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Analysis of labour market needs for engineers with enhanced knowledge in renewable energy in some European and Latin-American Countries

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Abstract

One of the main challenges related to the renewable energy labour market is that of human capital and as a consequence the educational profile of future employees is of paramount importance. Unfortunately, the skill level gained at University does not always fit with the practical needs of industry thus reducing the benefit-cost ratio of new employees and slowing down the

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transition to a green economy. Within this context, ‘The Crux’ project co-funded by EU under the framework of the Erasmus + programme aims at improving the renewable energy engineering curriculum at different university levels in several Universities of Latin America and Europe. In order to better appreciate the potential impact of the project, a survey on the labour market need for specialists with enhanced knowledge and skills in renewable and sustainable energy technologies has been conducted in the related EU and Latin America countries. More precisely, 60 organizations have been interviewed and almost 70% of them are interested in employing engineers with enhanced knowledge on renewable energy in the next three years. The analysis has shown significant discrepancies between EU and Latin American organizations. In fact, while future employees in EU countries will be mainly related to solar energy and management, the former together with wind and biomass will represent the main renewable energy working sector in Latin American countries. Moreover, MSc level will be the most demanded in EU while bachelor education seems to satisfy the future industry requirements in Latin America. Despite each country having its own needs, the research carried out under this EU project confirms the potential of renewable energy education on the global labour market in the near future.

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Keywords: training and education; engineering; renewable energy technologies; sustainable energy technologies; green economy.

1. Introduction

Since the ratification of the Kyoto protocol in 2005 until the last Paris Agreements in 2015, the labour market related to green economy has been boosted, creating an ever-increasing demand of linked employment. According to Bowen et al. [1], for instance, 19.4% of US workers could be considered directly or indirectly occupied in jobs related to green economy. In the context of green economy, renewable energies are widely recognized as one of the key pillars in energy transition for carbon reduction. At European level, directive 2009/28/CE RED 1 [2] as well as RED 2 [3] when entered into force, are strongly promoting the participation of renewable energies towards 2020 and 2030 respectively. Therefore, in order to achieve the ambitious targets set for the energy sector educational provision needs to be significantly transformed. One of the main contributions affecting this transition is related to the growing renewable energy labour market which is based on the human capital and consequently the educational profile of future employees. Several studies have been conducted at national [4–6], European [7] and global level [8,9] on this issue. Often the knowledge and skills gained at University level do not fit with the practical needs of the industries thus enlarging the adaptation and formation period of the new employees and decreasing the consequent benefit-cost ratio. For these reasons, educating green collars workers to develop and promote renewable energy technologies with technical, professional and managerial abilities to satisfy the energy demand in a sustainable way is among the mission of many university programmes worldwide.

In this context, ‘The Crux’ project [10], co-funded by EU under the framework of the European Union’s Erasmus + programme is also aimed at improving the renewable energy engineering curriculum at different university levels in several Universities of Latin America and Europe. More precisely 3 EU Universities in the United Kingdom, Italy and Spain, and 6 Latin American Universities in Brazil, Colombia and Cuba are collaborating in this project. All of them experience an increasing interest in offering advanced and up-to-date Bachelor and Master courses on renewable energy in order to provide engineers with enhanced knowledge and skills on sustainable energy technologies and their application and thereby indirectly contribute to meeting the ambitious targets set out for climate change mitigation at an International level.

With reference to these countries, in the last decades Brazil and Colombia are going through a rapid modernization and expansion of their industrial sector as a result of intensive investments from global companies. An increasing number of renewable energy plants are being created across these countries and this process has shown the need for a new type of engineer, with a deeper professional educational background in renewable energy engineering and expertise in the design, operation and maintenance of such plants. Due to changing national policy similar processes are also expected to take place in Cuba in the coming years thus widening the requests for and the

opportunities of new engineers. Europe instead aims at reinforcing its leading role as renewable energy producer at global level.

Hence, a survey on the labour market needs for specialists with enhanced knowledge and skills in renewable and sustainable energy technologies has been conducted in some EU and Latin America countries and some of the results are reported in this paper.

2. Methodology

The modernized teaching methods and contents to be implemented in ‘The Crux’ project have as their focus the satisfaction of the current and future market needs for highly qualified engineers to lead the advancements in renewable energy industry and to set out proper energy policies for sustainable development. High quality specialists in renewable energy engineering will be able to support governments, private organisations as well as corporate activities in the uptake of renewable energy technologies thereby contributing to the growing success of the green economy.

A questionnaire has been defined and presented to different stakeholders acting in this field in order to carry out an analysis of the market demand and its training needs. To better estimate the labour market needs for specialists with enhanced knowledge and skills in renewable and sustainable energy technologies, industrial companies, NGOs as well as public and private organizations have been contacted as representative of the labour market for engineers. These organizations have been chosen because they both represent the different business activities in the renewable energy sector (see Table 1) and they have previously shown a high interest in renewable energy research and education through frequent collaboration with the universities involved in the project. Therefore, they have been asked for assistance and advice based on their significant expertise in the energy field. Sixty of them have responded to the questionnaire with more than 80% of those located in Latin America.

The questionnaire consisted of three parts. The first regarded the company profile in terms of: typology of organization, type of activity/interest in the renewable energy sector; size of the company (number of employees); and market extent. The second part focused on their employees level of qualification: degree of qualification, knowledge in renewable energy for each degree of qualification, main renewable energy field of knowledge (solar, wind, biomass and biofuels...). Finally, the third part focused on training needs of the labour market such as willingness of the company to hire Bachelor, Master and/or Ph.D. students in the next three years; rough estimation of future students to be hired, for each degree of study; interest in hiring Bachelor, Master and/or Ph.D. students with high knowledge and skill specialization in renewable energy; main topic of renewable energy specialization (solar, wind, biomass and biofuels...); opinion about the strategic importance of engineers highly specialized in the renewable energy sector for both the company and the whole of Society; and a willingness to host students for a 4-6 weeks training period as a part of their project thesis.

3. Results and discussion

The initial questions were aimed at evaluating the current background of the organizations in terms of their size, market and type of activity involved in. At a Global level, 28.3% of the organisations have fewer than 10 employees, 15.0% were in the range of 10 to 50 employees, 18.3% between 50 and 100, 16.7% from 100 to 500 and finally 21.7% have more than 500 employees. However, these percentages change significantly from country to country. For example, in Cuba only 6.3% of the organisations have fewer than 10 employees, 25% more than 500 while a greater part of them (about 43.8%) have a number of employees in the range of 50-100 thus depicting rather well the national business in this field and the potential needs. Moreover, in Colombia almost 50% of the interviewed organisations (21 in total) has a number of employees >100. On the contrary, in Europe the organisations which responded to the questionnaire were less representative of the energy business sector but they did allow for a proper identification of the wider labour market needs because of the wide variety of activities considered. Indeed, the main energy companies used to be focused on very specific activities thus requiring also a very specific educational background.

With reference to the type of activity in the renewable energy sector, the overall result of the analysis has shown that the majority are involved in ‘Design & Engineering Development’ and ‘Power Production’ as reported in Table 1.

Table 1. Type of activity on renewable energy of the organization

Activity	Total	Percentage
Sales and Marketing	3	5.0%
Power Production	17	28.3%
Power Transmission & Distribution	5	8.3%
Monitoring, Inspection & Maintenance	2	3.3%
Design & Engineering development	19	31.7%
Research & Development	4	6.7%
Energy Auditing	1	1.7%
Capacity Building	3	5.0%
Policies & Economics	3	5.0%
Other	3	5.0%

As regard their market, it is mainly focused at a national level as shown in Table 2:

Table 2. Market of the organisations

Level	Total	Percentage
Regional	8	13.3%
National	35	58.3%
Continental	3	5.0%
International	14	23.3%

These organisations hire employees with different levels of qualification as reported in Table 3 at global level:

Table 3. Range of qualification of the present employees of the organisations

Qualification	Percentage
Bachelor	42.9%
Master	34.5%
PhD	17.9%
Other	4.8%

These percentages refer merely to the companies and not to the number of employees with a specific level of qualification. Moreover, they significantly change when comparing different countries. For example, most of organisations in the European countries have employees with Master or PhD level of education, while in Brazil the majority of them have Bachelor level of education. With respect to their knowledge on renewable energy the following results have arisen:

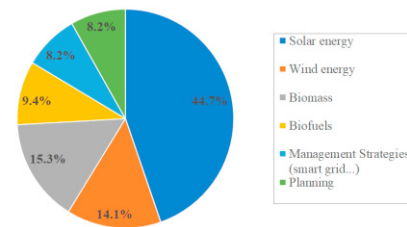


Fig. 1. Knowledge of present employees on renewable energy

The second part of the survey, was aimed at evaluating each organization's interest in recruiting new engineers in the near future, the field of their expertise and their willingness to the project in general.

At global level, more than 80% of the companies/organizations interviewed have shown their interest in employing new engineers in the next three years. Furthermore, 85% of them are interested in recruiting engineers with enhanced knowledge and skills in RE thus underlining the potential impact of 'The Crux' project on the market. In order to better appreciate the link of labour market needs with the geographic area, data on degree level and field of expertise have been disaggregated into European Countries and Latin American ones. Figures 2 and 3 show the obtained results of the survey.

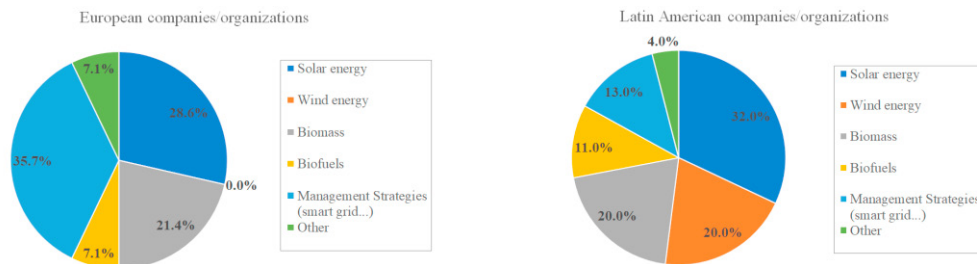


Fig. 2. Knowledge of future employees on renewable energy

Despite the number of involved European companies/organizations being low, in Europe interest seems to be more focused on management and solar energy. In Latin America, the number of responding companies/organizations is much higher and the survey clearly shows a lower interest in management but a higher interest in wind and biofuels compared to Europe. In terms of the range of qualification of future employees, European companies and organizations are mainly interested in engineers with Master degree of education and few of them on PhD. On the contrary, in Latin America most of them are interested in Bachelor and Master engineers with similar percentages. However, the percentages shown in Figure 3 refer merely to the interest of companies on recruiting an engineer with a specific level of qualification, and they significantly change when comparing different countries.

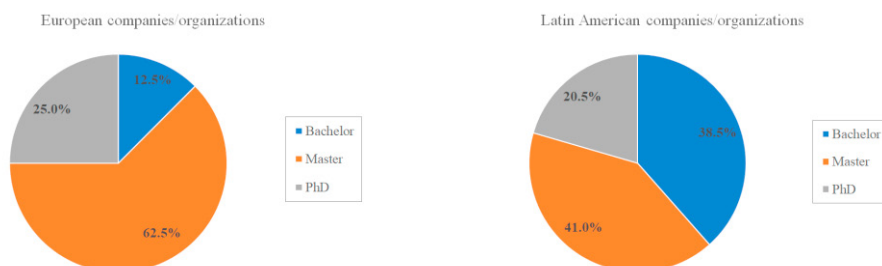


Fig. 3. Range of qualification of future employees on renewable energy

4. Conclusions

The increasing human capital requirement of the growing renewable energy sector makes proper education of young engineers to renewable and sustainable energy technologies of paramount importance. Many universities worldwide are paying attention to this request, such as those involved in ‘The Crux’ project aimed at improving the renewable energy engineering curriculum at different university levels in several universities of Latin America and Europe.

Since the satisfaction of the current and future labour market needs are fundamental aims for the modernization of engineering curricula, a survey on the labour market needs in specialists with enhanced knowledge in this field has been conducted by the members of the consortium in the related countries of interest. Industrial, private and public organisations as well as NGOs have been interviewed as representative of the labour market in the energy sector. Results of the survey show that satisfaction of the knowledge of the current employees on renewable energy is limited especially at Bachelor degree level. On the contrary, almost 70% of the interviewed organisations report a remarkable interest in employees with enhanced knowledge and skills in renewable energy. Although the requested field of expertise may be different and specific of each country and organisations surveyed clearly prove that good opportunities exist for young engineers with proper skills in the forthcoming years.

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References

- [1] Bowen A, Kuralbayeva K, Tipoe EL. Characterising Green Employment: The impacts of ‘greening’ on workforce composition. *Energy Econ* 2018. doi:10.1016/j.eneco.2018.03.015.
- [2] L_2009140EN.01001601.xml n.d. <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32009L0028&from=ES> (accessed May 25, 2018).
- [3] Weblet Importer n.d. <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52016PC0767&from=EN> (accessed May 26, 2018).
- [4] Ocetkiewicz I, Tomaszewska B, Mróz A. Renewable energy in education for sustainable development. The Polish experience. *Renew Sustain Energy Rev* 2017;80:92–7. doi:10.1016/j.rser.2017.05.144.
- [5] Kayahan Karakul A. Educating labour force for a green economy and renewable energy jobs in Turkey: A quantitative approach. *Renew Sustain Energy Rev* 2016;63:568–78. doi:10.1016/j.rser.2016.05.072.
- [6] Alawin AA, Rahmeh TA, Jaber JO, Loubani S, Dalu SA, Awad W, et al. Renewable energy education in engineering schools in Jordan: Existing courses and level of awareness of senior students. *Renew Sustain Energy Rev* 2016;65:308–18. doi:10.1016/j.rser.2016.07.003.
- [7] Busawon AN, Penlington R, Perera N. Engineering continuing professional development and mobility in the European green job market. 2nd Int. Symp. Environ. Friendly Energies Appl. EFEA 2012, 2012. doi:10.1109/EFEA.2012.6294063.
- [8] Nowotny J, Dodson J, Fiechter S, Gür TM, Kennedy B, Macyk W, et al. Towards global sustainability: Education on environmentally clean energy technologies. *Renew Sustain Energy Rev* 2018;81:2541–51. doi:10.1016/j.rser.2017.06.060.
- [9] Kandpal TC, Broman L. Renewable energy education: A global status review. *Renew Sustain Energy Rev* 2014;34:300–24. doi:10.1016/j.rser.2014.02.039.
- [10] The Crux Project n.d. <http://www.thecruxproject.eu/> (accessed May 26, 2018).