

# Assessment Report

## Expected Result 1 – Activity 1.1

**PICTURE OF THE CURRENT STATUS OF EDUCATION IN ENERGY ENGINEERING  
IN KENYA, ETHIOPIA AND TANZANIA**

### **ENERGISE**

**(Enlarged Network in Education and Research for a Growing  
Impact of Sustainable Energy engineering on local development)**

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## *Executive summary*

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The present report is developed within the framework of the ENERGISE project (Enlarged Network in Education and Research for a Growing Impact of Sustainable Energy engineering on local development), and in particular in order to achieve the **Expected Result 1 “The picture of the current status of education in energy engineering extended to the three partner countries is completed”**. Several questionnaires and interviews have been carried out, as well as other materials such as staff’s CVs have been collected and analyzed.

The analysis focuses on a wide range of Higher Education Institutions located in the Kenya, Ethiopia and Tanzania, and provides a comprehensive picture of the current status of education in energy engineering in Kenya, Ethiopia and Tanzania.

The Expected Result 1 is made up of three different main activities. Hence, the structure of the report, which is organized in three main parts, reflects this formulation.

### **Assessment for teaching methodologies and quality (Activity 1.1.1)**

The aim of this Activity is to develop a global state of the art of the current status of the available curricula, the teaching methodologies, the quality monitoring system, and the condition of the laboratories and of their facilities. Specifically, the Activity is subdivided in three sub-activities, which are:

Act. 1.1.1.1 - Evaluation and comparisons of Curricula

Act. 1.1.1.2 - Evaluation of Teaching methodologies and quality monitoring systems

Act. 1.1.1.3 - Evaluation of the status of laboratories and other facilities

#### **Evaluation and comparisons of Curricula (Activity 1.1.1.1)**

The curricula related to Energy Engineering available in the partner countries’ HEIs are briefly analyzed.

From the analysis it emerges that the two Kenyan HEIs that are part of the ENERGISE consortium (**Technical University of Kenya** and **Technical University of Mombasa**) do not have a curriculum in Energy Engineering. However, some of their curricula appear to be particularly relevant for the issue. Hence, it could be interesting to take into consideration these programs as a base for the development of the new courses in the framework of the new MSc in Energy Engineering, such as BSc and MSc programmes in Mechanical and Electrical Engineering. Besides, other Institutions in the country present courses in Energy Engineering (Kenyatta University, Jaramogi Oginga Odinga University of Science and Technology, Jomo Kenyatta University of Agriculture and Technology, Dedan Kimathi University of Technology, Masinde Muliro University of Science And Technology, Moi University, Mount Kenya University) and hence collaborations could be established with them.

At **Dar es Salaam Institute of Technology**, only one Master programme is present (Master of Engineering in Maintenance Management), while several Bachelors of Engineering are available. Some of these Bachelors

have several courses that can be considered as a basis for the development of energy-related courses. Specifically, the courses linked to Electrical Engineering are extremely interesting for the design of the new Master in Energy Engineering, above all the ones that exploit the Renewable Energy Lab. It is worth to note that a high level MSc in Energy Engineering is available at Nelson Mandela African Institution of Science and Technology, another public technical Tanzanian HEI.

Finally, **Jimma University** already has a MSc in Sustainable Energy, but an upgrading is necessary. Hence, the MSc already available will be the basis for the design of the new innovative MSc.

### Evaluation of Teaching methodologies and quality monitoring systems (Activity 1.1.1.2)

Focusing on the assessment of teaching in the partner countries and specifically in the partner HEIs, data analysis clearly points out the **positive overall satisfaction of students** regarding the implementation of courses, even if in almost all the HEIs the **infrastructures are not adequate** and even the teaching materials are insufficient.

In addition, another common feature of the interviewed HEIs is that many students reports the **limited selection of available “trainings on the job”**, that leads to the disadvantage of not having an adequate exchange of knowledge and competences between universities and the labor market; indeed, in general, a major international exposure would be envisaged.

Regarding students’ preparation, the **overall level of achievements** scholars are able to provide at the end of each cycle of studies is **good**, and teachers are generally satisfied with the background the students have at the beginning of the courses of studies.

In the same way, the students have stated that a **strong motivation is transmitted by teachers**; besides, even if the teachers generally have a good basic preparation, the **need for more training and advanced courses** is stressed by lecturers themselves. This **necessity of capacity building**, indeed, is essential not only to deliver academic curricula in line with the ever changing labor market, but also to keep updated with the latest technology. In this framework, international exposure as well as capacity building could improve research and innovation, also acting as a driving force for enhancing **scientific publications**.

In all the three involved countries, there are no **quality evaluation systems** based on internationally recognized standards and this is another point on which the ENERGISE project should work.

Finally, looking at **gender balance**, engineering faculties related to energy have the lowest percentage of female students compared to other programmes (for instance, in business-related programmes).

### Evaluation of the status of laboratories and other facilities (Activity 1.1.1.3)

Analyzing the data, almost all the involved universities clearly show an **inadequacy of infrastructures**.

The most critical evaluation is related to **laboratories**, which often do not have a dedicated budget, with negative consequences for the frequency of maintenance operations and for the upgrading of the facilities. Indeed, **instrumentation repairs and replacements are not usually scheduled**, and these activities are performed only when the need arises. Furthermore, the shortage of funds implies outdated equipment without technological development, failing to assure a concrete approach to didactics.

Particularly, focusing on the Dar es Salaam Institute of Technology, the Renewable Energy Lab is present within the Faculty of Electrical Engineering, and it is equipped with several interesting facilities and software, which could be employed to develop practical activities with the courses of the future MSc in Energy Engineering. Besides, at TUK several labs linked to energy issues are available, such as the

Thermodynamics Lab and the Fluid Dynamics Lab; in the same way, at TUM some interesting labs are present in the Mechanical Department and in the Electronic one, in addition to some PV panels installed on the roof of the buildings. Finally, also Jimma University has many labs for the implementation of integrative activities related to Energy Engineering courses.

When looking at the situation regarding **ICT laboratories**, the picture is more positive, being most of the equipment relatively modern. On the other hand, the ICT labs reveal **several issues related to internet connection**: in fact many workstations have access to the web, but there is an urgency to improve internet reliability and bandwidth to allow an actual profitable use of the connection. What is more, **the number of workstations is limited**.

The final recommendation, encountered in almost all the interviewed stakeholders, is to give a boost to existing facilities with state-of-the-art equipment. Furthermore, back-up systems could be useful to face the problem of frequent blackouts in order to provide a better lighting system and computers always connected to the web.

Being some of the activities included the project based on on-line trainings, the enhancement of the ICT labs is a central issue.

### **Assessment for teachers' competences (Activity 1.1.2)**

The aim of this Activity is to provide an assessment of the average level of competences and capabilities of the teaching staff of each involved ACP partner Institution. In order to do that, the Europass CVs have been collected and analyzed. As a matter of facts, the Europass CV is a standard framework for the transparent presentation of qualifications and competences in accordance with the Copenhagen process.

Particularly, there are four areas that are taken into account, and they are:

- educational background and skills
- didactical activities and competences
- research
- languages knowledge.

The analysis is based on a sample of CVs from the staff of the four partner HEIs.

The analysis of the data collected at **Technical University of Kenya** reports that professors lack some competences, linked to Energy Engineering, in their educational background. As a matter of facts, most of the professors hold just a Bachelor degree. However, they are willing to improve their skills. This fact is reflected also by a low number of scientific publications, which, on the other side, is also due to the low quality of infrastructures (in particular labs). The weakness related to the skills can be mitigated by implementing specific training courses. As a matter of facts, from the study it has emerged that lectures, and especially young professors, which represent the largest share in the teaching staff, have a high determination and willingness to develop additional soft skills. On the other hand, the old technological infrastructures would require improvements to enhance the quality of the learning process and research.

As per **Technical University of Mombasa**, professors' academic background in engineering is very heterogeneous, ranging from electrical to mechanical, chemical, industrial engineering, and so on. The staff has specific skills regarding some aspects, but others are missing, and also in this case the number of scientific publications is low. Nonetheless, there is a high determination of the professors to improve their skills with preparatory training courses. This objective could be reached more easily because of the low average age of the lecturers, which search for international exposure and, as a consequence, hold as an added value a good knowledge of different languages.

From the analysis at **Dar es Salaam Institute of Technology**, it emerges that professors have quite a satisfactory academic background and work experience: most of them hold a Master's or a PhD, and their specialization ranges in a number of different engineering fields. Furthermore, their teaching attitude and English level increase their professional skills. On the other hand, their weaknesses mainly deal with a lack of research in some areas, specifically related to energy, and with the bad conditions of some university infrastructures.

Lastly, when looking at the situation at Jimma University, the professors reveal a good preparation in different engineering fields, but the academic staff is mainly composed by young professors, hence lacking of working and teaching experience. Moreover, another important weakness regards the women's presence among the professors in staff, which is very low. However, also in this case from the analysis it emerges that professors have a high willingness to improve their skills and capabilities. As per infrastructures, the picture is similar to the case of the other HEIs.

### Assessment for stakeholders' needs (Activity 1.1.3)

The main goal of this Activity is to define the most suitable conditions for the creation of a network that allows the matching of labour-market needs with new academic competences, aiming at the introduction of new energy professional profiles. This activity is strongly related with Bologna and Copenhagen processes, with reference to the "knowledge alliance" as a keyword for the development of curricula synergic with labour market, standing that knowledge and competence exchange between university and business is a key factor for success. Hence, interviews with private bodies have been arranged. What is more, also the feedbacks from public bodies, N.G.O.s, associations and citizens have been taken into account, in order to have a real comprehensive framework of the actual needs.

The following groups of stakeholders have been interviewed:

- **Public Bodies:** public stakeholders (in particular energy and agricultural agencies) have been contacted to understand their needs and potential networking joint activities that could be carried out with the HEI itself.
- **Private Bodies:** labour-market needs should have a central role in the definition of curricula. Therefore, also private stakeholders (SMEs in particular) have been interviewed. This activity should also sustain the creation of a larger network thanks to a sensitization process.

- **Civil society** (associations and local N.G.O.s): another strategic partnership is the one with the civil society that has been asked to expose its opinion through the voice of local NGOs and associations. Surveys and meetings have been carried on to introduce the project and receive opinions and suggestions.
- **Citizens:** the new Master of Science is called to play an active role in improving citizens life conditions. For this reason, they have been interviewed in order to receive their suggestions and feedbacks.

In the following, the main findings of the conducted interviews will be summarized.

Referring to Kenya, the main issues regarding **electricity** concern power failures, power fluctuations, and unreliable power supply. On the other hand, there is no access to **modern fuels** because the policies being advocated by most African governments are insufficient, and no proper follow-ups are done with regard to these policies. As a consequence, on the domestic side cheaper and free sources of energy are preferred irrespective of the health hazards posed, such as carbon monoxide and dioxin emissions from burning plastic. Moreover, the impact of unreliable electricity supply on businesses and manufacturing is very negative. This is a common figure in sub-Saharan Africa, where the issue of unreliability has made the production cost of most products to be very expensive thereby slowing down development. Therefore, beyond the different point of view, all the Kenyan consulted stakeholders confirm, averagely, that **the current supply of energy in the country is not adequate**.

The interviews carried out in Tanzania have evidenced that globally the region is affected by **energy poverty** since the majority of the population has no access to energy and even the small amount that is accessible is not efficient. These issues pose a great challenge and make it difficult to achieve the sustainable development goals. The surveyed stakeholders stress **lack of funding** to launch projects, **deficiency of specialized competences** within the energy sector and scarcity of multi-skilled professional profiles. Also new recruits often do not have a previous working experience or have never taken part in any project linked to the energy issue.

From the analysis, it clearly emerges that also in Ethiopia the **access to energy level is quite low**, concerning both electricity and energy for cooking. Despite this, there is a great interest from almost all the possible stakeholders to collaborate with Jimma University and to be involved in projects related to energy issues. On the other hand, JU and the other universities should provide clearer information regarding the opportunities for the different stakeholders, in order to involve as many as possible of them in the process of improving access to energy in the country. Finally, it is worth to note that during this assessment phase another relevant issue has emerged: indeed, in Kenya and Tanzania a new exploitation of oil and gas is increasing. Nonetheless, the two countries lack experts in the field, while a future generation of professional engineers with the right skills in this sector would be needed.

### Conclusion

From the present study, it clearly emerges that in all the partner African countries there are **strong issues connected with access to sustainable energy**, both regarding electricity and energy for food. The frequent outages of electrical energy seriously damage the industrial production and prevent business from becoming actually competitive. What is more, the great majority of people cannot afford modern fuels and, hence, rely on traditional fuels and cooking facilities, thus causing several issues connected with health. In addition, a great potential for the exploitation of Oil&Gas reservoirs has been identified both in Kenya and in Tanzania, but the countries lack experts in the sector.

In this context, **the academic world is called upon to fill in the gap**. Nonetheless, at the moment the technical content of current university programmes does not always encounter these needs. Besides, they do not match the specialized technical requirements of the industrial world, and, in particular, current curricula do not address the requirements of the industrial energy sector.

For these reasons, energy related challenges should be addressed by the Universities starting from the following actions:

- development of new curricula on energy engineering, as well as operation and maintenance of energy systems
- improving research in order to build capacity and expertise in deploying sustainable energy products and systems at affordable costs
- enhance and foster the collaboration with both public and private sector, and in particular with industry.

Focusing on the analysis of the educational system in the partner African countries, the teaching system is globally at quite a good level, but some upgrades would be needed. In particular, some aspects to be addressed are the enhancement of technical competences and of staff's didactical and research approach. In general, it can be stated that Technical University of Kenya, Technical University of Mombasa, Dar es Salaam Institute of Technology and Jimma University present an important common feature with regards to academic staff: there is a basic knowledge concerning some technical competences, but a preparation strictly related to sustainable energy is missing. Specifically, it is worth noting that, while JU staff has a good technical preparation, TUK, TUM and DIT staff needs a stronger improvement of their competences.

Besides, the quality monitoring system employed in the HEIs should be enhanced in order to reach internationally recognized standards.

As per infrastructures, a number of labs and facilities is available in each HEI, but generally the equipment is out-of-date, or there is a shortage of funds that represents a barrier for repairs and replacements. Therefore, during the design phase of the new MSc in Energy Engineering a particular attention will be devoted to the adequate employment of the available labs, while specific considerations should be reported about to the situation of ICT labs, since some of the project activities on capacity building should be based on on-line trainings.

Another important feature is the networking among the different stakeholders. Indeed, the design of the new MSc has to take into consideration their opinions in order to develop a path which actually meets their



needs. Therefore, the network among all the different stakeholders should be strengthened, conducting joint research for innovation. Universities should also fill the gap between labor-market's needs and graduates' skills and, on the other side, institutions and organizations should cooperate and collaborate with the academic world in terms of consultancy services, seminars and student's training to achieve actually high-quality curricula.

To conclude, the ENERGISE project could contribute to solve these energy issues. Particularly through ER2, it could improve the aspects related to the lack of some technical competences and soft skills, thus contributing to an overall enhancement of Kenyan, Tanzanian and Ethiopian academic system. In particular, the activities scheduled within the framework of the project aim at these objectives, thanks to in presence and on-line trainings. Moreover, the fact itself of being involved in a European project will help ACP partner HEIs to increase their international exposure and to strengthen their network with foreign universities and with stakeholders coming from many different contexts.

