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STEM Education and Renewable Energy Jobs

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Abstract

The positive impacts of an increasing share of renewable energy on the softening of climate change and on reduced energy import dependency are indisputable. Renewable energy means the energy produced by wind, solar, geothermal, hydropower, biomass, solid waste. Wind, solar, geothermal and hydropower energies need the engineer's workforce and engineering is one of the STEM (Science, Technology, Engineering, and Mathematics) areas. Biomass and solid waste energies need environmental engineers' workforce and environmental engineers need STEM field expertise. Overall, the STEM areas touch upon every facet of renewable energy needs. If STEM skills increase, the youth of today will get more job opportunities, because more and more jobs are created by "Renewable energy sources (RES)".

Recently there has been a big push to reduce carbon footprint all over the world. Countries are trying to find ways to reduce the carbon footprint on their land. RES is one of the ways the amount of carbon produced can be curtailed while comparing to the energy produced by fossil fuels. Right now, humankind realizes that renewable energy should be encouraged for preventing global temperature rise. Renewable energy production in the future will create more job opportunities. To meet the need for the future workforce, the youth of today needs to be educated with STEM skills.

In the United States, an income tax credit is allowed for the production of electricity from qualified energy resources at qualified facilities. The energy resources that are classified as qualified are wind energy, closed-loop biomass, open-loop biomass, geothermal energy, solar energy, small irrigation power, municipal solid waste, and qualified hydropower production. The tax credit encourages more entrepreneurs to invest capital in renewable energy production and thereby create more STEM-related jobs.

This paper is going to highlight the importance of the relationship between renewable energy jobs and the skill set required to handle those jobs by STEM areas. The whole society is responsible to make our future generation STEM savvy so that they can match the need for jobs that are going to be created by renewable energy production. Data from different countries are analyzed to compare renewable energy jobs and the relationship to STEM areas' skill set use.

Introduction

Renewable energy is slowly replacing the conventional fossil-based energy. However, the question is whether it will replace fossil-based energy and create more Science, Technology, Engineering and Mathematics (STEM) jobs than the fossil-based energy does.

Many countries and regions set targets to reduce carbon emissions after the Kyoto and Paris agreements were signed in 1997 and 2015 respectively. To meet the requirements of the Paris agreement, the governments have to work towards introducing the renewable energy technology that eventually creates jobs in STEM fields. Renewable energy includes solar technology, wind power, water force, biomass, and

the alternative technologies that lead to the production of innovative construction materials that use low-energy for constructing roads, bridges, dams, tunnels, and buildings.

STEM has become increasingly central to economic enrichment and growth in the U.S.A. The educators at colleges play an active role in bringing STEM interested students to college for their higher education beyond high school diplomas. It could be because of the dire need for the STEM graduates to face future job growth in the renewable energy sector. STEM education is very important for the future generation of students to survive in the world of today. In countries such as China, Japan, France, Germany there is evidence that the leaders are encouraging STEM education among their youth population. From 2011 to 2020, the development of Renewable energy will create about 7 million job opportunities in China (Wenjia & Mu, 2014).

Renewable energy production

The portfolio of policies in China show that the renewable energy development is a high priority for dealing with the climate change challenges. China witnessed a roaring development in the installed renewable energy capacity during the period of 12th Five Year Plan (2010 – 2015), increasing from 250 GW in 2010 to approximately 500 GW in 2015. Wind power and Solar energy contribute 40% and 16.5% increase respectively to renewable energy production. China's total primary energy consumption will increase to 15% by 2020 and 20% by 2030 as per Nationally Determined Contributions (NDC) under the Paris Agreement. China plans to implementseveral policy instruments to further boost renewable energy deployment in the electric power sector.

The case study from China suggests that per 1 TWh expansion of Solar Photovoltaic and Wind power would create up to 45,000 and 16,000, respectively, direct and indirect jobs in China. However, the scale of induced job changes are quite significant and may even lead to net job losses in the whole economy in some cases (Wang, 2018).

European Union promised to raise the level of renewable energy sources in overall energy consumption to 20% in 2020. The audacious target across EU Member States is justified as a means for "promoting the security of energy supply, promoting technological development and innovation and providing opportunities for employment and regional development".

World legislators and policymakers assess the new ways of pushing renewable energy as a panacea to our persistent socio-economic problems. Creating more jobs with renewable energy production needs more green subsidies to encourage entrepreneurs to introduce new ways of using solar, wind and water resources. The conventional energy production is always easier and quicker to produce the electric power needed and not renewable energy production because the latter one is a new area to venture into (Keller, 2013).

A product of many current studies that resulted in an innovative employment model can help the policy-makers to answer the following three key questions:

1. What are the sensitivities of employment creation of taking up several different green energy methodologies and energy efficiency?

2. How overall job opportunities will be affected by the colossal growth of the RE sector considering the losses in employment in the fossil bound energy sector?

3. Do low carbon energy production methods such as nuclear energy or carbon capture and storage create employment?

Some key conclusions are arrived at after applying the concept of employment per unit of energy.

1. More jobs are created by renewable energy and low carbon entities than the fossil-based counterparts.
2. Solar photovoltaic panels usage creates most of the jobs per unit of electricity output among all other renewable energy sectors.
3. Renewable energy and energy efficiency can contribute to much lower CO2 emissions and significant job creation.
4. An integration of Energy Efficiency, Renewable energy, and low carbon approaches such as nuclear and Carbon Capture and Storage can yield over 4 million job-years through 2030 with over 50% of the electricity supply from non-fossil supply sources. (Wei, 2010)

Case study from Europe and Ireland

The report from Ireland examines the methods and processes used to appraise the job creation potential of renewable energy technologies (RET) industry to the economy, in particular, the use of jobs/MW, and assesses the reliability of their use. The analysis of the results was done based on different countries' individual basis with more emphasis on Ireland as a case study. The main focus of study was on wind power technology. Other technologies were also examined to some extent.

Figure 1 depicts the comparison of installed wind power in Ireland to the rest of Europe projected capacity until 2020 for Ireland and 2030 for Europe.

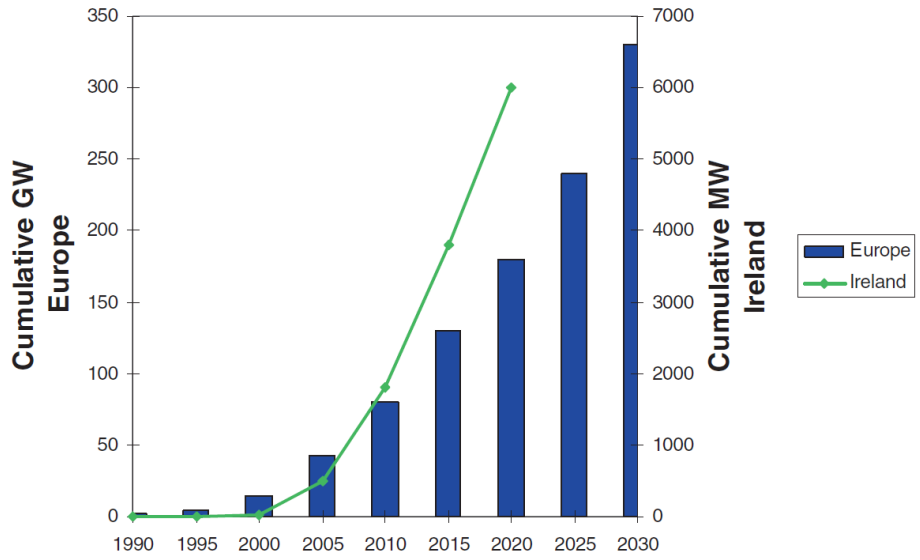

Figure 1 Comparison of installed wind power in Ireland to rest of Europe

Figure 2 shows the wind energy production level in the year 2007. The countries that produced the most wind energy were Spain and Germany topping the list with 3.6 GW and 1.6 GW respectively installed in the year 2007. Ireland's capacity for the year 2007 was small with only 59 MW. Many research reports use cumulative MW data in their jobs. The cumulative MW installed in 2007, jobs created in 2007 and the Jobs/Cumulative MW installed is shown in figure 3. It can be noticed in figure 3, that Spain, Germany, and Denmark produced more energy and jobs in 2007.

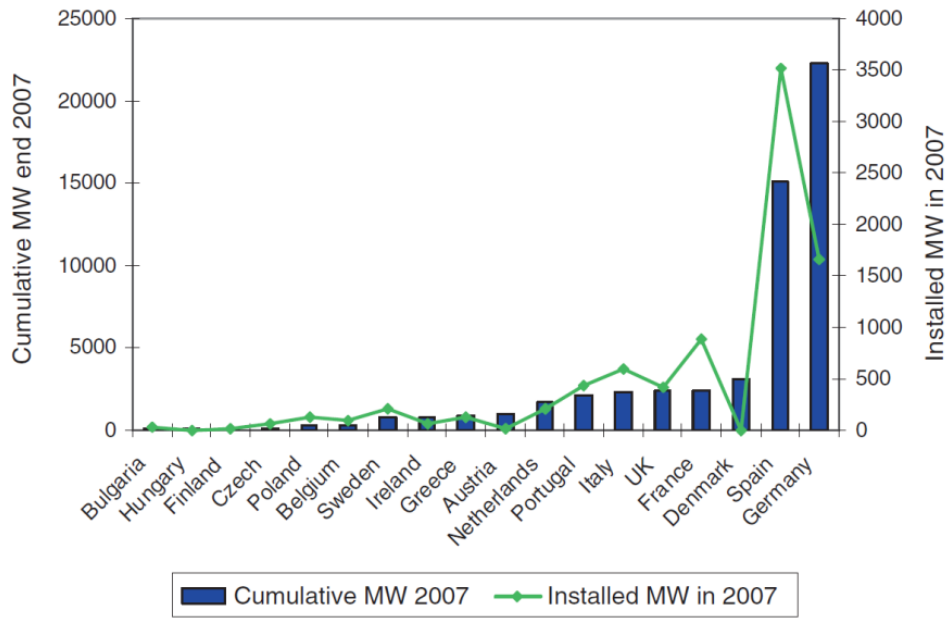

Figure 2 Cumulative wind capacity by the end of 2007 and Year 2007 only installed

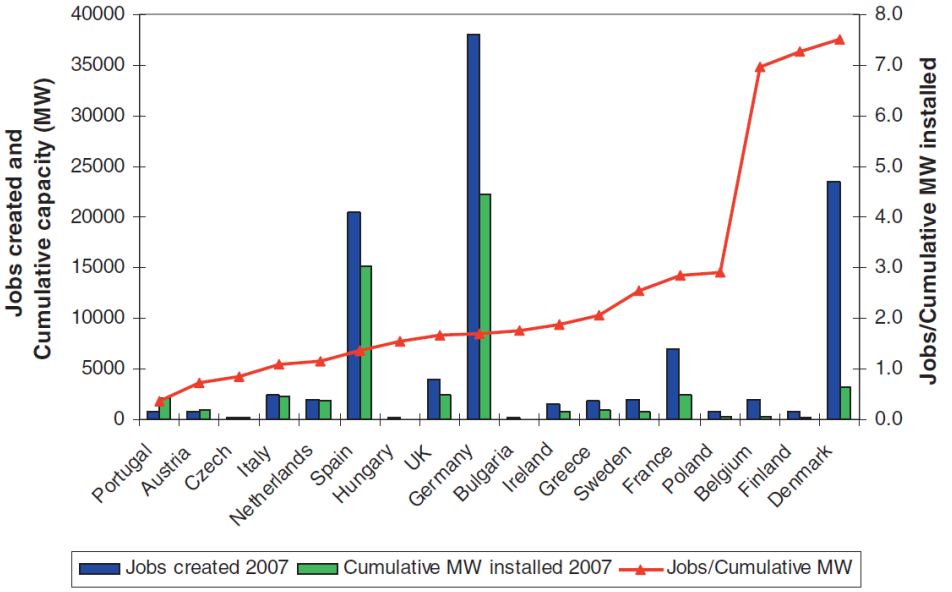

Figure 3 Direct jobs created in Europe 2007, cumulative capacity installed until 2007 resultant jobs/MW

The manufacturing of wind turbines gives more employment opportunities. Nevertheless, the industry creates jobs in research and development, system design, installation and maintenance, education and training, energy auditing and management and consulting.

From a case study from Germany, it is known as far as back in 1997 the Building Code of Germany was altered via a change in legislation to bring the “wind power” projects as the highly favored projects in the law. Germany exceeded its target of 12.5% of minimum electricity consumption from renewable sources for 2010. It expects the total employment in the renewable energy sector as high as 330,000 in total by 2030.

Also, Germany has 67 waste-to-energy facilities that process 17.8 million tons of waste annually. German waste industry can employ more than 250,000 persons from refuse collectors to engineers. From the data of 2012, Spain has more than 1,000 renewable energy companies. Jobs created by these 1000 companies are 89,000 directly related to RE. Spain expects to create more than half a million jobs by 2020. 24 million tons of urban waste and 48 million tons of industrial waste were collected in Spain in 2008. Ten waste-to-energy facilities consumed over 1.8 million tons of waste per year in Spain (Dalton, 2011).

In the middle east region, many countries have recognized its renewable energy potential and fixed deadlines to finish large scale RE projects. A number of subsidies, incentive schemes, state laws, rules, and regulations have been introduced to support these initiatives in the region. Morocco expects 42% of the installed capacity of renewable energy by 2020. Iran has a target of 10% of electricity generation from renewable energy resources by 2020. Saudi Arabia plans to have 54 GW of renewable energy production by the year 2032. Dubai plans for 5% of the final energy from renewables by 2030.

STEM Training for Renewable Energy Jobs

More training has to be given to the students that are interested in the STEM field to secure Renewable Energy jobs. Even though Turkey has implemented great number of policies regarding green economy especially that produces many renewable energy jobs, it has not focused much on training the workforce for handling renewable energy jobs. However, recently it has been investing more money and effort to train its workers towards handling green jobs. The Turkish Vocational Qualification Institute has published standards for four green-collar jobs: Biogas Systems Staff, Photovoltaic Power Systems Staff, Solar Thermal Systems Staff, and Wind Power Systems Staff. Undergraduate education or merely a certificate from Vocational Qualification Institute can earn one a green job within the country or abroad. The public institution Vocational Qualification Institute should work more on green-collar jobs (Karakul, 2016).

Recently, Botswana witnessed a decline of consumer faith in solar energy technologies because of the lack of available trained workforce for the maintenance and repair of solar energy devices. Botswana government ordered a study to be undertaken to ascertain the required training programs and facilities that need upgrades for training their personnel to undertake renewable energy jobs. The study proposed seven training programs at progressively increasing skills and expertise levels that include few certificate courses in each of the solar photovoltaic technologies and a higher diploma in renewable energy technologies. A short course to upgrade the skills of the present maintenance personnel to alleviate immediate problems is also proposed (Jain, 2002).

Renewable energy training should be looked at in three different angles:

1. Leaders who are responsible for decision making (Administrators, Economists, Engineers, Planners)
2. Maintenance Technicians available in the local vicinity.
3. The users.

They can follow the important aspects for focusing as found below:

- The gradual improvement of research centers and the qualified personnel development,
- The founding of improved collaboration between the establishment of better coordination and energy needs and the choice of appropriate equipment.
- The creation of maintenance teams able to interact with the rural population in order to solve the technical problems they might face.

- To provide them with necessary information on the operation of the used equipment, raising the awareness of users on the methods of the effective use of this equipment (Benchike, 2001).

Conclusions

From the various case studies and experiences from different countries it could be concluded that the renewable energy production is going to increase in multifold and bring a lot of opportunities for STEM savvy students of the future.

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