# ROLE OF INDUSTRIES AND HIGHER SCHOOL OF ENGINEERING TOWARDS GREEN INDUSTRIALIZATION AND GREEN ECONOMY: MOROCCO CASE STUDY

Amina Laaroussi
Engineering Research Laboratory
ERFSI, ENSEM, Hassan II University, Casablanca, Morocco

Soumia Bakkali
Engineering Research Laboratory
ERFSI, ENSEM, Hassan II University, Casablanca, Morocco

Omar Cherkaoui
REMTEX Laboratory, Casablanca, Morocco

**Abstract**: The green economy was introduced in recent years at the national and international levels. It has appeared as a way that could assist to achieve sustainability, and it includes economic development. It has the ability to master emissions of gas effects, to make an effective utilization of natural resources and enhance productivity. This paper discusses the role of industries and higher school of engineering as contributors to the development of green economy. Industries are responsible to control the impact of their activities on the environment and on consumers, by the adoption of green technology and developing novel green products, which could in turn create or greening jobs and skills. Such contributions require the presence of manager profiles owning technology skills, thus an understanding of energy and environmental issues. The research presented here is a case study of a Moroccan engineering school. Which conducted a survey aiming to assess the awareness, attitudes, expectations and needs of the engineering students especially in green energy education, and thereby meet the challenges of sustainable development, satisfy to demands of Moroccan industrials and job market in terms of competency. Which requires a review on traditional methods of teaching and learning within school and simultaneously the utilization of E-learning method outside school and break up with the traditional practice disciplines. Moreover, the goal of this study is to train and develop competencies in both technical and environmental aspects and to highlight the utilization of E-learning as an advantageous key for developing countries like Morocco. Results of the realized survey provide a hard argument for a dimensional research to improve students learning ability and meet the needs of industries.

*Keywords:* Green industrialization, engineering education, green economy, skills, e-learning

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## Introduction

The green economy can be considered as a way to achieve sustainable development. It is a strategy consisted of a number of policies and action plans, which promotes a new development paradigm. It is not only desirable to protect and preserve the environment, but also it is economically justified for the reason that development will be stronger in a sustainable scenario. It is based on the integration of three pillars of sustainable development, which are the environmental, social and economic dimensions. Thus, it supports the creation of a strong economy that promotes equity and social well-being. Such promotion is achieved through investments that reduce emissions and pollution, improve energy efficiency, use of resources, and protect the environment by fighting against the degradation of ecosystems. Various definitions of a green economy are to be found in literature (Viesi et al., 2017), (Kim et al., 2016). However, the present green economy has two major dimensions. The first one is seen from a regulation point of view, which in fact defines green economy by the list of activities in compliance with

environmental regulations. This dimension calls for reflection on the risks that these regulatory constraints are susceptive to weigh on employment, economic growth and the competitiveness. The second dimension is seen from an economic point of view, which says that green economy includes activities generated by companies producing services and goods that help reduce, avoid or remove the environmental damages. Unlike the first one, this dimension highlights the opportunities for profit, investment and growth potential generated by these new activities.

For this purpose, on the one hand, industry will play a major and important role in this green economy because it will meet the needs to support equipment, infrastructure and energy needed for the production of final goods and services (Arouri et al., 2012). On the other hand, to realize the aims of industry, the engineers graduating from the higher school of engineering shall be able to keep up with the growing development in the green economy. In this respect, a survey was conducted to estimate the awareness of students regarding the green energy and green economy, and to assess their basic knowledge in this field that each engineer must acquire before going to the job market.

## Method

In-depth, theoretical knowledge of diverse energy technologies and systems has to be provided in energy education programs in university level to form professionals in this field. Besides, formation in renewable energy covers generally hands-on experiences and skills, training, fabrication, installation and maintenance.

Aware of the promising future of green energy sources in Morocco, the education has been expanded in order to develop and improve curricula in the field of renewable energies and sustainable development, in the context to have compatibility and complementarity between training and skills delivered to engineering students in the higher school and core green skills that suits industrial needs. To realize this survey, we have chosen to use the know-How profile strategy (Elenurm, 2008) in the aim to assess learning inputs and outcomes of student and also to display the lack rate of acquisition in sustainable development domain. For this purpose, we are based on questionnaire replies that we have elaborated and received from 120 answers in three academic fields. We could identify 50 answers in Electrical Engineering, 50 answers in Mechanical Engineering and 20 answers in Industrial & Logistics Engineering.

## Results and Findings

Table 1. Questionnaire for replies with "Yes" Or "No"

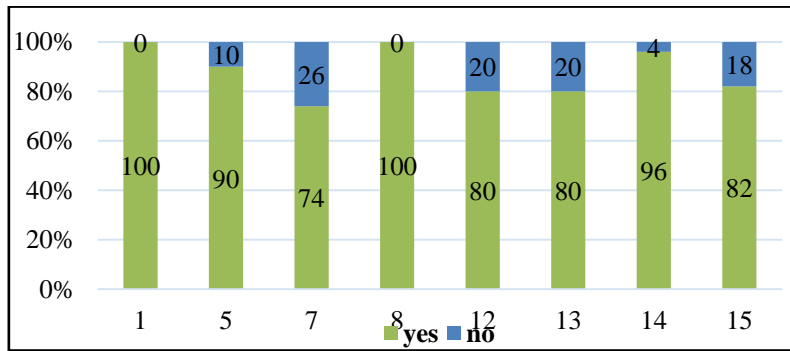| | **Questions** |
|---|---|
| **Q1** | Do you know what E-learning is? |
| **Q5** | Do you know what fossil fuels are? |
| **Q7** | Are you aware of fossil fuels adverse effects on the environment? |
| **Q8** | Do you know what renewable energies are? |
| **Q12** | Have you heard about green energy? |
| **Q13** | Have you ever studied a course on renewable energies and / or sustainable development in your specialty? |
| **Q14** | Be aware of the importance of using renewable energies within industries is there an added benefit to getting a job? |
| **Q15** | Do you prefer to have courses in renewable energies via an E-learning platform? |

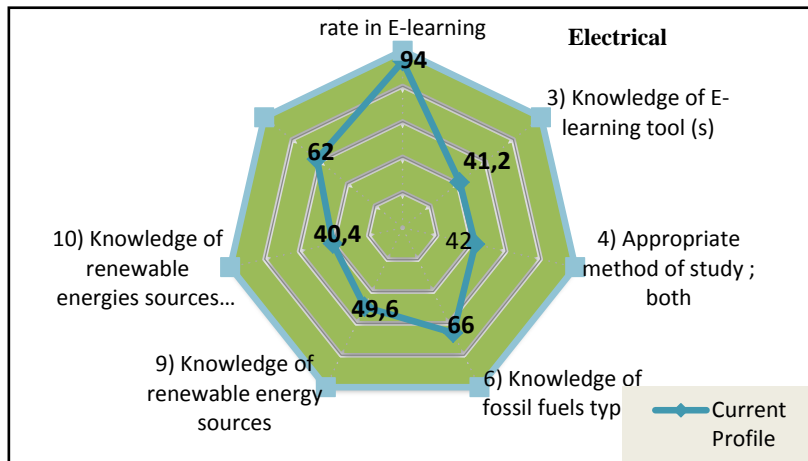Figure1. Percentage of the Electrical Engineering Student's Replies With Yes or No



Figure2. Percentage of the electrical engineering student's replies with multiple choice

The figure 1, exhibits the number of questions on the horizontal axis according to the table 1 and the percentages of the student's answers with Yes or No on the vertical axis for the specialization of Electrical Engineering. The figure 2 shows the percentage of the Electrical Engineering Student's Replies with Multiple Choice. As can be seen, their answers are positive for most of the questions. This is predictable and it seems normal, because, according to this field, they study different kinds of modules element like wind power, quality of electrical energy, audit and energy efficiency, design of industrial electrical networks etc. Which are in line with the demand on renewable energy and energy efficiency. Moreover, the student can boost his chance of consciousness and consolidate his skills in the case of question 7 (about their awareness of the effect of the fossil energies on the environment), and question 12 (green energy benefits). This can be accomplished by the use of E-learning tools. It is going to be with great help especially that 82% of students prefer and hope to have an E-learning platform to strengthen their competencies. In addition, these students are highly interested in E-learning method, they do not know much about it, but they want it to be part of the teaching method in their establishment. They have enough knowledge about fossil energies, they do not know enough about renewable energy, but they are optimistic about its future in Morocco. These students are future electrical engineers, so they know the importance of renewable energy, and they want to fortify their methods of formation to respond to the demands that this sector will be requiring from them in the future, and this through the integration of the E-learning in the teaching methods.
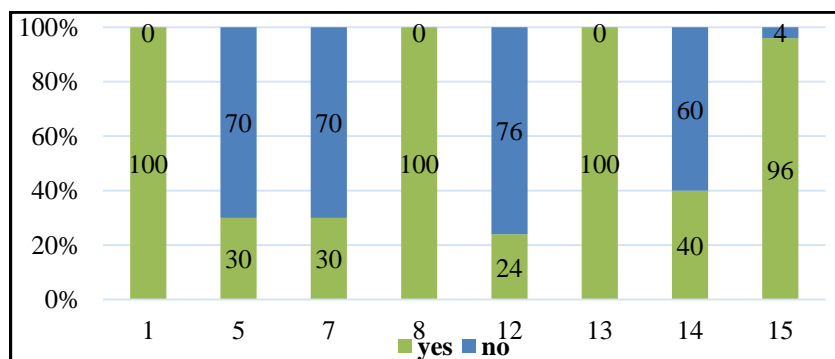


Figure3. Percentage of the mechanical engineering student's replies with yes or no
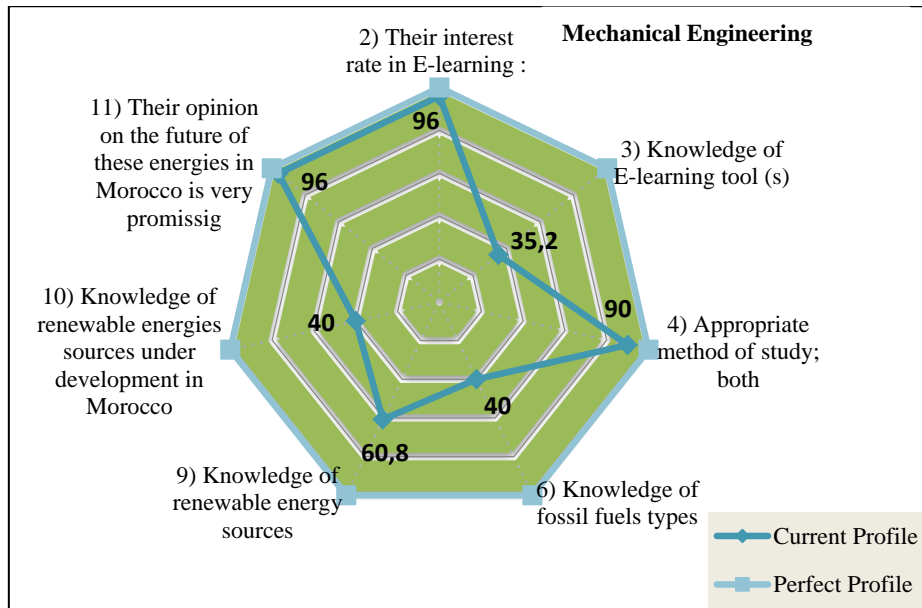
Figure 4. Percentage of the mechanical engineering student's replies with multiple choice

For the mechanical engineering, the figure shows that half of the questions are mostly negatively answered, 70% or more for 3 questions and 60% for another question. These questions related to their knowledge about fossil energies and their harmful effects on the environment, and about the green energies and the necessity of including them into their formation program. Students did not learn enough about renewable energies, this lack reflects the hole in their formation concerning this field. Regardless of their specialization, renewable energies shall have enough share in their formation to keep up with the growing development in the green economy, especially Morocco, for it is undergoing a promising progress in the field of renewable energies. These results arise several questions about the necessity of an alteration in the learning methods and revision of course content which are taught to engineer's students. Like other students, Mechanical engineering students are very interested in E-learning method although they do not know too much about it and its tools, they have poor knowledge regarding fossil and renewable energies, but they are very optimistic about the present and future development of the green energy in Morocco.
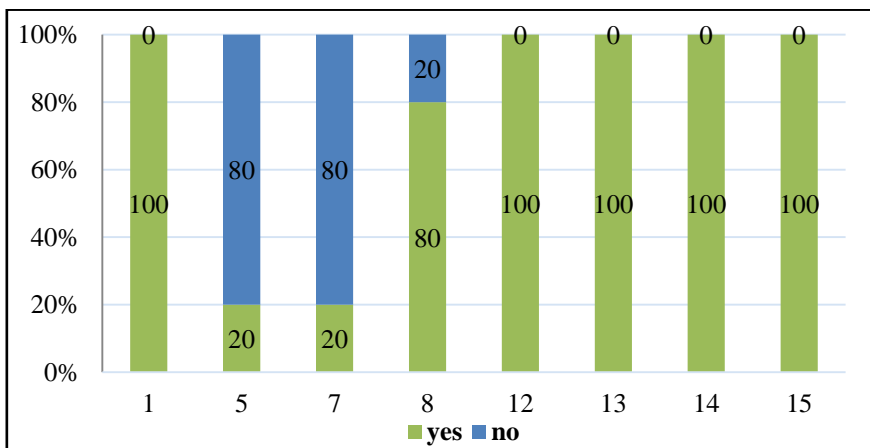


Figure5. Percentage of the industrial & logistics engineering student's replies with yes or no
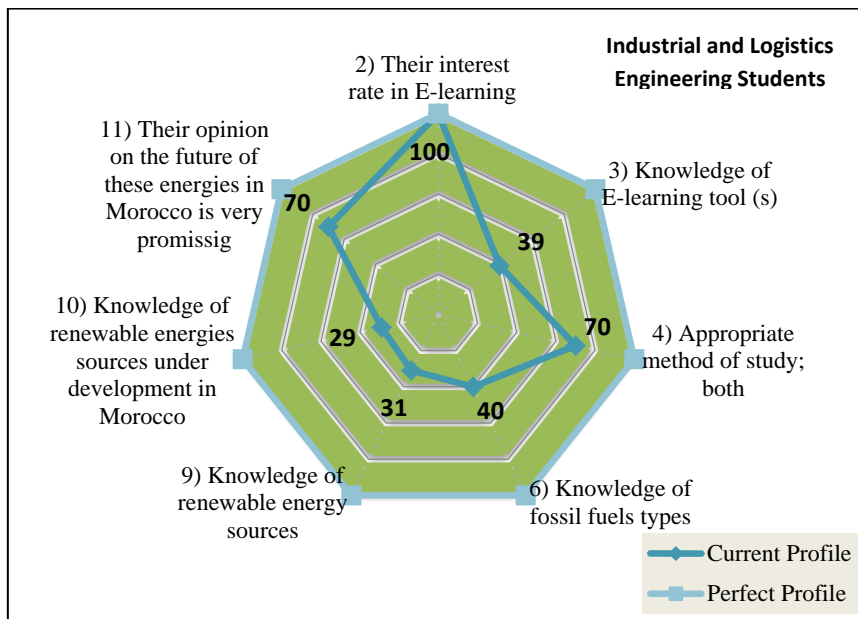
Figure 6. Percentage of the industrial and logistics engineering student's replies with multiple choice

The students of industrial and logistics engineering mostly do not know about fossil energies and their noxious impact, 80% of them are not aware of such a serious matter. In contrast, they have enough knowledge about the green energies, and are conscious about the importance of integrating the renewable energy in their training program. How could they be unconscious about fossil energies and be knowledgeable about green energies? Perhaps this is because students learn about the green energy without being taught the objective for which it was adopted in the first place, and its benefits on the environment in regards to fossil energies. Their formation program is poorly containing energies courses. Even though they do not know enough about E-learning, the industrial and logistics engineering students are all interested in it, they have minor knowledge about fossil and green energies, and they think that the renewable energy sector is promising in Morocco.

## Conclusion

In this paper, we have reported the great role of green economy as one that simultaneously promotes and improves the sustainability and economic growth. Then, we have reported the both role of industries and higher school of engineering to awards a green economy. As a result, of the survey realized in the higher school of engineering, we concluded that the electrical engineering does not require any training program modification, their students are already aware about the importance of the green energy, and the needs of the job market, and they assimilate the courses related to this topic. Contrariwise, in the two other specialties, it is necessary to make an adequate change in teaching method inside higher school, we suggest to create a platform to enable students to study outside school, and what's more, 96% of students in the three specialties prefer as has already been said to add the E-learning method to the traditional one. We propose also the integration of supplementary modules in connection with sustainable development and energy efficiency, because the rate of replies is smaller than what it should be.

## References

Viesi, D., Pozzar, F., Federici, A., Crema, L., Mahbub, M.S., (2017). Energy efficiency and sustainability assessment of about 500 small and medium-sized enterprises in Central Europe region. *Journal of Energy Policy, 105, 363-374.*

Kim, Y.S., Ha, T.K., (2016). Energy strategy and economic growth of russia. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 10(2), 376-379.*

Arouri, M., Ben Youssef, A., M'henni, H., Rault, C., (2012). Energy consumption , economic growth and CO2  emissions in Middle East and North African countries. *Journal of Energy Policy, 45, 342-349.*

Elenurm, T. (2008). Internationalization of enterprises in estonia. *Handbook of Research on European Business and Entrepreneur ship.*