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Activities on Photovoltaic Potential

[1]Francesca Taponecco, [2]Giorgio Belluardo
[1]Scientific Communication, [2]Institute for Renewable Energy, [1, 2] European Academy of Bolzano EURAC (Italy)
francesca.taponecco@eurac.edu

Abstract

The European Academy of Bolzano (EURAC) is a no-profit institution that consists of 11 research institutes, mainly focusing on scientific and technical fields. As a part of the Scientific Communication group, EURAC junior is a project that includes a series of didactical and dissemination initiatives and aims at bringing research and real applications in science teaching, as well as fostering interest and curiosity of students into science, by getting them inside the research center.

Besides annual lectures, summer and winter camps, training courses for teachers, activities for science festivals and fairs, during the scholastic year we daily offer workshops and experimental laboratories for school classes.

Starting from current research projects and in close cooperation with the researchers of the Institute for Renewable Energy, we developed a set of activities to introduce high school students to the fascinating world of renewable energy and in particular solar photovoltaic.

School classes spend three hours inside our research center, most of the material is open source and can be easily reproduced and discussed later on in the classroom. The contents are particularly interesting for students, as it is an inter- and multi-disciplinary field of study, including e.g. mathematics, physics, electro-technics, geometry, optics, ecology, geography, informatics, chemistry.

The laboratory starts with a visit of the solar plant which is placed on the terrace of the institute. Students can observe the PV cells and see how the plant is built.

Afterwards they receive a general introduction on energy and photovoltaic, which is followed by a presentation of the different PV technologies, their characteristics as efficiency, strengths and weaknesses, etc.

During the practical activity students can autonomously simulate how to build their own PV system, choosing the cells and placing them in the right way. They can calculate the produced energy and the power of the system. They analyze economic and ecologic implications calculating cost of the plant, relative payback time and final gain, as well as avoided CO2 emissions. For this task students use open source digital resources.

The workshop continues with a presentation regarding the project PV-Alps on the evaluation of how solar energy from photovoltaic can be most usefully exploited in the Swiss canton of Grisons and in the Italian region South Tyrol. A practical activity follows to explain students the spectral effects on the performance of different PV technologies.

The students conduct measurements, working both in collaborative group learning and individual exercises, and an experiment together with the researcher. In this approach, hands-on experiences and technical instruments are used to intuitively explain complex theory.

The workshop has been tested in several classes and teachers asked us to organize a training course in order to allow them to better integrate contents and activities of the workshop in their school programs. We collected a very positive response from teachers and students, they were happy to attend workshops and courses as they wish more contact between school and research institutes.

1. Introduction

EURAC junior is a science communication project that aims at building bridges between schools and science, facilitating an insight into the world of applied research at the European Academy of Bolzano, Italy - EURAC.

A broad series of didactical activities have been developed in the last 5 years, with the aim of communicating science and research to students and public in general. On an annual basis, we organize lectures, summer and winter camps, training courses for teachers, activities for science festivals and fairs, and, in particular, workshops and experimental laboratories for school classes. The target is not only that of communicating the research of the several research institutes, we especially aim at raising youth's curiosity and interest in science and research, showing relations between different disciplines, application fields and research project results, how to apply scientific methods, how science can affect and improve our lives and the places where we live.

2. Didactical activities

The program that EURAC junior offers to school classes is possible thanks to the cooperation with the different EURAC research institutes. EURAC is a centre for applied research which is constituted of 11 different institutes, mainly focusing on technical and scientific fields of research. The institutes are grouped in 4 areas which are: autonomies, health, mountain and technology.

This paper in particular provides detail on our last didactical laboratory, with focus on renewable energy and photovoltaic.

Our laboratories are workshop for classes that deepen specific topics, offering a balanced program of theoretical and practical activities. After brief introductions and short ice-breaking activities, an active participation is required and a problem needs to be solved. Students can work autonomously and in collaborative group learning, and receive insights and support from experts and researchers.

3. The lab on solar electricity potential

Starting from current research projects and in close cooperation with the researchers of the Institute for Renewable Energy, a set of activities have been developed to introduce high school students to the fascinating world of renewable energies and in particular solar photovoltaic.

Students expressed strong interest in this field, and teachers of different disciplines were involved in the testing-phase of the lab. The contents are particularly interesting for school classes, being this field of study inter- and multi-disciplinary, including e.g. mathematics, physics, electro-technics, geometry, optics, ecology, geography, informatics, chemistry.

The 3-hours laboratory starts with a visit of the solar photovoltaic plant, which is placed on the terrace of the institute. Students can observe PV cells, how they are interconnected, how PV modules are placed and oriented and how the plant is built.

Afterwards they receive background information and specific presentations in order to approach the practical activities.

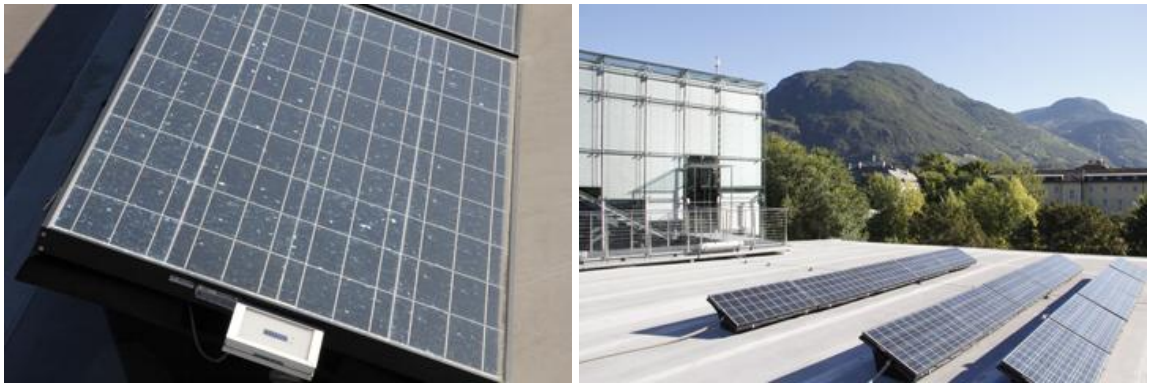

Fig.1. Solar photovoltaic plant

3.1 Themes

Depending on the school level, students receive theoretical basis and a general introduction on energy and on photovoltaic technology, they learn the differences between different PV-modules technologies, relative characteristics, weakness and strengths, etc.
This is followed by a technical presentation which explains how to evaluate incoming solar radiation, what is solar electricity potential, and which is the relationship between the solar spectrum and the performance of the different modules. The presentation is also aimed at showing goals, methodology and results of the project PV-Alps, funded under the program INTERREG IV Italy-Switzerland. In PV-Alps, high resolution radiation maps are derived from satellite images, taking into account the local morphology and cloudiness of the Swiss canton of Grisons and of the Italian region South Tyrol. The energy potential from photovoltaic of the abovementioned areas is therefore derived using an innovative approach which takes into account temperature and spectral effects on the photovoltaic module behaviour. Finally, an analysis of the energy potential maps is carried out in order to produce a handbook to orientate and support decision-makers in the sustainable energy planning of their territories.

Fig.2. School class visiting the PV plant

3.2 Practical activities and resources

During the practical activity students can autonomously simulate how to build their own PV system, choosing the cells and placing them in the right way. They can calculate the power of the system and the produced energy. They analyse economic and ecologic implications calculating cost of the plant, relative payback time and final gain, as well as avoided CO_2 emissions. For this task students use open source digital resources. The material used can be easily reproduced and discussed later on in the classroom.

Fig.3. Lab activities

4. Outlook

The feedback collected from students and teachers allowed us to improve and extend the lab. Ongoing work is the development of a practical experiment to show students the spectral effects of light on the performance of different PV technologies.

5. Conclusions

As a part of the Scientific Communication group of the European Academy of Bolzano, EURAC junior is a project that includes a series of didactical and dissemination initiatives and aims at bringing research and real applications in science teaching, as well as fostering interest and curiosity of students into science, by getting them inside the research center.

This contribution presents the laboratory of photovoltaic and solar potential, which has been developed in cooperation with the EURAC research Institute for Renewable Energy. The lab has been tested in several classes and teachers asked us to organize a training course in order to allow them to better integrate contents and exercises of the workshop in their school programs and teaching activities. We collected a very positive response from teachers and students, they were happy to attend workshops and courses; they wish more contact between school and research institutes as this proved to enhance students' understanding and motivation as well as interest in technical disciplines.

6. Acknowledgements

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