DEVELOPMENT OF OPEN EDUCATIONAL RESOURCES FOR RENEWABLE ENERGY AND THE ENERGY TRANSITION PROCESS

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Abstract

The dissemination of knowledge about renewable energies is understood as a social task with the highest topicality. The transfer of teaching content on renewable energies into digital open educational resources offers the opportunity to significantly accelerate the implementation of the energy transition. Thus, in the here presented project six German universities create open educational resources for the energy transition. These materials are available to the public on the internet under a free license. So far there has been no publicly accessible, editable media that cover entire learning units about renewable energies extensively and in high technical quality. Thus, in this project, the content that remains up-to-date for a longer period is appropriately prepared in terms of media didactics. The materials enable lecturers to provide students with in-depth training about technologies for the energy transition. In a particular way, the created material is also suitable for making the general public knowledgeable about the energy transition with scientifically based material.

Keywords: energy transition, renewable energies, open educational resources, dissemination, digitalization

1. Introduction

The dissemination of knowledge about renewable energies is considered to be a societal task with the highest topicality and urgency. The transfer of teaching content into digital open educational resource (OER) formats is a unique opportunity to significantly accelerate the energy transition at the highest and most efficient level. In addition, multiplier effects can generate additional value for a climate-friendly energy structure change that requires skilled workers. Thus, in this paper the project "OER4EE – technologies for the energy transition" is presented. In this project a consortium consisting of experts in the field of renewable energies from six German universities (Technische Hochschule Köln, RWTH Aachen, Fachhochschule Aachen, Hochschule Bonn-Rhein-Sieg, Ruhr-Universität Bochum and Hochschule Düsseldorf) create open educational resources for the energy transition. The project is funded by the „ Ministry of Culture and Science of North Rhine-Westphalia " in cooperation with DH.nrw and lasts from 09/2020 until 08/2022. The produced materials will be available on the internet via the platform ORCA.NRW [1]. The material is published under the license CC-BY-SA 4.0 [2]. This means that the material may be reproduced and distributed further and that it may be changed and built on, including commercially under the following conditions: the author has to be mentioned and it has to be indicated of whether changes have been made. Changes and distribution may only be made under the same license (CC-BY-SA) [2].

In the socially and technologically dynamic field of technologies for the energy transition, today's lecturers use specially created PowerPoint slides. There are no publicly accessible, editable media, that cover the entire learning units in high professional quality, although media didactic approaches would be helpful in many aspects. Some

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of the technical content does not change very quickly and a media-didactic presentation would therefore be worthwhile. Another part of the content requires file formats that can be changed quickly in order to keep them up to date.

The project has the task of appropriately preparing the content that remains up-to-date in terms of media didactics, for example with teaching videos, review questions and discussion videos. The materials created in this way also enable lecturers outside the project consortium to provide students with in-depth training.

2. Target group

The main target group as users of the materials created in this project are lecturers and students of engineering. At the six participating universities there are 22 courses for which the material is relevant. These courses are shown in the Figure 1.

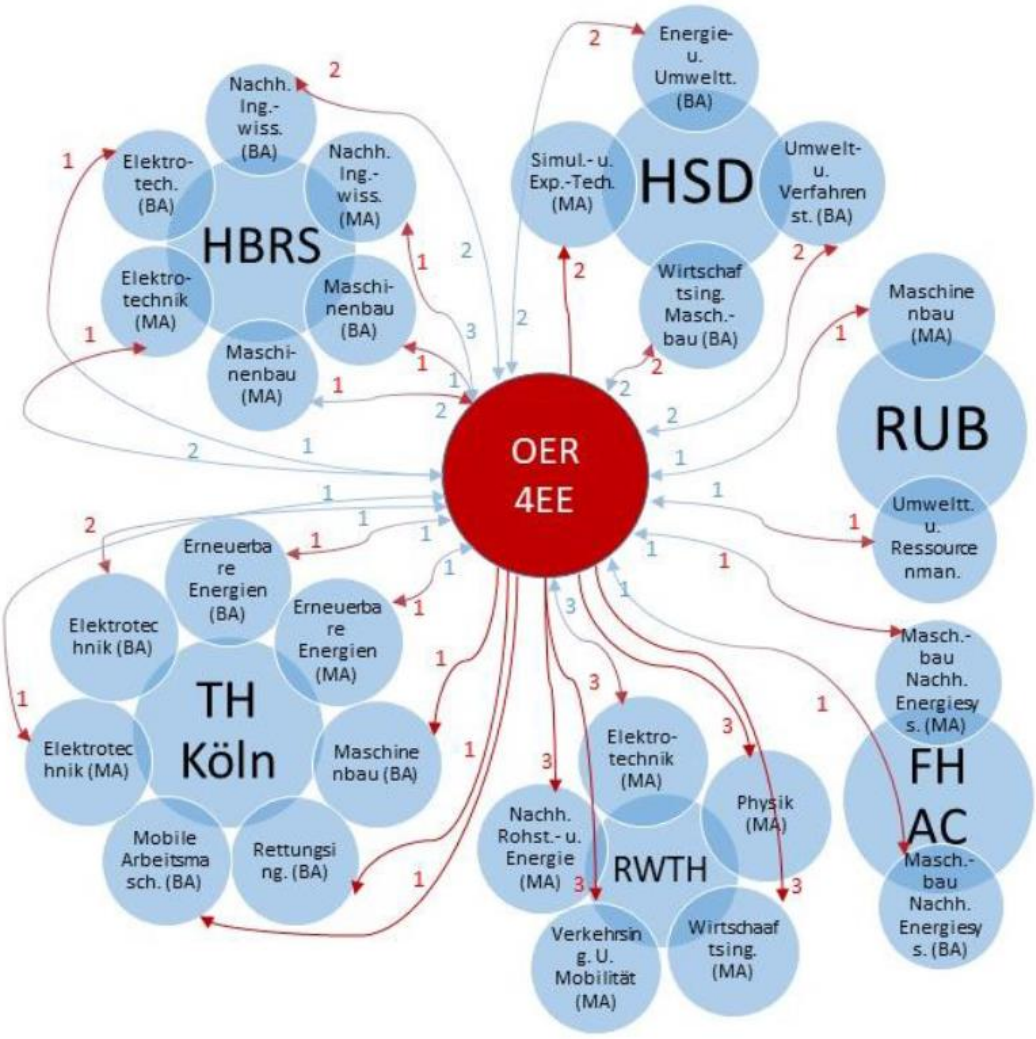

Figure 1: Courses at the participating universities in which the material is to be used.

All courses deal with the topic of renewable energies and the system technology required for the energy transition. This includes both bachelor and master degree programs. These courses include the classic disciplines such as electrical engineering and mechanical engineering, but also courses that have been further developed from these disciplines such as "Energy and Environmental Technology", "Environmental and Process Engineering", "Environmental and Resource Management", "Sustainable Engineering" or dedicated to that topic coordinated courses such as "Renewable Energies". Graduates of the planned modules should receive in-depth skills in the assessment and analysis of technologies for the energy transition through digital exercise options. The material is also suitable for making the general public knowledgeable about technologies of the energy transition with

scientifically founded material: It can be assumed that schools with physics courses, energy working groups or the like, as well as interested citizen groups and associations, will use the freely available materials to better inform and educate oneself. In this way, the material also helps to promote innovation and open discussion in society, especially in the conflict-prone area of energy.

3. Content of the teaching/learning offer

The energy transition is a complex topic which, in addition to purely technological perspectives, also has social, economic and environmental perspectives. The project covers many of these aspects, but can only form a nucleus, which is able to lay the foundation for a comprehensive OER offer in the field of "technologies for the energy transition". For this reason, the structure of the OER offer is of great importance. The aim is that the OER offer can also be supplemented after the end of the project and also by actors who are not part of the project consortium. The contents are divided into three groups: technologies for the use of renewable resources, energy storage and efficient energy use. Within these groups, the contents are specified in more detail. In the case of energy storage systems, for example, a subgroup are batteries. These are further classified according to the technology such as lithium batteries. In each subject, the focus is on four different methodological specializations. These are "Technology", "System analysis", "environmental impact" and economics.

Figure 2 shows all subjects in the left column. The participating universities are listed on the first line. The green fields indicate the universities that produce the corresponding content. The yellow fields indicate the universities taking part in the project that use the produced content. In the case of battery storage for example RWTH Aachen and Ruhr-Universität Bochum produce the content and the other participating universities will use this content in their own courses.

	Content green: create gelb: take over from others	TH Köln	RWTH Aachen	FH Aachen	Ruhr-Univ. Bochum	HS Bonn-Rhein-Sieg	HS Düsseldorf
Renewable Energies: Generation and System	Renewable energies overview, energy supply of the future						
	Biomass						
	Photovoltaics						
	Wind energy	L					
	Solar thermal	S					
	Solar thermal power generation						
	Energy 4.0	M					
	Sector coupling	S					
Energy storage	Energy storage in modern power grids	S					
	Battery storage	S					
	Power storage without batteries						
	Gas storage, e.g. for storing hydrogen						
	Hot water storage						
	High temperature heat storage including Power2Heat	S					
Energy efficiency	CHP						
	Heat pumps	S					
	System technology for energy efficiency	ME					

Figure 2: Subjects and universities that create the content (green) or use the content (yellow)

4. Development of the material

The material produced until now is mainly videos with greenscreen technology, videos with light-board-technology, screencast tutorials and guided Python-simulations. In case of videos with greenscreen technology the speaker stands in front of a green screen during the video production, afterwards the green screen is exchanged by the prepared power point slides. Figure 3 shows a video production in Camtasia.

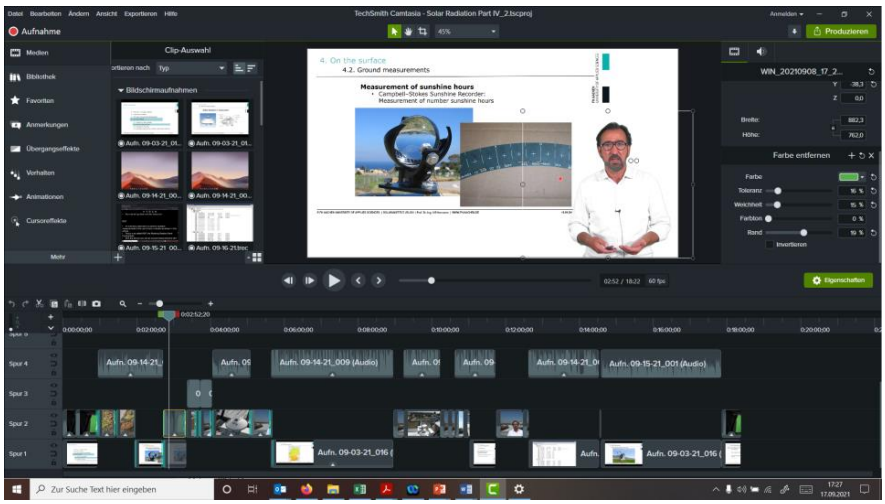

Figure 3: Production of a teaching video in Camtasia.

Due to the license requirements of CC-BY-SA the power point slides shown in the videos have been completely redesigned. All graphics were created from scratch in order to be able to distribute them under the CC-BY-SA-license.

In Figure 4 four exemplary screenshots of produced videos are shown. The two videos on the left side are produced using the greenscreen-technology. In the video at the bottom right, the speaker was filmed directly in front of a presentation wall. In the video at the top right the picture and the text was drawn via a tablet while the speaker gives an explanation orally.

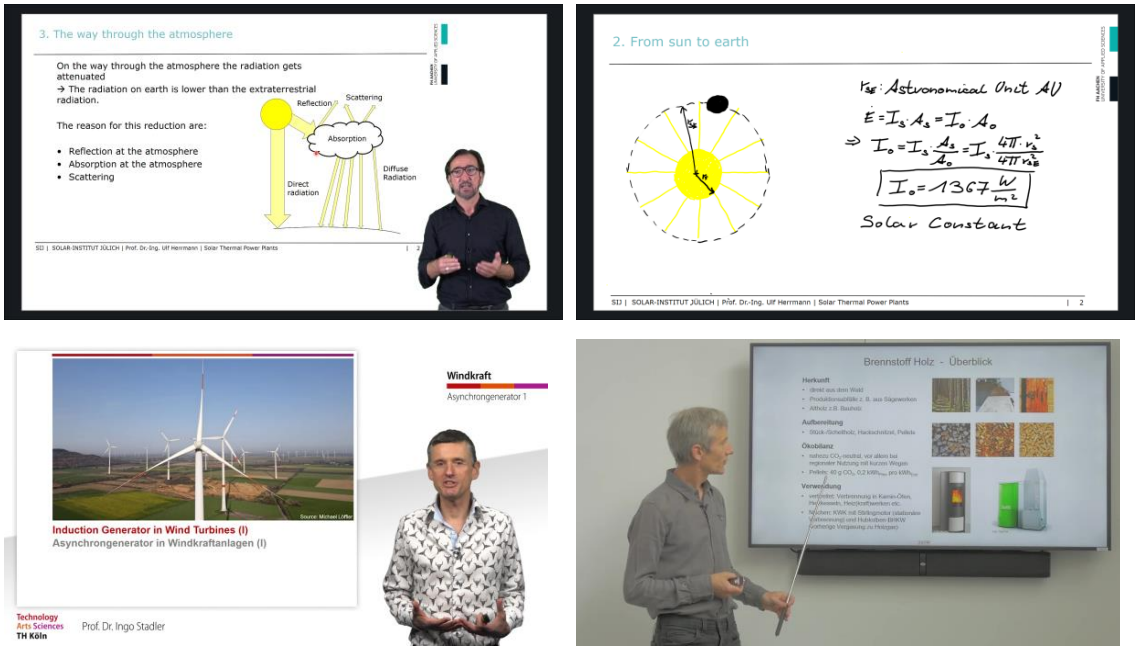

Figure 4: Screenshots of produced teaching videos

5. Quality assurance

In the beginning, the project consortium agreed on common quality standards, which are appropriately safeguarded in all quality assurance measures. This includes that every content is checked in terms of content and didactic by at least one peer. Criteria were defined for this review, which are then checked by the peers. These criteria include, for example, questions about the understanding and traceability of the teaching materials, as well as questions about the speed of speech and the length of the videos. In addition, all content modules are checked

for formal quality criteria (e.g. sensible font size, general comprehensibility) by a defined group of project employees.

At the moment the materials are used in courses for the first time. The materials are then evaluated by students using evaluation sheets that were created within the project.

6. Use of the teaching / learning offer

The resulting materials are designed in such a way that they are suitable for use by lecturers in courses as well as enabling students to catch up on the content or learn the content independently, for example to prepare for a laboratory or exam.

At the moment the materials are used in courses for the first time in different scenarios. Thereby suitable and current scenarios and methods are tested in teaching practice. The exchange of experiences about the use of the materials in teaching practice is an integral part of the collaboration and flows into general use as iteratively improved material (subject content and methods). In the sense of flipped classrooms, for example, the material can be used for preparation, while questions and topics can be discussed in more depth in face-to-face events in person or online.

A declared aim of the teaching materials is to enable other lecturers in the same subject to use and develop them further. Lecturers can use the modular components of the subject content in self-designed teaching-learning scenarios. On the one hand lecturers can directly use the produced videos or part of the videos in their own courses, on the other hand they can use the PowerPoint slides of the videos and adapt them. This means that all the advantages of innovative, digital teaching and learning concepts can be used for the individual university and target group. Additionally, lecturers can use the materials to supplement their own lectures with additional content and thus make use of the full expertise of the respective university professors.

At the moment, the project consortium is gaining initial experience with the reusability of teaching material by other lecturers. It became clear that very good metadata is important for teaching videos. As a result, lecturers who use other people's material can quickly and efficiently find suitable videos for their own course from a large pool of materials without having to watch all of the videos. Furthermore, short teaching videos are very beneficial, so that the users of the materials can put together their own course from short sequences. In addition, it is helpful to not only provide the videos, but also the associated PowerPoint slides. This means that users of the teaching materials can e.g. simply further develop graphics. In this way they also have the basis to supplement the teaching videos with additional aspects if necessary.

7. Conclusion

The project partners agree that OER creates a high level of added value. There is agreement in the consortium that the quality of the teaching materials has increased compared to previously existing teaching materials. On the one hand, this is due to the mutually enriching exchange in the consortium on content-related and didactic topics as well as legal issues and technical implementation. On the other hand, the project-internal quality control leads to high-quality teaching materials. This is a basic requirement for the material to be available worldwide, freely and permanently on the Internet. The users of OER can therefore benefit from the expertise of the creators and receive teaching materials of high quality.

8. Acknowledgments

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9. References

[1] https://www.orca.nrw/, Accessed 8.10.2021

[2] https://creativecommons.org/licenses/by-sa/4.0/deed.de, creative commons, Accessed 8.10.2021