomass). The importance of the carbon economy will also be discussed by examining some international processes as REDD initiative or Green Fund for the Climate (UN).

Finally, some conclusions from a recent prospective analysis of Central African forest ecosystems will focus on the evolution dynamics, expected impacts and strategic actions able to address positively the wood-energy challenges that will face Africa in the future.

(1) Makala project: www.makala.cirad.fr (EU EuropeAid DCI-ENV/2008/151-384)

Key words : Domestic Energy, Africa, Wood, Charcoal, Natural Resource Degradation, NR Sustainable Management, Agroforestry

(lecture 19)

Prof Hervé Jeanmart

10 :00 **A locally manufactured gasification technology for the valorization of agricultural wastes in West African countries**

Prof Hervé Jeanmart (1), Séverin Tanoh (2), Wilfried Ouedraogo (3), Yohan Richardson (2), Sayon Sidibe (2), Frédéric Bourgois (1) and François Pinta (4)

(1) Université catholique de Louvain, Louvain-la-Neuve, Belgium; (2) Institut International d'Ingénierie de l'Eau et de l'Environnement, Ouagadougou, Burkina Faso; (3) Institut de Recherche en Sciences Appliquées et Technologies, Ouagadougou, Burkina Faso; (4) Centre de coopération internationale en recherche agronomique pour le développement, Montpellier, France

ABSTRACT

A locally manufactured gasification technology for the valorization of agricultural wastes in West African countries

Rural populations in Africa depend nearly exclusively on woody biomass to satisfy their energy needs that are usually limited to cooking and some food processing.

Nevertheless, this limited use together with the biomass exported to the cities lead to an unsustainable pressure on the resources. At the same time, agricultural activities lead to the production of large quantities of residues (cotton stalk, rice husks, etc.).

These wastes have an energetic potential that could be exploited locally. But, contrary to woody biomass, the combustion of these residues is complex. Gasification could help converting efficiently these residues into more useful forms of energy: not only heat but also electricity. Downdraft fixed bed gasifiers are the most suitable technology for the range of power (50…200kWth) and feedstocks considered. While gasification could significantly improve the access to energy in rural areas, the imported technologies (e.g. from Europe and India) are too complex and thus not resilient.

Existing local technologies do not sufficiently take into account the peculiarities of the gasification process and of the available feedstocks. A technology designed to be efficiently manufactured, operated, and maintained locally could overcome the barriers that prevent the development of gasification in rural areas of West African countries.

Such a concept entails many challenges. The characteristics of the feedstocks, especially the moisture and ash content, may vary a lot. The quality of the available steel makes it unsuitable for high temperature processes and prone to corrosion. The local manufacturing techniques must be adapted to produce airtight vessels from available parts. The cooling and cleaning requirements for the syngas must be matched without producing hazardous liquid effluents. Yet the numerous challenges can be overcome with suitable designs for the different parts of the gasification facility.

After a description of the potential contribution of agricultural wastes to the energy needs in rural Africa, these challenges shall be detailed and illustrated with results, including experimental data, taken from the development steps of a gasification technology manufactured in Burkina Faso for the production of heat and electricity.

(lecture 20)

Prof István E. Markó

10:20 **Examining energy production in Africa from the chemistry viewpoint**

Prof István E. Markó, Laboratoire de Chimie Organique et Médicinale, UCL, Belgium

ABSTRACT

Africa, like many developing countries, needs increasing amounts of reliable and cheap energy to improve the quality of life of its population, to eradicate poverty, to ensure its social and economic development and to provide a proper and efficient health system. Access to such reliable and cheap energies requires a pragmatic approach, in which recognition that adequate infrastructures and appropriate financial support are primary key parameters in providing an unbiased analysis of the situation.

Whilst several sources of energy are available, the most accessible ones involve at present fossil-type energy (gas, oil and coal) as well as bio-sources (wood and dried animal dung).

The lecture will focus on the chemistry related to energy production from these sources. It will highlight the chemicals produced during these combustion processes and discuss the relative toxicities (or lack of toxicities) of the by-products thus generated. The presentation will also compare the energy obtained from these different sources on a weight basis and offer some suggestions for future possible solutions.

The notions of sustainability, reliability, efficiency and availability in the context of the African energy supply will also be discussed.

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POSTER PRESENTATIONS (35 in total)

(poster 10)

Private sector involvement in energy production: experiences of the Belgian Development Agency from Rwanda and Mozambique

by Muriel Lambert de Rouvroit, Frederik Van Herzeele, Benoît Legrand (as unit coordinator) and Paul Verlé (as head of department), all in Infrastructure and Environment Unit, Belgian Development Agency (BTC)

ABSTRACT

Not available yet.

(poster 11)

Industrial waste heat recovery – Innovative solutions for steel industry

T. Steinparzer, A. Fleischanderl, M. Haselgrübler, P. Trunner / Primetals Technologies, Linz, Austria GmbH / A joint venture of Siemens, Mitsubishi HI and co

ABSTRACT

Keywords: Industrial waste heat recovery,steelmaking, integrated steelmaking, electric steelmaking

Africa's population is growing rapidly. Therefore, it is crucial to provide dedicated infrastructure and energy grids, especially electric energy, to a broad part of the population. A high diversity in energy production leads to a robust and stable energy network which is key for industrial and GDP growth. Power generation by industrial waste heat recovery can be a corner stone for an efficient and socially acceptable energy system.

Over the last years, waste heat recovery in steel industry attracted more and more attention. Additionally, the demand for increasing energy efficiency is one of the global megatrends of our time. The combination of steel production and waste heat recovery systems leads to a win-win situation for economic growth and decentralized power generation. Besides economic and social aspects, natural resources are saved and an economic value is created (e.g. by carbon emission trading). The presented waste heat recovery systems are based on simple and proven technologies (e.g.: hot water production, steam generation, ORC units, etc.). This fact makes an application also from a social point of view reasonable.

Waste heat recovery potential for mini mills (electric steelmaking) and integrated steel plants will be presented. Additionally, typical waste heat recovery solutions and possibilities for waste heat utilization will be introduced.

The objective of this paper is to demonstrate possibilities for energy recovery and utilization for integrated steel making as well as for the electric steelmaking route under consideration of the economic feasibility. Focus of the paper is electricity generation out of waste heat from steelmaking processes.

(poster 12)

"Mini mill plants" for steelmaking: sustainable production of charcoal as fuel source while taking care of environmental and social issues in forest plantations

Roosevelt de Paula Almado, Health and Safety, Environment and Forest Research Manager, ArcelorMittal BioFlorestas Ltda., São Geraldo – Martinho Campos - Brasil

ABSTRACT

FOREST PLANTATIONS: CLEAN AND RENEWABLE ENERGY

INTRODUCTION

Brazil is a potentially forested country, with a great territorial extension, deep soils of medium to low fertility, adequate climate and currently one of the best productivities of the world as well as a low cost of wood placement in the industry. ArcelorMittal BioFlorestas is the ArcelorMittal Group company responsible for the production of charcoal from wood from sustainable forests. The production of pig iron in Brazil can be done by two routes, one to coal and the other by vegetable charcoal from renewable eucalyptus plantation. The company has approximately 100,000 hectares of forest crops with species of the genus Eucalyptus, as well as 40,000 hectares of native forest areas for preservation. Forest Management is the management of forest resources with the objective of obtaining economic and social benefits, respecting the mechanisms of sustainability of the ecosystem. ArcelorMittal BioFlorestas has the FSC Certification. Our plantations are formed predominantly by eucalyptus hybrids selected to better adapt to local climatic and soil conditions, providing significant gains in productivity (40 m^3/ha/Year) and wood quality. Currently, on average, the wood is harvested at the age of seven, ranging from six to eight. After the first harvest of trees, the plantations are managed by reforestation (new planting) or regrowth management. The company's planning is two rotations of the plantation.

II. FOREST ACTIVITIES

1- PLANNING: The planning of the planting, harvesting and production of charcoal to supply the ArcelorMittal Brazil plants contemplates the short, medium and long term, seeking the best use of natural resources and minimizing possible social and environmental impacts.

2- ENVIRONMENTAL TECHNOLOGY AND RESEARCH: We have developed research to improve the genetic quality of plantations and improve the forest management system.

3- FORMATION OF NEW PLANTATIONS: ArcelorMittal BioFlorestas only performs forest implantation in areas that do not have native forest cover. In the preparation of soil, the company uses the Minimum Cultivation technique, which consists in the minimum possible stirring in the soil without the use of

fire, which favors the maintenance of its characteristics and avoids erosion, compaction and reduction of fertility.

4- DEVELOPMENT AND MAINTENANCE OF FORESTS: Forest maintenance consists of activities related to the forest growth phase, that is, activities that ensure the good growth of the planted forest, such as by controlling the infestation of competing weeds, pests and diseases, and the supply of nutrients throughout this development, like potassium, calcium, magnesium and boron.

5. FOREST PROTECTION: ArcelorMittal BioFlorestas carries out the continuous monitoring of pests, diseases and weeds through programs and techniques developed through partnerships with universities and / or conducting periodic surveys in their areas.

6- FOREST INVENTORY: Monitoring of the wood stock, growth and dynamics of the planted forest is done through the continuous forest inventory, which uses sampling techniques to obtain data that allow the projection of the volume per hectare and trees of the plantations to a desired age. With this information, it is possible to decide the most opportune moment for the harvest.

7- FOREST HARVEST: Harvesting uses equipment that enables efficient, safe and environmentally sound operation. At ArcelorMittal BioFlorestas, it is carried out by means of different systems: Feller, which makes the trees felling; Skidder, who pulls the trees from the field to the loaders and the tracing pin, which traces the wood and loads the wood. The harvest is the operation with the greatest impact, as it changes the landscape, causes animals to move and increases the traffic of heavy vehicles. The company seeks to reduce these effects by taking every precaution to avoid damaging native vegetation, using equipment with low soil impact and reinforcing the dialogue with neighboring communities.

III. VEGETABLE CHARCOAL PRODUCTION

It is the transformation of the wood of renewable forests of eucalypt into charcoal through masonry ovens, by the action of heat, in the presence of controlled amounts of oxygen. The charcoal produced by the company is used as a reductive term in the production of steel and is destined to the plants of ArcelorMittal Brazil, such as at ArcelorMittal Juiz de Fora. The furnaces are spatially fixed in a single location called the UPE - Energy Production Unit. Special attention is provided for the choice of locality such as the relationship between predominant direction of the winds and proximity to communities and natural reserves. ArcelorMittal, aiming at the reduction of atmospheric effluents, develops research related to its use for co-generation of energy.

IV. INCREASE ENERGY EFFICIENCY

Charcoal is one of the energy sources of the Brazilian energy matrix, and has a production efficiency of up to 35%; That is, every 100 kilos of wood can produce about 35 kilos of charcoal. ArcelorMittal BioFlorestas carries out this search through continuous improvement projects identified by the operational teams or signaled by the company's directives. This work counts on the academic support of partner federal institutions and knowledge management of the ArcelorMittal group technical team

(CTO), and through investment funds for R&D, such as ANEEL (National Agency for Electric Energy). In addition to initiatives in Energy Efficiency, ArcelorMittal BioFlorestas also experiences other sustainability pillars, such as Social Responsibility specially for communities in the region and feasibility of sustainable solutions: the adopted Energy Efficiency approaches must respect the investment premises of the ArcelorMittal group.

Another economic pillar is carbon credit projects, currently 3 are in progress: credit for forests planted to small and medium-sized farmers, credit for the replacement of coke by charcoal in blast furnaces and credit for burning methane in production of charcoal. ArcelorMittal BioFlorestas has among its energy efficiency improvement projects the Smoke Burner, the Wood Dryer and the Energy Cogeneration.

Smoke Burner: It consists of a combustion chamber that burns the process's carbonization residual gases by transforming methane into carbon dioxide. This transformation reduces the environmental impact of this residual gas by 21 times, related to the impact of methane on carbon dioxide. This burning process transforms the waste gas at 110 ° C into a higher amount of gas at 900 ° C, which becomes a renewable waste heat.

Wood Dryer: Is an equipment that works like a greenhouse. In it the wood that will be charred is stored and receives the residual heat from the aforementioned process in order to decrease its moisture. Thus, drier wood when carbonized reduces the need for energy to remove its moisture inside the kiln during the carbonization process. As the fuel of this process is the wood itself, through this process it is possible to increase energy efficiency by up to 30%, in addition to increasing the productivity and profitability of the activity by up to 10%. The drier wood, by promoting a higher productivity, reducing the burning of coal, also contributes to the improvement of the quality of the product, as the charcoal has a larger grain size (<15% fines) and a lower incidence of discharge fire, (lower % humidity and % fines).

Energy Cogeneration: Also benefits from the residual heat generated by the Smoke Burner. A stove receives this residual heat and also atmospheric air, which becomes superheated. An adapted gas turbine compresses this atmospheric air before it enters the heat recuperator and receives it after the long-overheated heat exchanger, when it is expanded, generating electric energy. We can consider that every thousand tons of charcoal produced can generate 1MW electric, increasing the energy efficiency of charcoal production by about 14%, and increase the profitability of the company by selling this energy to other companies in the group or to the grid. The potential of ArcelorMittal BioFlorestas is 30MW electric.

This initiative is carried out in partnership with CEMIG (Minas Gerais Energy Company) through ANEEL's research incentive program.

(poster 13)

Variable-speed pumped hydro energy storage: bringing flexibility to the South African grid in order to accommodate future developments in nuclear energy and renewables

Thomas Mercier, PhD student & Research Assistant (Université Laval and Université catholique de Louvain)

ABSTRACT

Pumped hydro energy storage (PHES) is the most established technology for largescale energy storage. While it is mainly used for balancing the grid on an hourly basis, with fixed power set points in pump and turbine modes, guide vanes control enables PHES units to provide frequency control in turbine mode. Recent developments in power electronics have provided PHES with a variable-speed feature, thereby extending the operation ranges and enabling new, more precise and rapid control strategies. South Africa has a relatively infant but growing renewable energy industry.

According to its department of energy, renewable energy will contribute to a total of 18.2 GW by 2030 (about 42% of the new build). Regarding nuclear energy, 9.6 GW will be added by 2030. In order to ensure the reliable operation of the power grid while integrating significant amounts of renewable intermittent generation on the one hand, and of non-flexible nuclear generation on the other hand, flexibility will be needed. PHES is a good candidate to provide this flexibility, and this is not a coincidence if South Africa has already several PHES plants, as Ingula 1332 MW, Palmiet 400 MW, and Drakensberg 1000 MW, all with reversible fixed-speed Francis pump-turbines. In this poster presentation we will discuss the operation ranges of fixed- and variablespeed Francis pump-turbines. The presentation will emphasize the capabilities brought variable-speed machines and how it can help South Africa to accommodate new renewable and nuclear generation capacities.

(poster14)

Archimedean screw turbine: opportunity for rural electrification in D.R. Congo ?

Prof. Jean Paul Katond Mbay, Université de Lubumbashi, DR Congo, and Prof. Patrick Hendrick (ULB - Belgium)

ABSTRACT

Located in the center of Africa, DR Congo is a country populated by nearly 70 million people, including more than 70% who live in rural areas. The country has an electricity service rate that ranks as the lowest in the world (less than 1%). DR Congo has a significant energy potential. It is estimated that exploitable hydropower potential of 100,000 MW.

Today, it is urgent to make use of this potential to increase the rate of access to electricity using small rivers around the villages to build micro-hydro power plants. As part of my PhD work at École Polytechnique de Bruxelles (ULB) in partnership with the University of Lubumbashi in DR Congo, we have designed and manufactured locally (in Lubumbashi) a test bench of Archimedean's screw turbines having two blades and large pitch.

The goal is to simplify manufacturing and reduce the amount of steel used for the screw relative to the screws used in Europe. The optimal combination is the configuration of the screw inclined at $\alpha = 22.5$ ° relative to the horizon and which is oriented helix $\beta = 45$ ° on the cylinder of the screw. Currently, we are in the process of installing a prototype on a farm.

(poster15)

Small hydropower development in Burundi

Jean Bosco Niyonzima (1), Patrick. Hendrick (1*),

(1) Université Libre de Bruxelles, Aero-Thermo-Mechanics, (ULB Polytechnic School), Belgium, and (1*) Promoter and Head of Department Aero-Thermo-Mechanics (ULB)

ABSTRACT

There is no clear and commonly accepted international definition of small scale hydropower. The European Directive accepts a small hydropower at 10 MW, Canada defines small hydropower as the power plant which has a capacity between 20 and 25 MW, US Directive accepts small hydropower of up to 10 MW in total. The context of Burundi classifies the small hydropower plant as a plant with a capacity lower than 10 MW. In Burundi, all existing hydropower plants are classified within the small hydropower units excluded the ones of Rwegura with a capacity of 18 MW.

Firstly, this paper aims to describe small hydropower in Burundi and examines the strong need of electricity of the country. The first hydropower plant was implemented in 1980 while the last one was implemented in 1986.

The total national installed capacity is around 35 MW (in 2016) compared to an electricity demand of 250 MW by 2020, not including the required electricity for mines. Several conflicts took place in the country after the independence (1962), which slowed strongly down the socio-economic development of the country and resulted in the limitation of the hydropower infrastructures. Currently, several hydropower projects are under study while others are under construction in order to boost the electricity production and consequently facing well to the country energy challenges. The country looks like a no power country. There is no available tool that can be used to inform about the energy situation of the country.

Finally, the second aim of this paper is to propose a Sankey diagram in which we can find global information on the Burundi energy situation, the so- called “Energy flow chart”.

(poster 16)

Turbulent Hydro - Decentralized low-head micro-hydro power for Africa, inspired by nature

Geert Slachmuylders and Wim Verheirstraeten, Turbulent Hydro, Innovator Under 35 EU 2016, Best start-up in Start-up Nations Summit 2015

ABSTRACT

TURBULENT HYDRO | POSTER SUMMARY / TECH OVERVIEW

Turbulent develops micro hydro-power plants based on “biomimicry” to create clean, reliable and affordable energy for even the most remote communities. Turbulent’s unique technology enables the use of very low height differences in rivers (1 - 3m) in an efficient way, without impact on the local ecosystem. Adding an easy to install product – without the need for a dam - combined with a modular design and control software, Turbulent delivers the first micro hydropower plants, profitable without the need for government grants.

WHY

Africa has problems with maintenance and follow up of current power plant initiatives. Hydropower solutions usually need a high level of maintenance. Most on a daily basis. A classic scenario is locals will forget to tend to the turbine which will be damaged over time. Replacement parts and skilled workers are then needed with high costs. Turbulent requires close to no maintenance and the turbine blades can be repaired as a car body.

Africa typically needs off the grid, independent solutions. Turbulent is a Turn-key solution that can be installed by low skilled workers. All that is needed is a small truck delivery and a few batches of concrete. Turbulent hydro plants can be up and running in a week with close to no civil engineering.

WHAT

Micro Vortex turbine producing 5 to 100 kW depending on flow and height difference.

Low height difference needed, as small as 1 to 3 meters.

Creating energy from centripetal force rather than water pressure.

NB

Guinean project confirmed through feasibility study, awaiting financial support.

4 turbines of 30kW.

VISUALS

ON LAND, SHORT BYPASS /DROP ON LAND, LONG BYPASS

(poster 17)

Development of energy efficiency and passive technologies in buildings for improving users' comfort: experience of the Belgian Development Agency in Uganda, Senegal and Palestine

Benoît Legrand (as unit coordinator) and Paul Verlé (as head of department), both in Infrastructure and Environment Unit, Belgian Development Agency (BTC), and Jan Van Lint, BTC- Uganda

RESUME

Depuis 2010 la Coopération belge s'efforce de façon plus explicite à promouvoir l'efficience énergétique des bâtiments dont elle appuie la construction. L'approche se base sur une analyse détaillée du contexte local et de son climat afin d'adapter la conception architecturale de manière à assurer un meilleur confort des usagers sans apport d'énergie supplémentaire.

Le premier champ d'investigation fut la Palestine au travers d'un programme de constructions scolaires. Il fut possible de convaincre les autorités d'ériger l'école pilote de Wadi Al Mughayer, construite en 2014 en y intégrant différentes technologies appropriées visant à combattre le froid en hiver et de se prémunir de la chaleur durant les mois d'été.

Outre une réflexion sur l'optimalisation de l'orientation des locaux, le renforcement de l'isolation et la systématisation de systèmes de protection solaires amovibles, trois types d'approches furent testées : (i) la géothermie avec l'installation de puits canadiens ; (ii) la ventilation forcée par des cheminées solaires ; (iii) le chauffage solaire via des murs solaires. Tant le personnel enseignant que les écoliers, se sont, dès l'ouverture de l'école, montré très enthousiastes par rapport à ces différents équipements, le ministère central exprimant de son côté certaines réserves. Différentes salles aux caractéristiques similaires disposent d'équipements diversifiés, permettant une analyse comparative. Un monitoring continu sur une période d'un an est en cours visant à objectiver l'évaluation de ces différents équipements et leur combinaison. Les conclusions de l'analyse sont attendues pour juin 2017. Elle devrait confirmer la perception d'une faible plus-value apportée par les puits canadiens et les cheminées solaires pour un coût important à la différence de murs solaires, ou des brise-soleils amovibles particulièrement efficaces pour un investissement limité.

Une approche similaire fut mise en œuvre en Ouganda au travers de la réhabilitation/extension de 3 centres de formation des enseignants. Les conditions climatiques relativement clémentes n'impliquent pas d'investissement majeurs. L'approche s'est axée, d'une part, sur l'apport de lumière naturelle sans surchauffe, l'optimalisation de la ventilation naturelle, des aménagements extérieurs ombragés et, d'autres part sur la promotion des énergies renouvelables via l'installation de panneaux photovoltaïques, le biogaz ou des fours améliorés, permettant à la fois de sensibiliser les étudiants à ces alternatives mais également de les former.

L'expérience acquise dans les 2 précédents projets a influencé la conception de bureaux d'assurance maladie (UDAM) dans deux localités du Sénégal. L'emploi de la terre crue, de cheminées solaires, de puits canadiens et de tours à vents furent envisagés. La faiblesse de l'expertise locale tant pour la conception que la mise en œuvre des bâtiments à contraint la CTB de réduire ses ambitions. Une part seulement de ces technologies sera finalement mise en œuvre.

Ces trois exemples sont illustratifs de certaines difficultés récurrentes dont la réticence de certaines autorités à l'innovation ou l'emploi de technologies perçues comme rétrogrades, mais aussi la difficulté de trouver l'expertise nécessaire pour les concevoir et les mettre en œuvre. Ces obstacles levés, le niveau de satisfaction des usagers est par la suite généralement très positif.

(poster 18)

Penetration of solar energy in Kenya and prospects for the next 10 to 15 years

Prof. Izael Pereira Da Silva

B.Sc. (Eng), MSc., PhD in Power Systems Engineering from the Univ. of Sao Paulo (Brazil) Deputy Vice Chancellor – Academic Affairs Strathmore University in Kenya

ABSTRACT

Not available yet.

(poster 19)

Affordable Mobile Solar Water Pumps for Small Farmers

Ahmed Abbas, SunCity Energy / The American University in Cairo, Egypt

ABSTRACT

KEYWORDS: Solar, Pump, Irrigation, Mobile, Farmers

The agriculture sector in Egypt employs more than 29% of the Egyptian work force. Out of 8.4 million feddan of agriculture and cultivated land, around 60% of the holders own less than 1 feddan, and another 20% of the holders have between 1 to 3 feddan (El-Nahrawy, 2011). Surface water is by far the major and dominant source of irrigation in Egypt, representing 83% of irrigation water. Due to technical difficulty and high initial costs, most farmers are not able to connect to the national electricity grid to be able to use electric pumps. This has resulted in a vast use of diesel pumps, a mature technology that has been there for decades and farmers are very familiar with.

Under new subsidies reform plans and regulations, diesel prices have increased 78% in July 2014 (GHANY, 2014). Following this increase, prices of oil and lubricants have followed the same trend. In a country with a total bill of about $17 Billion of annual subsidies (Heerwig, 2013) – 20% of annual budget – these structural changes are investable. However, implications of these regulations have hampered; an already poor and marginalized group of small farmers. Small farmers aren't able to switch from diesel to solar energy due to several reasons. Solar pumping systems come at a very high initial price tag, beyond affordability of this segment.

Moreover, economically existing solar pumping solutions fail to provide an economically viable alternative to diesel pumps. Installing a solar pump for one or two feddan is not a feasible solution. My research started with unstructured interviews with farmers in Tema, Sohag to understand their agriculture practices, irrigation methods, average number and time of irrigation per year, cost of irrigation, source of water and available alternatives. Data compiled and analyzed from these interviews along with primary data from FAO and other sources were used to design a comprehensive model of irrigation needs of small farmers; less than 2 feddan.

Based on this model, we have put a technical design for a new product that would meet the needs of these farmers at a feasible cost and innovative business model. My product is a Mobile Solar Pump that is capable of pumping up to 60 cubic meters of water from surface water. This unit can irrigate one feddan in 6 to 8 hours, almost the same time as diesel pumps. "Mobile" means a group of farmers can share the system and eventually split the initial cost, or one person can use it as a source of income by renting it to other farmers. Using a very efficient pump and solar system helps in reducing the power and the price tag of the unit considerably. In addition to that, the system has zero operating cost and is almost maintenance-free. We anticipate that for each 1000 units we produce and sell locally, we will be able to create 7 to 10 permanent green job, reduce emissions by thousands of tons annually.

(poster 20)

Solar thermal energy and molten salt storage (CSP+): a solution for dispatchable solar electricity generation

Michel LALMAND, Vice President Solar, Sales & Marketing, Cockerill Maintenance & Ingénierie (CMI)

ABSTRACT

Topics:

1. Dispatchability
    - Availability of solar energy (like wind energy) is intermittent
    - Network stability request Dispatchability (= capability to adapt electricity generation to the demand)
    - Presently by having other dispatchable sources in stand-by (Hydropower, Gas plants, …). Expensive.
    - By energy storage: part of the energy received is stored to generate electricity on demand.
    - Storage methods?
        - Mechanical (Pumping-Turbining, …)
        - Chemical (Batteries, …)
        - Thermal: STE

2. Solar Thermal Electricity
    - Different technologies
        - Dishes + Sterling Engine
        - Parabolic Through
        - Fresnel
        - Central Towers
    - Advantages of Central Towers

3. Constraints of STE
    - Suitable areas in Africa.

4. Some examples
    - Pictures.

(poster 21)

Concentrated Solar Power (CSP) technologies for electricity generation in Harare, Zimbabwe: comparison of two options, Solar Tower (ST) and Parabolic Trough (PT)

Luckywell Seyitini, Great Zimbabwe University, Department of Physics, Geography and Environmental Science

ABSTRACT

Sub-theme: Sustainable Environment and Resource Management

Keywords: Concentrating solar power, Solar Model Advisor, Solar tower, Parabolic Trough.

Capacity utilisation of solar energy in Zimbabwe is still low. Currently, only small scale photovoltaic (PV) solar systems are dominating in the market mainly for domestic applications. This study analyses the feasibility of investing in concentrating solar power (CSP) technologies for electricity generation. The software, Solar Advisor Model (SAM) developed by the National Renewable Energy Laboratory (NREL) was used to design a 100 MW solar thermal power plant in Harare using different technologies namely Solar Tower (ST) and Parabolic Trough (PT) CSP technologies. The performance and financial predictions for the power plant were analysed and compared for the two technologies used. The results of the annual electricity output (GWh), plant installation costs and levelised cost of energy ($/kWh) were used to determine whether it is technically and economically viable to invest in CSP technologies and recommend to policy makers and potential investors which technology is better.

(poster 22)

Nuclear Energy and Sustainable Development in Africa: Challenges and Ways Forward

Vincent Lukanda Mwamba, François Kazadi Kabuya (1) and Petrus Bompere Lemo (2)

(1) Commissariat Général à l'Energie Atomique, PO BOX 868 Kinshasa XI, DR Congo

(2) Comité National de Protection contre les Rayonnements Ionisants, Kinshasa, DR Congo

ABSTRACT

Despite the lack of consensus on the compatibility of nuclear energy with sustainable development, today nuclear technologies are regarded by many as a viable option to satisfy specific needs countries related. In a recent IAEA's update for projections of nuclear power, it is expected that up to 20 new countries will be operating nuclear power plants by the year 2030 worldwide. Approximately twenty countries of them in Africa region are considering or have expressed interest in developing nuclear power programs.

On one hand, the safe and secure introduction of nuclear power plants can only be realized through the adherence, by concerned countries, to the major international instruments related to safety, security and non-proliferation, and the establishment of competent and sustainable national infrastructures that include effective and independent nuclear regulatory systems.

On the other hand, implementing a nuclear power program involves important challenges associated with the long-term safety and security of nuclear materials and radioactive sources, in terms of adequate storage and disposal facilities, the procurement and management of spent fuel and radioactive waste and, financial arrangements for decommissioning as well. How can these countries ensure that plans for introduction of nuclear power plants do not proceed more quickly than the plans for establishing the necessary infrastructure for safety and security? While current sustainable development frameworks are still in the cradle, how can these concerned governments expect that their approaches within the nuclear energy systems are fairly consistent with sustainable development goals?

This paper presents results of study and analysis carried out on ten African countries, interested in acquiring nuclear power plants. The emphasis is put on challenges faced in terms of consistency of their nuclear programs with the sustainable development goals, in particular in terms of available resources, policy and infrastructures and funding as well. Also addressed are perspectives and opportunities for these countries to move their nuclear programs forwards.

The main prerequisites discussed are national energy needs and financing, legal and regulatory frameworks, safety and security, and human resource requirements. It appeared from this study and analysis that key elements to comply their nuclear programs with sustainable development goals consist in strong political commitment and effective leadership among Policy makers and nuclear Regulators. Committed Government will ensure provide nuclear safety regulators with both financial and skilled human resources, show the necessary transparency to national and international community. Appropriate regulatory leadership will guarantee effective and efficient implementation

of the regulatory framework to support smooth introduction of nuclear power plants in compliance with goals of sustainable development.

(poster 23)

How the IAEA uses nuclear science and technology to help countries meet their development goals and keep nuclear technology in peaceful use

Gerd Dercon, joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture,

Head of the Soil and Water Management & Crop Nutrition Laboratory, Department of Nuclear Sciences and Applications (NA), IAEA, Seibersdorf, Austria

Abstract : not available yet.

(poster 24)

Electricity and heat generation solutions from renewable energy sources for remote households in Central Africa

Maarten VERGOTE, Dr Ir, Major – Associate Professor, Department of Physics, Ecole

Royale Militaire - Koninklijke Militaire School

Abstract : not available yet.

(poster 25)

The cogeneration in sugar mill: an energetic deposit opportunity for sustainable development in Sub-Saharan Africa

KANA-DONFACK P., Prof. KAPSEU César and TCHEUKAM-TOKO D., Department of Electrical Energy and Automatic System Engineering, ENSAI, University of Ngaoundere, Cameroon

ABSTRACT

(PPT no 1) Introduction

Context

Electricity production dominated by hydroelectric and thermal power stations face to the following problems

Problem: While in countries like Cuba, sugar can produce 25% of the national electrical energy. In sub-Saharan Africa, technology is obsolete and requires some sugar mills to stop production because of the poor quality of steam from the boiler.

objective. Analyze the potential contribution of this technology to sustainable development in sub-Saharan Africa

(PPT no 2) A comparative study of the various bagasse conversion technologies to produce electrical energy.

Following the fact that 1 tons of cane milling can produce 100 kwh of energy, we analyze production potential for country en potential contribution to the national grid

- Sub-Saharan energy situation was present
- Analysis with typical case from Cameroon sugar factory.

(PPT no 3) Result and discussion

1-contribution of the technology to sustainable development

No environment impact,

Reduction of pollution risk du to firing and methanisation during the storage,

availability of fuel and no cost (waste)

Create businesses activities to local community,

Technology transfer,

reduction of nation fossil fuel importation for power generation

2- energetic situation of sub-Saharan Africa

Energetic deficit of 700 MW mean up to 4O % of the rate of growth,

Loss of 10% of GDP due to shedding,

Low electrification rate (22.5%)

3- potential contribution to national demand (tab. 1)

Up to 30% for some country

Up to 2% of the national demand

4- analyze: typical case of Cameroon

Up to 3 % of national demand, but seven (07) time the surrounding population

(PPT no 4) Conclusion

Even if to the national scale, the contribution is not considerable, they can permit to reduce the price input to the transport (40%) when the production factory is far from the consumers.

The operation can be multi fuel (Coal…)

(poster 26)

Bio-economic potential of alternative biofuel trees: an alternative liquid biofuel production model based on oily seeds of native tree species

Floris Dalemans, PhD student KUL, and Prof. Dr. ir. Bart Muys, Forest Ecology and Management, Division Forest, Nature and Landscape, Department of Earth and Environmental Sciences, University of Leuven (KU Leuven), Michael Jacobson, Professor at Pennsylvania State University, and Christine Magaju, World Agroforestry Centre (ICRAF)

ABSTRACT

Not available yet.

Topic 3 - Research, innovation and education in support of sustainable energy policies

(4 lectures + 9 posters, 25 October)

(lecture 1)

Prof. Pierre Dillenbourg

11:10 **MOOCs with African Universities: Lessons Learned**

Prof. Pierre Dillenbourg, Swiss Federal Institute of Technology of Lausanne (EPFL), directeur académique du Centre pour l'éducation à l'ère digitale à l'EPFL (MOOC Factory, including MOOC Afrique)

ABSTRACT

In 2012, EPFL has launch a MOOC initiative with African universities that belong to RESCIF, a North-South network of French speaking universities of sciences and technologies. The MOOC initiative especially targeted sub-Saharan countries. Some MOOCs developed in French for our own students have been integrated into related courses from African campus. Other MOOCs have been co-developped by teachers from EPFL and from African universities and produced at EPFL. An obvious difficulty has been and still is the bandwidth inside and outside African campuses. A more fondamental issue concerns the nature of skills to be acquired in a MOOC, from vocational skills to academic skills. This dilemma is not specific to the African context but also depicts the evolution of MOOCs produced by Coursera, Udacity or EdX. In this talk, I will report the successes and pitfalls we encountered and the solutions we develpped.

(lecture 2)

Dr. Erick Tambo

11:30 **E-Learning for Renewable Energy Higher Education in Africa: Challenges, Potential and Outlook**

Dr. Erick Tambo, Lucy Larbi and Joerg Szazynski, United Nations University, Institute for Environment and Human Security (UNU-EHS), Bonn

ABSTRACT

Renewable energy markets in Africa are still in their early stages. In order to enter the job market, for example as renewable energy entrepreneurs or policy makers, graduates of renewable energy higher education programmes have to be highly flexible and innovative. Therefore, renewable energy programmes need to offer a broad curriculum, straining the universities' human and financial resources. At the same time, distance education has gained significant relevance in Africa, due to decreasing costs of mobile devices, increasing connectivity and a fast developing ICT market. In this light, distance education approaches promise to be low cost, and high impact opportunities for university education. By complementing university programmes with eLearning, human and financial resources can be used more efficiently, while students are provided with modern teaching methods and up-to-date knowledge to successfully enter the job market.

The contribution will present results of an assessment study on "E-Learning for Renewable Energy Higher Education in Africa: Challenges, Potential and Outlook" conducted within the context of the Africa-EU Renewable Energy Cooperation Programme (RECP) which is canalizing all efforts in shaping the renewable energy market development by training the next generation of energy professionals and promoting renewable energy research in Africa.

The contribution will address topic 4 of the conference namely "*Research, innovation and education in support of sustainable energy policies*" through enabling higher education lecturers and managers who seek to use eLearning technologies to enhance educational programmes and courses, and to address managers who aim to implement eLearning supported renewable energy programmes and curricula in their institutions with a focus on Africa.

The contribution will:

- provide an overview of eLearning and distance education in Africa, as well as of main actors and initiatives with regards to renewable energy Higher education in Africa ;
- sketch eLearning programmes and educational technologies related to renewable energy higher education in Europe and lessons learned;

- Discuss potentials of renewable energy and distance learning in Africa and present recommendations respectively short term and long term activities to enhance and strengthen renewable energy higher education and induce a way forward.

MOOCS, Open Educational Resources (OER) and Learning Technology to support practical exercise in renewable energy education will be particularly addressed.

(lecture 3)

Nicolas Roland

11:50 **Massive Open Online Courses : an answer to the issues facing higher education in sub-Saharan Africa ?**

Nicolas Roland (Recherche-action "ULB Podcast"), Eric Uyttebrouck, ULB, Cellule PRAC-TICE (Pédagogie, Recherche-Action & TICE), and Prof. Philippe Emplit, ULB, Director of the Département de support aux activités académiques

ABSTRACT

Massive open online courses (MOOCs) represent nowadays a global phenomenon in the education and distance learning fields (Karsenti, 2013). Following the success of these courses on the African continent (Caramel, 2015), the research « MOOC Afrique : analyse des besoins, étude de faisabilité et recommandations » (Roland, Stavroulakis & Emplit, 2016) provides a state of the production and usage practices of these MOOCs in sub-Saharan Africa – supported by study visits in Senegal and Cameroon – and looks at how they can provide a relevant answer to the issues facing higher education. Moreover, this research initiates reflections on the quality of education and its control in view to deploy such schemes in the African context.

This communication proposes, in the first instance, to view historically how universities ensured this quality control in their distance training schemes as well as an overview of the current practices in the MOOCs' production. Secondly, we will present the methodology of the "MOOC Afrique" research, which combines a user-centric methodology (Roland, 2012), a design-based research approach and a participatory audit (Aubert-Lotarski & al., 2006). We demonstrate that the complementarity of these different approaches aims to place such a development in an efficient quality assurance process involving the final users from the early stages of the project development. By interviewing different levels of stakeholders through a number of methodological instruments, the results allow us to grasp the meaning that African users give to these MOOCs, the way they appropriate them – or would like to appropriate them – and modify some of their functions in order to answer in an optimal way to their needs regarding teaching and learning. In the third and final phase, we will describe the main recommendations provided by this research in order to offer solutions (in technical, pedagogical and development terms) that are adapted, perennial and promoting the empowerment of the local populations in the development of distance learning and MOOCs.

(lecture 4)

Prof Sandra Soares-Frazão

12:10 **Sharing knowledge online and improving education using MOOCs**

Prof Sandra Soares-Frazão and Emeritus Prof Yves Zech, Génie Civil et Environnemental, UCL

ABSTRACT

The development of the Internet offers a wide range of new opportunities for the world of education. Massive Open Online Courses (MOOC) are developed by several international renowned institutions in different fields related to their course programs. A MOOC is typically conceived as a series of short videos where the professors explain the key topics of the course, complemented in some case with additional documents to be read by the learners. Associated to the videos, exercises are provided, mostly under the form of quiz, to check the understanding and progresses of the learner. Open forums and discussions between the learners and with the professors provide a certain level of interaction, so that a community of learners is formed during the course. In the field of engineering for example, anyone in the world can follow courses about programming, basic fluid mechanics, mathematics, thermodynamics, river hydraulics, etc. Some of these courses, while open to the worldwide community, are closely linked to courses offered by these institutions to their regular students, and the professors often combine classical teaching with online material provided to the students. Some other courses are developed specifically for learners all around the world, allowing them to acquire specialised knowledge in an interactive way, without any official registration as regular students from these institutions.

Such open courses that can generally be followed free of charge really constitute an opportunity for Southern countries: with this new, up-to-date and interactive material, students and learners from these countries can access knowledge that was before restricted to a limited number of institutions.

Of course, this new world of knowledge also opens new questions, especially about evaluation and certification. What is the real value of a certificate delivered after completion of a MOOC? How to be sure that the person registered to the MOOC is the right real person who completed the graded activities? Then, in Southern countries, a frequent concern of the professors is the possible loss of responsibility and power of decision in the evaluation process. Can the professors still decide whether a student passes or not? Will the professors all be replaced by computers? Technical issues also arise: following a MOOC usually requires a good quality Internet connection to watch the videos, download the additional course material, participate in forum activities and discussions and perform the graded assignments. Can such an Internet connection be guaranteed all over the world? Certainly not.

To propose adapted answers and solutions to all these questions, a new and innovative way of thinking teaching activities is required. Based on the recent experience of a MOOC in Fluvial Hydraulics developed at the Université catholique de Louvain in collaboration with the State University of Haiti that was followed by a large number of learners issued from Southern countries, these questions will

be discussed with the aim of proposing possible solutions for making these new technologies affordable and useful to anyone in the world.

POSTER PRESENTATIONS (35 in total)

(poster 27)

Role of renewable energies in the fight against global warming: the context of Africa

Prof Yezouma Coulibaly, PhD INP Grenoble, Institut International d'Ingénierie de l'eau et de l'environnement (2iE), Ouagadougou

ABSTRACT

Africa is the most vulnerable continent to the effects of climate change. To combat these effects, the governments of the concerned countries multiply the calls for aid while making the effort to reduce greenhouse gas emissions, as their own contribution to the fight against global warming. One of the most effective ways of this initiative in relation to energy use is the energy transition, which today consists in replacing the energies of stocks with renewable energies sources.

The objective of this presentation is to take stock of mature renewable energy technologies and their utility in solving energy problems in especially in Africa.

It is then an overview of energy problems in Africa. It deals with energy as a whole and its degradation. It also deals with renewable energies sources and how they can help to solve African Energy problems. It explores their potential uses, advantages and disadvantages for Africa.

2iE in Ouagadougou has been thriving for some years now in a scientific research for the development of these renewable energies. To this end, the centre has set up two large laboratories which are today a reference in Africa. These are the solar energy and energy saving laboratories (LESEE) on the one hand and the laboratory of biomass energy and biofuel (LBEB) on the other hand. The presentation focuses on this very pragmatic research undertaken within 2iE and how it contributes to solving energy problems in African countries.

The presentation ends with a conclusion in the form of perspectives and suggestions for the solution of energy problems by a rapid development of renewable energies for Africa.

(poster 28)

Hydrocarbon resources in the Democratic Republic of Congo – a potential source of development for the country?

Bernard RESPAUT, Ir, MBA, Chief Executive, European Copper Institute, Brussels

ABSTRACT

The Democratic Republic of Congo (DRC) abounds in natural resources, be it minerals, precious stones or fertile soil. Yet it keeps being plagued by poverty, political instability and insecurity.

The DRC participates in the current regain of interest in Africa for the development of hydrocarbon resources, since such potential deposits have been previously identified in the country. Hence the question as to whether and if so, how a development in the exploitation of hydrocarbons in the DRC will contribute to its development.

Oil currently plays a minor role in the economy of the DRC: some 20'000 barrels per day are extracted from the coastal Muanda basin and are exported without refining due to a lack of such infrastructure. Thus, oil does not participate in the resolution of the acute energy deficit in Congo-Kinshasa, which hinders its economic development. Alternative energy sources exist, mainly hydroelectricity which however requires significant investments to be put into exploitation.

Oil and gas deposits have been identified in several parts of the DRC. The economic character of oil reservoirs in the Graben Albertine, the Cuvette Centrale and the Tanganyika Lake still need to be proven, but gas in the Kivu Lake presents a definite potential as its exploitation in the Rwandan part of this lake confirms. Additional oil resources could also be exploited in the Muanda basin. We can hence conclude that the DRC could enjoy a boost in its economic development through the exploitation of some of the hydrocarbons trapped in its subsoil.

The lecture will focus on the key elements which need to be in place to enable this development of hydrocarbons (a) to materialize and (b) to bring a positive contribution to the economy and living conditions of the DRC. Inspired by the concept of "Positive Peace" developed by the Institute for Economics and Peace, a set of five key elements or "variables" has been identified and their interrelations will be analyzed. These five elements are infrastructure, key competencies, governance, local and international actors. After describing their current state, two limit scenarios will be built: a positive one leading to a virtuous circle where the five variables reinforce each other and a negative one, creating a vicious circle in which the development of hydrocarbons actually, contributes to more poverty, instability and insecurity in the DRC.

The comparison of these two limit scenarios enables to identify which concrete actions a country like Belgium (which shares a part of its history with the DRC) could initiate, alone or through international institutions, to favour the development of a positive scenario in the DRC. These actions pertain to the three classical instruments of international influence: diplomacy, development and defence ("the 3Ds").

(poster 29)

Zero Emissions Energy in an African context

Tim Berckmoes, CEO / Gedelegeerd Bestuurder of Anglo Belgian Corporation (diesel engines for shipping, railways and power generators)

ABSTRACT

The energy need in Africa is immense as still 80% of the rural population does not have access to electricity.

Belgian companies have special expertise in these hybrid power solutions in combination with zero emissions and zero carbon footprint.

Energy solutions in Africa should satisfy following criteria:

- Neutral in CO2
- Zero exhaust emissions
- Maximum solar production
- Maximum Wind energy
- Use of local fuels
- Easy installation
- Easy transport of equipment to inland sites
- Simplicity in use
- Low maintenance
- Financing of the projects to be provided
- If not connected to the grid then distribution till final customer

ABC has developed hybrid power solutions based on a maximum solar panel electricity production in combination with diesel gensets for compensation during the night or during clowdy conditions. As reference Kiffa hybrid power plant in Mauretanië.

Hybrid containerised solutions exist with Photo-voltaic cells in combination with Xant wind turbines and ABC engines on biofuels such as local palm oil. Maximum use of solar and wind energy is guaranteed while the ABC generatings sets compensate any drop in production from the solar cells or during low wind conditions on site.

ABC contracting foresees the distribution of the energy from the power plant upto the local consumers from 120 kV high voltage down to 400V low voltage distribution. Also renovation of existing hydro power plants can bring quick improvement to the critical situation in Africa. ABC contracting has references in Mukungwa (Rwanda), Inga and Ruzizi (RDC). All equipment is foreseen in 40 feet containers allowing easy access to difficult sites and short installation time without complex civil works.

Because ABC produces their engines in factories with ultra low C02 emissions and because of the group renovating in average 130 MW of hydro power per year and because the ABC group is the owner of 35.000 hectares of plantations in RDC and also an arboretum in Burundi, the remaining low CO2 emissions are compensated at a rate of 10 ton/hectare/year. All remaining exhaust gases after combustion are neutralysed by Selective Catalytic Reduction techniques.

In this way the energy production is adapted to African needs with zero emissions and zero carbon footprint.

(poster 30)

Distributed generation systems as a solution to reduce load shedding in central Africa

Okana M.N., Kitoko L.S., Kamabu T., Département d'Electricité, Faculté Polytechnique, Université de Kinshasa, R.D. Congo

ABSTRACT

Introduction

Distributed generation (DG) could be a solution for :

- improving access to electricity in rural areas
- reducing load shedding in bigger cities.

Impacts on distribution grids in Central Africa has been investigated by simulating integration of DG in the grids of Kinshasa city with DIgSILENT.

……

Conclusion

- It is possible to reduce the load shedding by installing small, modular generation systems in the distribution grid.
- Systems using SG have greater benefit on grid operation.
- Solar PV improve grid parameters but the availability of power during night is still an issue.
- Systems with IG seem to be not suitable for grid facing load shedding problems.
- DG technologies offer opportunities for small scale producers (1 - 300 kW) to actively participate in electricity market.
- It will be important to investigate on short-circuit, power quality, stability, monitoring and management issues.

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(poster 31)

Linking Sustainable Energy with Soil Health and Carbon Sequestration through Frugal Innovation

Venkata Ramayya Ancha, Professor of Mechanical Engineering & Sustainable Energy Engineering, Institute of Technology, Jimma University, Ethiopia

ABSTRACT

Considering the need for integrated initiatives addressing interrelated problems like deforestation, land degradation, malnutrition, climate change, inefficient biomass burning with associated health risks while providing social and financial benefits, a carbon negative strategy utilizing biochar has been employed in this work to realize the complementary and synergistic objectives of effective environmental management for sustainable development. Considering the amenable properties of biochar for soil amendment, water retention and the resultant multi-dimensional benefits encompassing energy security, agricultural yield enhancement, beneficial waste management, climate change mitigation through carbon sequestration and substitution of inorganic fertilizer, experimental investigations have been carried out resulting in the development of prototypes through frugal innovation approaches.

New energy efficient allothermal and autothermal pyrolysis cook stove configurations co-producing biochar have been developed, deployed and field tested using agricultural residues, waste biomass and other agro-industry waste for integration of cooking with low cost domestic carbon sequestration. Pyrolysis kilns for agricultural residues and bone waste have been developed and tested at farm scale. An innovative biochar based indigenous organic fertilizer employing bone char rich in phosphorous, branded as Abyssinia Phosphorous, has been developed along with pelletizer machines for packaging and marketing by micro enterprises promoting climate smart agriculture. Keeping subsistence farming prevalent in the local context, both researcher and farmer managed agronomy trails have been conducted and the data gathered over a four year period demonstrated clearly and unambiguously the beneficial impact of biochar on enhanced grain as well as biomass yield from different crops in this regard.. As part of agro-ecological intensification, studies have also been conducted on different soil types collected from different regions in Ethiopia for subsequent scale up and adaptation of the approaches developed in this work.

The work carried out in this work amply demonstrates the fact that bichar production from sustainably grown and waste biomass feed stocks coupled with its use as a soil amendment provides a convenient link promoting both energy and food security while at the same time offering a low cost and effective carbon sequestration route for climate change mitigation. The present work also helps to demonstrate the role of frugal innovation towards the development of affordable prototypes that fit in the local context which can greatly help in the attainment of most of the Sustainable Development goals, i.e. 1,2,3,5,6,7,8,11,12,13 and 15.

Keywords: Sustainable energy, Biochar, Soil amendment, Pyrolysis cook stove co-producing biochar, Pyrolysis kilns. Carbon sequestration, Biochar based fertilizer, Frugal innovation

(poster 32)

Building sustainable partnerships in EU-Africa Research and Innovation Initiatives: Experiences from a Finnish University Network

Eva Kagiri, Finnish University Partnership for International Development (UniPID), Senior Planning Officer FinCEAL Africa, University of Jyväskylä, Finland.

ABSTRACT

Not available yet.

(poster 33)

Fuel cells in emerging countries: a flexible device for the production of electricity from 1W to tens of MWs

Dr. Jean-Luc Delplancke, Ecole Polytechnique - 4MAT, Université Libre de Bruxelles, former Programme Head of Unit of EU Joint Undertaking “Fuel Cells and Hydrogen”

ABSTRACT

Fuel cells, discovered by Schönbein and Grove in 1838 correspond to an old technology with a very complex history. They are efficient electrochemical generating power devices invented more than 40 years before the classic dynamo generators, the combustion engines or the gas turbines. But they were more or less completely forgotten until the launch of the NASA Gemini and Apollo development programmes in the sixties. There is today a renewed interest for this technology generated by the concept of « Hydrogen Economy » and sustainable growth.

A fuel cell is a static and compact electrochemical device transforming a fuel (natural gas, biogas, hydrogen…) and an oxidizer (oxygen or air) into electricity, heat and pure water. Fuel cells allow a very efficient use of fossil or renewable energy sources, do not generate green house gases (if powered by hydrogen), NOx, SOx, particulates or noise and are highly modular with power ranging from 1 W to tens of MWs. The list of fuel cell applications includes portable applications like the replacement of batteries for cellular phones, laptop… transport applications like passenger cars, delivery vehicles, buses, trains, boats… electricity micro-generation for distributed residential use or off-grid locations, medium power plant for co-generation, industrial processes, malls, hospitals, airports and large power plant (largest power plant in 2016 located in South Korea – 59 MW).

Hydrogen is not only the most abundant element in the universe but is also an essential energy carrier, should mankind target to limit climate global warming and to achieve the ambitions of multiple international agreements like the COP21. Hydrogen may be stored for long durations and offers a clean, sustainable and flexible solution for a low-carbon economy when produced by water electrolysis and renewable energy sources (RES). These renewable energy sources are not evenly distributed throughout the world. Hydrogen transport at scale and over large distances, e.g., from areas with a high potential for renewable power generation to areas with high demand of energy may become an economically attractive option for emerging countries.

The objective of this poster is to highlight the potentials of hydrogen generation from renewable energy sources in combination with electricity and drinkable water production by means of fuel cells for the local and international development of emerging countries with a special focus on Africa.

(poster 34)

Sustainability of Solar Mini-Grids in Nigeria

Adedoyin Adeleke and Chuks Diji

(Centre for Petroleum, Energy Economics and Law, University of Ibadan, Nigeria)

and Debora Ley

(Central America Regional Clean Energy Initiative, Guatemala City, Guatemala)

ABSTRACT

Despite the abundant solar energy resource in Nigeria *vis-a-vis* the high deficiency energy of the country, the uptake of renewable energy in Nigeria is abysmally low. However, while the average lifespan expected of a solar photovoltaic (PV) system is 20-25years (with replacement of some components at intervals), many PV systems in Nigeria fail within 2-3years of operation. This anomaly has been identified with solar mini-grids alongside other applications for which the solar PV technology has been deployed in the country.

To identify the factors responsible for the failure of mini-grids in Nigeria, the study assessed the sustainability of solar mini-grids from five perspectives, namely; technical, economic, social, institutional and environmental. Facility assessment, focus group discussions and interviews with key informants were the methodologies of data collection employed in the two case studies selected from the northern and southern Nigeria.

Findings from the study reveal that the sustainability of solar mini-grid projects is multidimensional. A project could fail due to a failure in one or a combination of the multidimensional factors. That is, the study shows that the sustainability of a solar mini-grid project does not only depend on its technical viability but also on its performances from economic, social, institutional and environmental perspectives. Furthermore, technical failure could result from the failure in other dimension(s) of the project.

Based on the multidimensional factors identified to be responsible for the failure of solar mini-grids in Nigeria, the study recommends the adoption of standards for components of PV systems that are being imported into the country, and development of a national curriculum for training of installers. High level of stakeholder engagement, community participation, operation of mini-grids with business models, strategic planning for productive use of energy and adequate institutional framework for monitoring and maintenance are also recommended for the sustainability of solar mini-grids in Nigeria.

The case projects assessed in the study were selected from the two major climatic zones in the country which makes the factors identified typical of the factors that determine the success and failure of other projects in the country. However, taking more case studies will be of advantage to identify more site-specific factors responsible for the success and failure of solar mini-grids. In addition, high rate of failure are also being experienced on the solar PV applications in Nigeria and other African countries. Such applications include solar home systems and solar street lighting systems. Hence, a similar study

on the sustainability of solar home systems and solar street lighting systems will provide insights on the factors responsible for their early failure.

Keywords: solar, photovoltaic, mini-grid, sustainability, failure

(poster 35)

Historical path of sustainable energy promotion in African rural areas

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FERDEDSI « Forum Énergies Renouvelables pour le Développement Durable par la Solidarité Internationale »

ABSTRACT

From an ongoing process that starts in 2003 by a master student field research on energy problems in African's rural areas[1], this paper shall first of all illustrate the historical path from academic work to multi energy organizations in Africa and then show a way to support the process in all aspects, in order to make the whole system sustainable and helpful, as well to any African institution and communities as to any North and South organization engaged in an energy partnership with Africa.

This paper links the output of an achieved thesis[2] project at university of Kassel (2004-2009) to expectable results of a new thesis topic[3] (ongoing). The new research also studies the impacts of the previous thesis work in the African universe of integrated research and actions for real social, economic, technic, scientific and cultural sustainable development. The both research work follows the logic of Solidarity Economy with the involvement of endogenous visions for local development.

The aim of this paper is to show the various local actions on energy entrepreneurship and the promotion of renewable energies as a strategy of fighting against poverty in African rural areas. One of the great output since 2006 is the creation of various local energy organizations and the network Ferdedsi / IPEED[4] in Africa.

These organizations help highlighting the energy dimension of poverty in all its various forms; among which the various social exclusions and the forgotten energy needs of people and communities in all activities dimensions. For instance, it shows the nature degradation and the women painful work with their struggle in all spheres linked to energy. It also shows the weakness of putting research and academic work in action and putting universities in interdisciplinary interventions.

Various up-to-date and useful studies on energy problems done since 2003, with the involvement of various partners from international Development cooperation, universities and enterprises will be part

[1] Dr. Marthe Djuikom Master work on 1- women organizations work in northern Cameroon (2002) and 2- Solar Energy in Northern Cameroon for socio economic development (2003-2004).

[2] Dr. Marthe Djuikom thesis at University of Kassel (2004-2009) : „Nachhaltige Energie für ländliche Entwicklung in dem Sub-Sahara Afrika: interdisziplinäre Herangehensweise und organisatorische Herausforderung" for: "Sustainable energies for rural development in Sub-Saharan Africa: interdisciplinary approach and organizational challenge " (300p). This work was improved and completed with field experiences, new analysis..etc to a book in French (612p)

[3] Benjamin Bender actual thesis work at Uni-Kassel : « Bildung über Wasser und erneuerbare Energien als Ausgangsthemen für ein Curriculum zur Förderung von ländlicher Entwicklung in Kamerun" (working title)

[4] FERDEDSI is in French. Nowadays this means: "Renewable Energies Forum for sustainable Development and International Solidarity ". This name is in process to become in French : ''Forum Energies Renouvelables pour un Développement Economique Durable Solidaire et Intégré'' (FERDEDSI) meaning "Renewable Energies Forum for sustainable Solidary and Integrated Development" and "IPEED also in French stands for Institute of Practices on water and Energy for Development. That is the training institute links to the whole Ferdedsi Process in Africa.

of this paper presentation. They were mainly done in Cameroon (from 2003 to date), the Gambia (2008), Niger (2009), Burundi and RDcongo on various topics as: socio economic, technical, cartography, organizational, communities as well as households energy needs' analysis, their affordability and capacity to pay for alternative energy..etc. The studies also identified areas having potential resources (physical, human, organizational…) for supporting renewable energies pilots and experimental projects in our learning process. That help indeed for sensitization on renewable energy promotion but mostly for a local training program.

The first training frame was the training by doing (practice during installation of energy systems). It was quickly follows in second steps by the in-house training and practice in a process of building a new generation of local energy entrepreneurs. Finally a third and fourth steps raised up and were on course's delocalization at local and regional level with local communities and authorities' awareness on various energy matters. This involves the southern regions and international interns (students from various universities). Since beginning 2016 we are improving southern expert's qualification with very short training and visit of local experts to European enterprise (1 to 3 weeks).

The vision behind this local experts preparation is the negotiation of; as well the various international courses for Africa, adapted to the African context and problems, as to help increasing the capacity building of local researchers , academics and practitioners that we are struggling to connect to our trained local energy entrepreneurs.