www.smagrinet.eu

SMAGRINET

POWERING SMART GRID
EXPERTISE IN EUROPE

his project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

CONTACT US
info@smagrinet.eu

TAL TECH

Univerza v Ljubljani

TECHNISCHE UNIVERSITÄT DRESDEN

LOBA®

CIVITTA

ktu kaunas university of technology 1922

Technische Universität Berlin

ETL ESTONIAN ELECTRICITY INDUSTRIES

UNIVERSITÉ DE LORRAINE

DELIVERABLE 4.1.

SHORT-TERM PROGRAMMES

DELIVERABLE TYPE
Report

MONTH AND DATE OF DELIVERY
Month 16, November 30

WORK PACKAGE
WP 4

LEADER
ULOR

DISSEMINATION LEVEL
Report

AUTRHORS
Kévin Berger
Laurent Dupont
Catarina Pereira
Alex Gabriel

PROGRAMME
H2020

CONTRACT NUMBER
837626

DURATION
30 Months

START
April 2019

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

Contributors

Name	Organisation
Kévin Berger	ULOR
Laurent Dupont	ULOR
Catarina Pereira	LOBA
Alex Gabriel	ULOR

Peer Review

Name	Organisation
Karl Kull	TalTech

Revision History

Version	Date	Reviewer	Modifications
1.1	01/12/2019	Kévin Berger	First draft
1.2	15/09/2020	Kévin Berger	Corrected draft
2.0	01/11/2020	Karl Kull	Final version

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

INDEX OF CONTENTS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

1. Introduction

The main objectives of the SMAGRINET project are to impact the instrictions and the sensitization concerning smart grid in order to accelerate its adoption and implementation. The WP3 provides modules to integrate in the actual university programmes. However, there is a need for the capacity building programmes to rapidly respond to the urgent energy transition challenges. To do so, the WP4 initially suggested 3 short-term programmes for different target groups .

The initial idea was to repackage the information from WP3 modules into three tiers of specialization intensity and blended methods. With the additional feedback received and gathered by ULOR – a further segmentation of categories was done in order to package information for stakeholders in a more convenient manner. The content of the programmes was modified follow the topics of the modules (WP3) and experience and needs of the target groups.

It was identified that the categories for the short-term programs should be packaged in the following categories:

- Challenges and contexts
- Electrical network elements
- Information system dedicated to energy
- Management and decisional systems
- Policy and economy in energy

As there are three main groups of stakeholders (engineering workforce, early-stage researchers and engineering researchers beyond the universities, broader public) the end result was a total of 15 programs including 72 instructional objectives, 36 topics with 36 high quality videos as supporting materials.

Based on the material prepared for the blended programme the trainers manual for the short-term programmes will be developed (T5.2) and a workshop for the trainers will be organized and held in November.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

2. Creation of the programs

2.1. Basis for the programs

According to the DoA it was expected that under this task a preliminary description of the programmes would be provided for the following stakeholders:

1. Policy makers and the broader public
2. Electrical engineering workforce
3. Early-stage engineering researcher

In order to make the best learning programs for stakeholder it is important to define and understand the needs of the stakeholders and their connected parties in order to tailor the information accordingly.

2.1.1. Continuing education programs designed for the general public and public administration

Continuing education course for broader public (public administration, policy makers, representatives of cities and regions, specialists, researchers and teaching staff having background other than engineering, future students, students from vocational education and applied higher education). This course has been developed for the purpose of **raising awareness** about **electrical engineering field among people and society as a whole**. These courses are targeting the general public and representatives of public administration (decision makers and managers from the cities and regions) who are specialists in the field can be included to the group. The courses will not have as much depth as compared to the other programs but will cover the whole array of themes in the information HUB of SMAGRINET.

In addition to the educational value, it is hoped that this course will create more interest in the electrical engineering field and will raise the amount of people who are willing to come and study this field.
As the knowledge about electrical engineering grows, so will its popularity among university applicants.

2.1.2. Continuing education programs designed for current electrical engineering workforce from industry

The courses were targeted for people currently working in the field of electrical engineering, who can benefit from complementing their current skill-set with knowledge regarding the new generation of electrical grid technology (smart grids). The target group includes current workforce from the industry,

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

incl. service providers, but also professional end users who have background in engineering.

The courses would be beneficial for workers that have worked in the field of electrical engineering for a long time and may not be been able to keep up with the advancement of technology in the utilities sector. These courses offer the electric industry a rapid way of up-skilling their workforce.

2.1.3. Continuing education programs designed for researchers

This course has been designed considering the needs of the early stage researchers and engineering researchers working not in the universities providing them a floor for networking and collaboration, exchange of experiences updating the knowledge on the smart grid subject.

2.2. Technical composition of the programs

The "Smart grid" subject covers a vast array of knowledge areas and the necessary multidisciplinary approach requires regular updates. The main task for this deliverable was at first to identify the concepts to integrate in this program and define the instructional objectives that is wanted to be address in order to reach the targeted profiles.

It was rather a big challenge to build a coherent and comprehensive plan for this course involving five European Universities. Literature reviews, benchmark and workshops led to defining 72 instructional objectives for the 3 target stakeholder groups.

The expertise of each partner has led to the creation of outstanding contents. This collaboration generated 36 videos to reach over 4 hours, 37 lectures and dozens of additional materials and links to external resources.

In order to provide a systemic view of what a smart grid is and related topics, the program has been structured into five interdisciplinary modules:

1. The context and challenges related to smart grid
2. The evolution of the electrical infrastructure
3. The fundamentals regarding the digitalization of the sector
4. The decisional system that is on top of the digital system
5. The economic and political dimension that impact the energy and electricity sector

These five modules are the backbone of the program; however, the "Smart Grid from A to Z" programs admit a range of three variations:

1. Broader public version for public decisions makers, managers, future students in the field
    a. **Objective:** Explain components and principles of the smart grid and experiment with some of them
    b. **Technicality:** No math

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

c. **Numbers of lectures:** 33 lectures
d. **Profile of participant:** General public, public decision maker, managers, future students

2. Electrical engineering workforce version dedicated to professionals from the energy domain who want to upgrade their knowledge on some aspects.
   a. **Objective:** Understand components and principles of the smart grid with examples to be consulted
   b. **Technicality:** Some formulas and graph plots
   c. **Numbers of lectures:** 47 lectures
   d. **Profile of participant:** Professional from the energy domain

3. Engineering researcher version for engineers and researchers with few knowledge in the domain of smart grid.
   a. **Objective:** Understand components and principles of the smart grid
   b. **Technicality:** Some formulas and graph plots
   c. **Numbers of lectures:** 44 lectures
   d. **Profile of participant:** Engineer/researcher with little knowledge in the energy domain, namely the smart grid

According to the nature of the program, the degree of detail and technicality differentiates the three variations.

2.3. Creation of the module's material

The best way to integrate the interdisciplinary and transdisciplinary aspects of the smart grid was to involve as many consortium members as possible in creating the educational and training content for the programmes. Therefore, Université de Lorraine, Technical University of Dresden, University of Ljubljana, Tallin University of Technology, Kaunas University of Technology and Technical University of Berlin joined forces in developing programmes that will tackle social, physical, informational and decisional aspects associated with the smart grid, as well as the political, economic and legal aspects that regulate its development. These aspects constituted the five modules of the program.

According to the learner's profile (engineering researcher, electrical engineering workforce, broader public) there are different pedagogical objectives and specific programs to best fit the learner's needs.

The detailed program content as well as the contribution responsibility is described in Table 1 below.

id	Modules	Targets	Objectives (main)	Final contributor
1	Challenge and context	Broader public	Describe the link between electricity and environment	TalTech

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

2	Challenge and context	Broader public	**Describe** physical principles related to smart grid	TUB
3	Challenge and context	Broader public	**Describe** challenges of TSO and DSO	TUB
4	Challenge and context	Broader public	**Identify** stakeholders related to energy production, distribution and sell	TUB
5	Challenge and context	Broader public	**Identify** regulated actors and activites and those that are not regulated	TUB
6	Challenge and context	Broader public	**Identify** common principles and concepts of smart grid, city…	TUB
7	Challenge and context	Broader public	**Identify** contribution of smart grid to each scale of energy management	TalTech
8	Challenge and context	Eng. Researcher, Elec. Eng. Workforce	**Explain** the link between electricity and environment	ULJUB
9	Challenge and context	Eng. Researcher, Elec. Eng. Workforce	**Distinguish** regulated actors and activites and those that are not regulated	TUB
10	Challenge and context	Eng. Researcher, Elec. Eng. Workforce	**Distinguish** stakeholders related to energy production, distribution and sell	TUB
11	Challenge and context	Eng. Researcher, Elec. Eng. Workforce	**Explain** physical principles related to smart grid	ULJUB
12	Challenge and context	Eng. Researcher, Elec. Eng. Workforce	**Explain** challenges of TSO and DSO	ULJUB
13	Challenge and context	Eng. Researcher, Elec. Eng. Workforce	**Explain** common principles and concepts of smart grid, smart city…	ULJUB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

14	Challenge and context	Eng. Researcher, Elec. Eng. Workforce	**Explain** contribution of smart grid to each scale of energy management	TalTech
15	Electrical Network Elements	Broader public	**Describe** the cycle of energy	TalTech
16	Electrical Network Elements	Broader public	**Describe** several thermal power production technologies and there caracteristics	TalTech
17	Electrical Network Elements	Broader public	**Describe** several renewable power generation technologies and there caracteristics	TUB
18	Electrical Network Elements	Broader public	**Describe** principle of combined power production	TalTech
19	Electrical Network Elements	Broader public	**Describe** power transportation and distribution	ULJUB
20	Electrical Network Elements	Broader public	**Identify** technologies from the landscape of electrical storage technologies	TalTech
21	Electrical Network Elements	Eng. Researcher, Elec. Eng. Workforce	**Explain** principles of several thermal power production technologies and there caracteristics	TalTech
22	Electrical Network Elements	Eng. Researcher, Elec. Eng. Workforce	**Explain** principles of several renewable power generation technologies and there caracteristics	TalTech
23	Electrical Network Elements	Eng. Researcher, Elec. Eng. Workforce	**Explain** principle of combined power production	TUB
24	Electrical Network Elements	Eng. Researcher, Elec. Eng. Workforce	**Explain** power transportation and distribution constraints	TUB
25	Electrical Network Elements	Eng. Researcher, Elec. Eng. Workforce	**Explain** principle of electricity storage technologies and their limits	TalTech

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

26	Electrical Network Elements	Eng. Researcher, Elec. Eng. Workforce	**Explain** power transformation	ULJUB
27	Information system dedicated to energy	Broader public	**Give** a definition of an information system	ULOR
28	Information system dedicated to energy	Broader public	**Identify** the role of IS in SG	ULOR
29	Information system dedicated to energy	Broader public	**Identify** the element of an IS in smart grid	ULOR
30	Information system dedicated to energy	Broader public	**Identify** features that make blockchain interesting in smart grid	ULOR
31	Information system dedicated to energy	Broader public	**Identify** the network components and communication involved in IS associated to smart grid	ULOR
32	Information system dedicated to energy	Broader public	**Identify** components of API	ULOR
33	Information system dedicated to energy	Broader public	**Identify** the main aspects and factors of cyber security that affect smart grids	ULOR
34	Information system dedicated to energy	Eng. Researcher, Elec. Eng. Workforce	**Describe** the structure of a SCADA system	ULOR
35	Information system dedicated to energy	Eng. Researcher, Elec. Eng. Workforce	**Describe** the process of information in automated system	ULOR
36	Information system dedicated to energy	Eng. Researcher, Elec. Eng. Workforce	**Describe** elements the of IS associated to smart grid	ULOR
37	Information system dedicated to energy	Eng. Researcher, Elec. Eng. Workforce	**Create** a simple representation of an information system	ULOR
38	Information system dedicated to energy	Eng. Researcher, Elec. Eng. Workforce	**Describe** the principle of blockchain	ULOR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

39	Information system dedicated to energy	Eng. Researcher, Elec. Eng. Workforce	**Identify** features that make blockchain interesting in smart grid	ULOR
40	Information system dedicated to energy	Eng. Researcher, Elec. Eng. Workforce	**Explain** the information exchanges in IS associated to smart grid	ULOR
41	Information system dedicated to energy	Eng. Researcher	**Describe** elements of API	ULOR
42	Information system dedicated to energy	Eng. Researcher, Elec. Eng. Workforce	**Explain** the main aspects and factors of cyber security that affect smart grids	ULOR
43	Information system dedicated to energy	Elec. Eng. Workforce	**Experiment** with an API	ULOR
44	Information system dedicated to energy	Elec. Eng. Workforce	**List** data conversions and transformations involved in computer network of information system	ULOR
45	Management and decisional system	Broader public	**Describe** challenges related energy distribution, transportation, production management	ULJUB
46	Management and decisional system	Eng. Researcher, Elec. Eng. Workforce	**Explain** challenges related energy distribution, transportation, production management	ULJUB
47	Management and decisional system	Broader public	**Describe** the type of forecasting and there benefits	ULJUB
48	Management and decisional system	Eng. Researcher, Elec. Eng. Workforce	**Explain** the type of forecasting and there benefits	ULJUB
49	Management and decisional system	Broader public	**Identify** how is structured Ai domain	TUD
50	Management and decisional system	Broader public, Eng. Researcher, Elec. Eng. Workforce	**Describe** steps to choose and implement AI	TUD

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

51	Management and decisional system	Broader public, Eng. Researcher, Elec. Eng. Workforce	**Describe** the concepts of demand side management	TUD
52	Management and decisional system	Broader public	**Explain** decision making process and interest of multicriteria decision analysis	TUD
53	Management and decisional system	Eng. Researcher, Elec. Eng. Workforce	**Explain** forecasting techniques	TUD
54	Management and decisional system	Eng. Researcher, Elec. Eng. Workforce	**Explain** how is structured AI domain	TUD
55	Management and decisional system	Eng. Researcher, Elec. Eng. Workforce	**Explain** how to choose and implement AI methods	TUD
56	Management and decisional system	Elec. Eng. Workforce	**Experiment** the usage of AI methods on energy data	TUD
57	Management and decisional system	Eng. Researcher, Elec. Eng. Workforce	**Explain** decision making process and interest of multicriteria decision analysis	TUD
58	Management and decisional system	Elec. Eng. Workforce	**Experiment** MCDA methods a case study (for instance infrastructure investment)	TUD
59	Policy and economy in energy	Broader public, Eng. Researcher, Elec. Eng. Workforce	**Explain** the business case and type of business from IoT sector and that will come to the energy sector	KTU
60	Policy and economy in energy	Broader public, Eng. Researcher, Elec. Eng. Workforce	**Describe** main rules associated to GDPR	KTU
61	Policy and economy in energy	Eng. Researcher, Elec. Eng. Workforce	**Identify** keys aspects of GDPR and how it modifies the Information system	KTU

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

62	Policy and economy in energy	Eng. Researcher, Elec. Eng. Workforce	**Describe** different taxes applied to energy	KTU
63	Policy and economy in energy	Broader public, Eng. Researcher, Elec. Eng. Workforce	Energy Policy, electricicty prices, regulation: **Understand** EU main policies and how it affects electricity prices and how they are regulated	KTU
64	Policy and economy in energy	Eng. Researcher, Elec. Eng. Workforce	Electricicty market pricing and long term demand forecasting: **Explain** how different consumers experience the electricity market and how the operators can benefit from available data	KTU
65	Policy and economy in energy	Eng. Researcher, Elec. Eng. Workforce	Power planning and Congestion management: **Explain** how the consumer and producer behaviour creates challenges for the and how they are mitigated	KTU
66	Policy and economy in energy	Eng. Researcher, Elec. Eng. Workforce	Electricity financial market and risk management: **Explain** How wholesale and retail electricity markets operate in the digitalised smartgrid and understanding future prospects	KTU
67	Policy and economy in energy	Broader public, Eng. Researcher, Elec. Eng. Workforce	Cost and benefit analysis: **Understand** how investments made into the grid and investments that are not made into the smart grid affect the grid tarif and the well-being of the electricity grid	KTU

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

68	Policy and economy in energy	Broader public, Eng. Researcher, Elec. Eng. Workforce	**Explain** the benefits of smart meters for consumers	KTU
69	Policy and economy in energy	Eng. Researcher, Elec. Eng. Workforce	**Explain** Clean Energy Package	KTU
70	Policy and economy in energy	Eng. Researcher, Elec. Eng. Workforce	**Explain** European Green Deal	KTU
71	Policy and economy in energy	Broader public, Eng. Researcher, Elec. Eng. Workforce	**Understand** Environmental issues	KTU
72	Policy and economy in energy	Broader public, Eng. Researcher, Elec. Eng. Workforce	**Describe** the societal challenges and role of consumers behaviour	KTU

Table 1. Allocation and responsibility of the material.

2.3.1. Video production and integration of the programs to the portal and CANVAS

Although videos seem to be a state-of-the-art element to attract attention notably to broader public, a continuous education program can't be limited to videos. Instructional requires further activities to guarantee a minimum of learning. However, putting together videos, lectures, quiz and any other links or schema requires tools known as Learning Management System (LMS).
The key interests of using a LMS are the ability to structure the instructional path, control the user traffic, monitor the progress, and provide self-evaluation activities in addition to features link video embedding and creation of lecture pages. LOBA firstly proposed the Zoho platform. However, a benchmark of the LMS benchmark from the literature as well as experimentations and reviews disqualified this platform. Various platforms were compared such as Sakai, Chamilo, Canvas, Claroline. Finally, it was preferred to use CANVAS LMS because it provides expected features mentioned above such as evaluation activities, progress saving, usage simplicity, modularity. It was also chosen because it is an open-source tools which is freely available online and can also be quite simply installed on local infrastructure. This choice consolidates the ambitions to spread the program and its content to other structures or universities. This platform has been linked to the smgarinet.eu portal.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

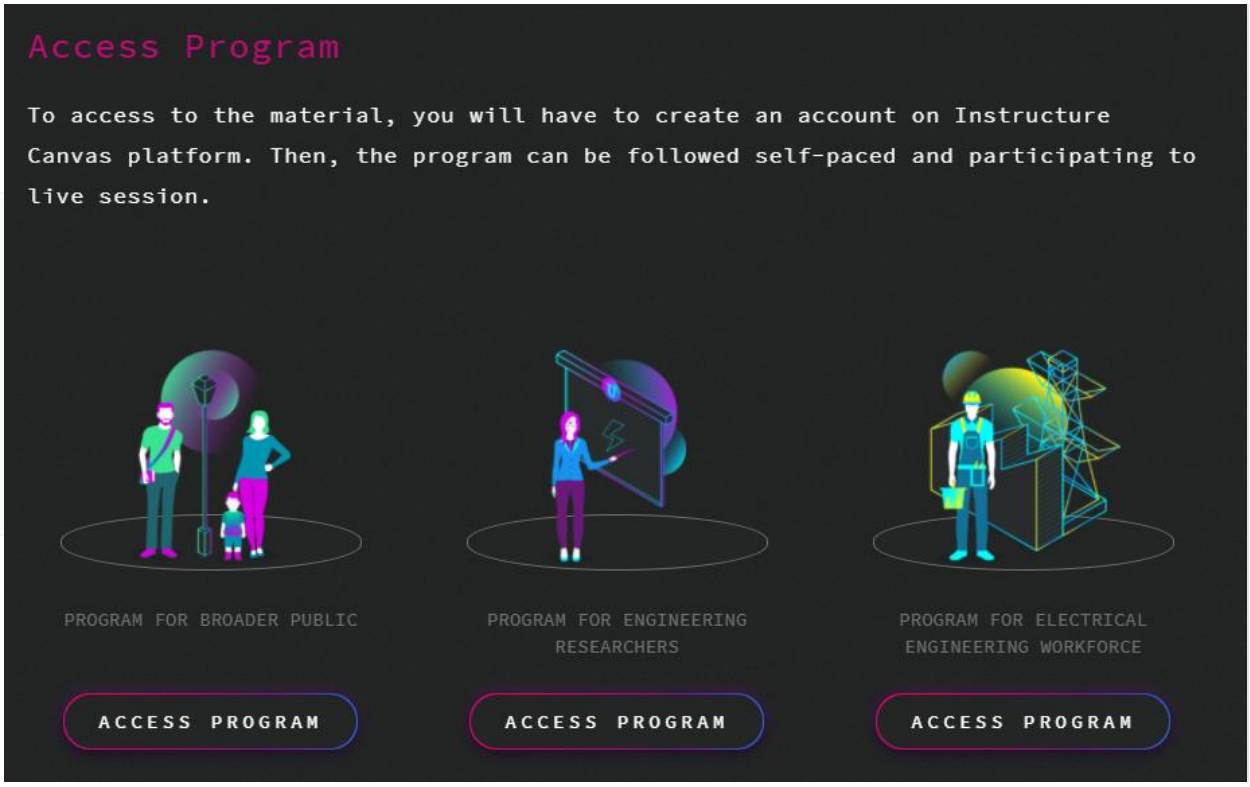

Figure 1. Access to SMAGRINET short-term-programs from smgarinet.eu portal.

Led by LOBA, the production of 36 videos for each objective started as soon as the material was sent to and finalised by ULOR. The design process, proofreading and execution of the videos was mainly performed by ULOR, LOBA and all partners.

All the videos can also be accessed through SMAGRINETS Youtube channel:

LINK: https://www.youtube.com/channel/UC3ZJduqSgycMzqruxDeKDXw

2.4. Participation and certification for the stakeholders

The programme will be accessible through the Smagrinet portal where participants can choose the preferred program then participants are invited to enrol to the program on the CANVAS LMS platform.
Each program has an introduction that states the target objectives and explains the structure and contents of each program.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

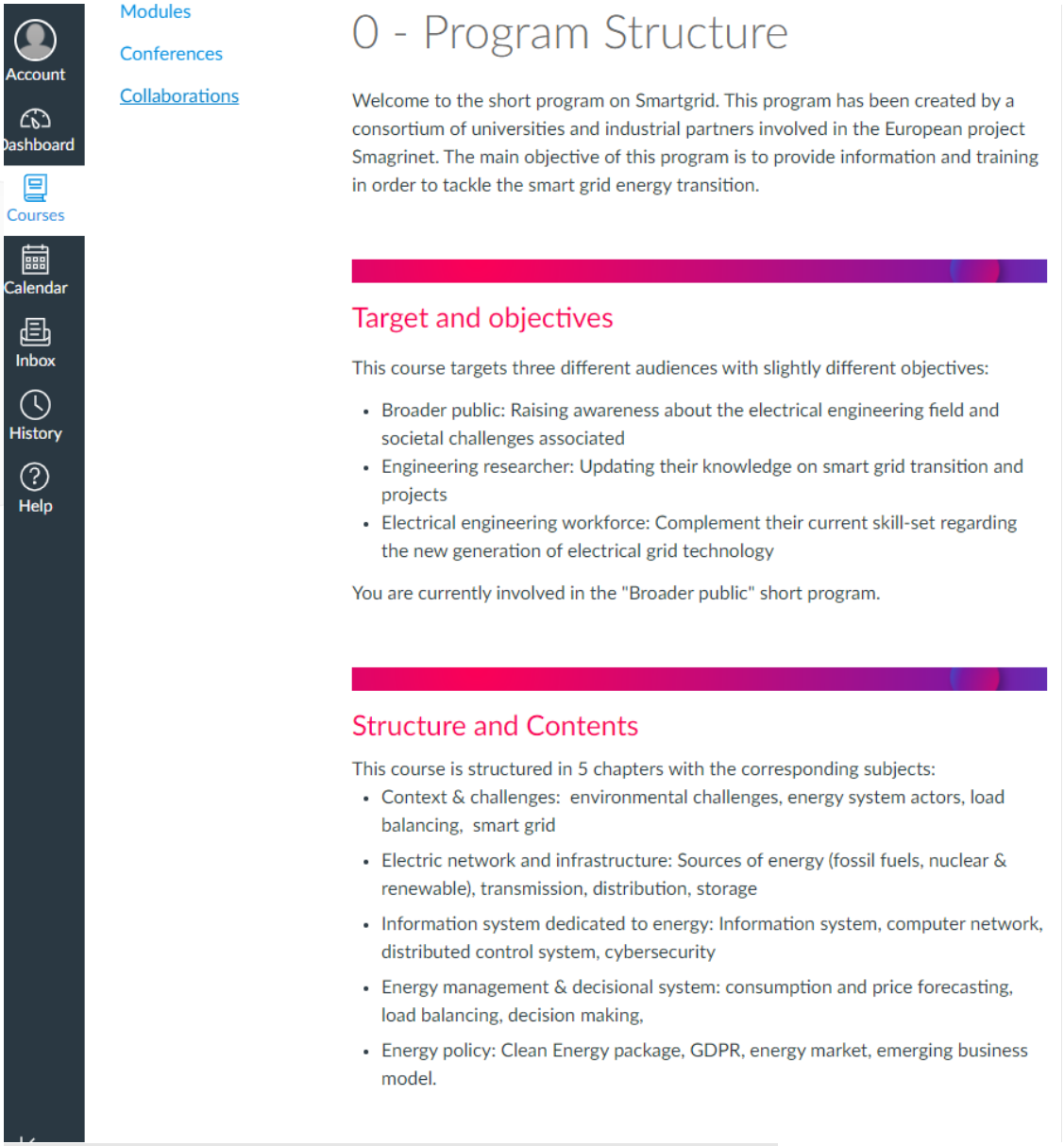

Figure 2. Program structure introduction on CANVAS.

If the participant is satisfied with the expectation of the course one may start with the contextual work of the study program.

Each program has a set of targets; these targets are divided into learning blocks which have the blended learning method integrated. By going through the lectures, videos and quizzes one can be expected to take the completion quiz in order to advance to the next block.

Some blocks have prerequisites and cannot be accessed before completing a pre-requisite block.

By the end of each course, a participant is expected to fill in the 'Certificate of Completion' form for the issuing of the SMAGRINET certificate of completion of a certain course.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

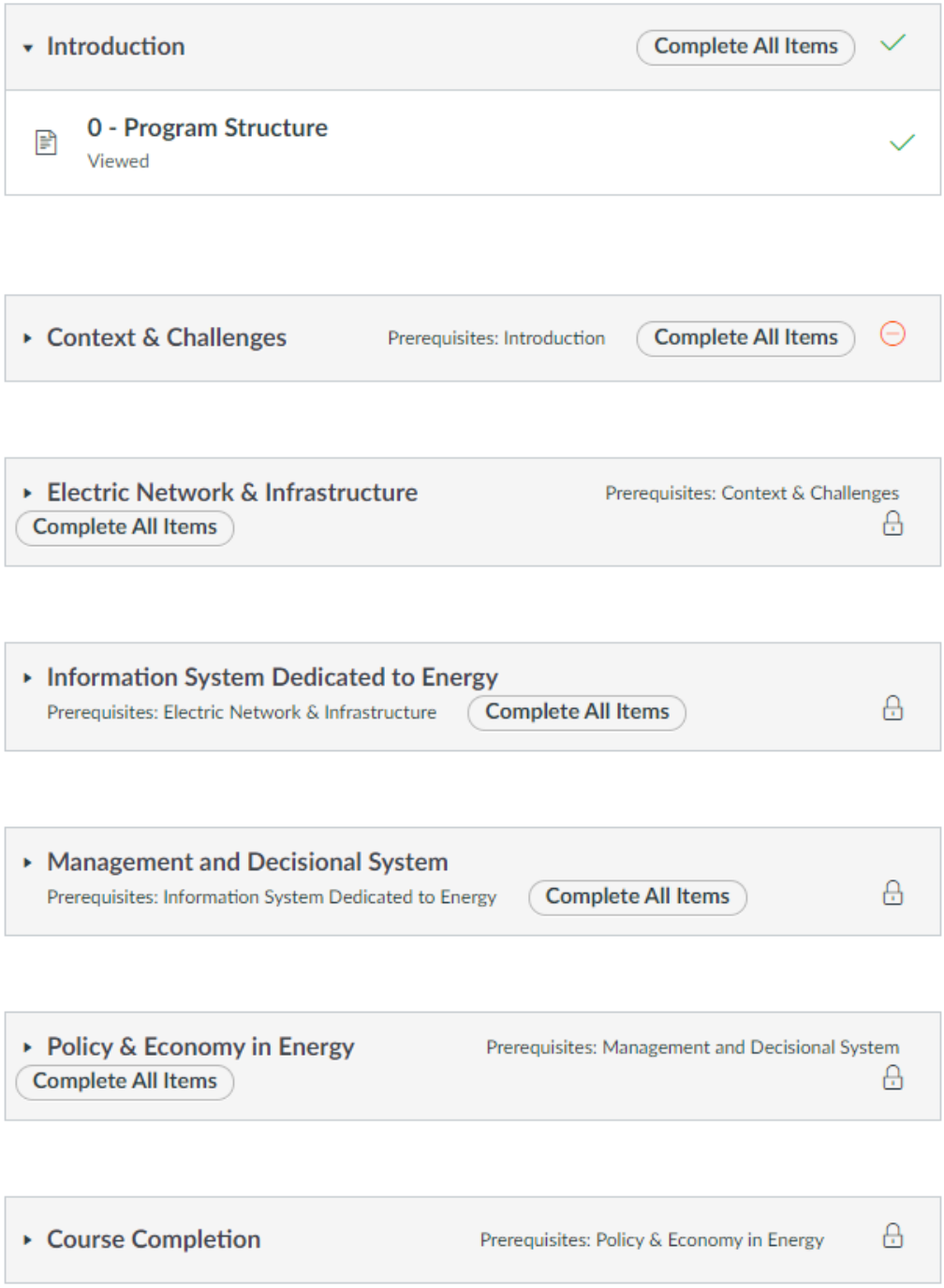

Figure 3. Task board of the CANVAS platform.

Upon completion of the training, the participant will receive a certificate of attendance to recognize and highlight their participation.

As highlighted by feedback and discussions, the programs provide quizzes, and deliver a certificate of completion but the edition of the certificate is not conditioned by the grades obtained in quiz.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

In order to obtain certificates a threshold of 70% of correct answers has been set up to obtain a SMAGRINET certificate of completion of a short-term program course.

3. Piloting phase

Although the progress has been belated from the original time schedule, it was of the utmost importance that the modules are of the upmost quality and repackaging the material with feedback on the solution produced the outcome that we are able to provide today.
Industry stakeholders among which the SMAGRINET AB companies also reside a total of over 300 participants have already pledged by HR and management from companies like: Elektrilevi, VKG energy, Estonian Cell, Elering, ABB network construction equipment, WEG Wurth Group. These people will be re-educated with the short-term programs in the next 4 months.

4. Conclusion

The smart grid topic is wide, covers various knowledge areas and some aspects need continuous progress (with hydrogen and CCS). Previous exchanges we've had with power facility industries and stakeholders highlighted the need for interdisciplinarity, and even transdisciplinary profiles.

But there are some obstacles in training interdisciplinary profiles. How to simultaneously present the interconnection between the smart grid domains and provide effective skills to make these connections understandable?
Based on the workshops we've conducted over the past eighteen months among students with different curriculums, it was decided to adopt a systemic perspective in order to provide for a meaningful interdisciplinary learning approach. Our own challenge, as academics, is to transpose these experiments into a blended learning program.

ULOR and other partners have already had contact with the local industries and clusters so the consortium as a whole has some idea about the number of participants to come. Partners are advised to contact each countries industry and public entities themselves.

Some partners also concurred that local industry clusters are a good way to disseminate the short-term program materials. As engineers in the clusters renew or apply for their competency or professional certificate by participating and completing sector relevant courses. SMAGRINET is one of the safest and fastest options for them and can provide them with the quality content and educational points that they need during the COVID period to keep the power industry going.

The piloting phase for all of the programs is ongoing and shall be concluded by the correct time, making sure that WP4 will be finished on time from the project point of view.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626

ESTONIA
www.ttu.ee

SLOVENIA
www.fe.uni-lj.si

GERMANY
www.tu-dresden.de

PORTUGAL
www.loba.cx

ESTONIA
www.civitta.com

LITHUANIA
www.ktu.edu

GERMANY
www.sense.tu-berlin.de

ESTONIA
www.elektriliit.ee

FRANCE
www.welcome.univ-lorraine.fr

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 837626