SMAGRINET

POWERING SMART GRID
EXPERTISE IN EUROPE

TAL TECH

Univerza v Ljubljani

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ETL ESTONIAN ELECTRICITY INDUSTRIES

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DELIVERABLE 4.4.

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1. Introduction

T4.3 Evaluation of the pilots and adjustment of the programmes – is the part of **WP4** Capacity building programmes for responding to urgent challenges.

Smart Grids represent intelligent grids, which are equipped with smart sensors for data acquisition, an information technology infrastructure and control algorithms. They can e.g. help to optimize the utilization of renewable energies and therefore support the energy transition. However, the topic of Smart Grids covers also many other different aspects, which makes it very challenging but also very interesting.

The SMAGRINET project aims to create a smart grid competence hub addressing the area of smart and flexible energy systems with interrelations between renewable energy and energy storage to enhance capacity of the European universities to engage with industry and key societal actors and to respond to the challenges of the energy transition.

The SMAGRINET project has the following **operational objective:**
to update, develop and implement a **capacity building programme** for boosting the research, innovation and education for energy transition.

To increase the awareness for issues related to Smart Grids and the ongoing energy transition, a **short-term blended learning program "SMART GRID from A to Z"** for 3 different target groups (broader public, researchers and workforce in the field of electrical engineering) has been developed within the WP4.

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 based on the results of T2.3:

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

Consortium developed 36 videos to reach over 4 hours, 37 lectures and dozens of additional materials and links to external resources for 3 different target groups:

   ✓ Broader public: public decisions makers, managers, future students in the field, students with a background different then engineering

   ✓ Electrical engineering workforce: professionals from the energy domain who want to upgrade their knowledge on some aspects

   ✓ Engineering researcher: Engineer/researcher with little knowledge in the energy domain, namely the smart grid

   First pilot and evaluation period: January 2021 – May 2021.

2. Evaluation of the Pilots

The evaluation targeted at making data-guided proposals for the adjustment of the pilot courses regarding different dimensions such as content, pedagogical needs and usefulness.

After holding kick-off meetings and clarifying the requirements of the evaluation of the short-term pilot courses, a general strategy was developed and shared with partners. An overview of the strategy was presented in the consortium in September 2020. The evaluation is set up in two parts addressing different target groups: Next to the participants of the pilot courses, the course developers of the consortium were invited to provide their opinion. In the next paragraphs, we will explain our procedure of questionnaire development and data collection. Next, we will provide the results and the recommendations ultimately derived from these results in order to make the most out of the SMAGRINET short-term programs.

Instead of focusing on one specific model of evaluation, we decided that a tailored approach would best fit the need of the task. To give an example of our reasoning, we discussed the usage of a very popular evaluation model from Kirkpatrick and Kirkpatrick with our partners when developing our evaluation approach.

The evaluation model of Kirkpatrick uses four levels of analysis: Reactions of participants, their learning, their behaviour and their (transfer) results. While the model is widely used and acknowledged, we still decided to use it as an orientation but not as our main approach. Our reasons were as follows:

Besides the fact that it takes a long time to measure behaviour changes and transfer success, the most difficult part is about cause and effect: To get it right, you would have to prove that a change in behaviour after taking a course is actually caused by that course itself. In order to achieve that, one would have to conduct a baseline measurement to find out how successful the behaviour/ knowledge/ attitude towards the subject already was. Also it would be necessary to exclude possible other reasons for a change in working behaviour (such as other trainings, stress, motivational issues, …). Additionally, there should be a control for possible character traits that may influence working behaviour (e. g. openness to new experience) as well as a comparable control group with similar tasks that does not take the course.

In short, models like the Kirkpatrick one are developed for a quite large and long-lasting evaluation team. Usually these models apply best in big companies for where they are developed. Still, it served as a major orientation for our own evaluation strategy, but within our limits of time and resources.

2.1. Participants' evaluation of the pilots

Every participant in every pilot course (broader public (BP), early stage researchers (RSCH), current electrical engineering workforce (WKFR)) was invited to take part in the evaluation. It was built directly into the courses within the learning management system in use (LMS Canvas). After every passed module (incl. knowledge quiz part), a module-related evaluation questionnaire with 5-6 items

could be filled out before continuing with the next module. One of these items addressed the individually perceived adequacy of the knowledge quiz part. The second item focused on the module learning goals as previously defined by our partners. In total, there were 15 questionnaires (for each of the 5 modules in each of the 3 pilot courses for BP, RSCH and WKFR). For illustration, see the exemplary questionnaire in the Appendix Figure 1. Items produced subjective quantitative and qualitative data regarding the strengths and developmental opportunities of the module.

Following data protection laws, participants were informed about the use of data. Data collection was conducted anonymously and voluntarily. As a consequence, the number of people participating in the evaluation is not necessarily equal to the overall number of people participating in the pilots. When looking at the results, please be aware that there might be self-selection effects. Some participants may be more eager to share their opinion than others. For example one might be very pleased or very dissatisfied with the course and therefore have a stronger motivation to share one's thoughts.

After participant data collection was finished, it was exported from LMS Canvas and preprocessed. As the start of participant recruiting and teaching of the courses varied greatly between universities, some teaching activities were still ongoing when we downloaded the module questionnaire data.

Quantitative data was analyzed and visualized using Microsoft Excel and IBM SPSS. Qualitative answers (stemming from open questions) were clustered.

2.1.1 Broader Public Course (BP)

The evaluation data of the first piloting round reported here is based on the courses organized by TUD-TUB, KTU, TalTech, ULOR and ULJUB for Broader Public (BP). The two biggest samples of participants within the **closed question** part over all modules were from TalTech (43%-47%; $N_{\emptyset} = 29$) and ULOR (37%-42%; $N_{\emptyset} = 24$). For the number of participants of the modules for each university see table 1. Empty answers were excluded from the analysis.

Table 1: Closed questions – number of participants per university and module.

	module 1		module 2		module 3		module 4		module 5	
	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent
TUB -TUD	2	2,9	2	3,0	1	1,6	1	1,6	0	0,0
ULJUB	9	13,2	8	12,1	8	12,7	7	11,3	5	8,8
KTU	3	4,4	2	3,0	1	1,6	1	1,6	1	1,8
TalTech	29	42,6	29	43,9	29	46,0	29	46,8	27	47,4
ULOR	25	36,8	25	37,9	24	38,1	24	38,7	24	42,1
Total	68	100,0	66	100,0	63	100,0	62	100,0	57	100,0

In comparison to the **closed questions,** in the section open question which was asked with „Is there anything you would like to change about the module you

just finished?" fewer participants took part. In average over all modules 17 participants left a comment for changing something within modules (see table 2).

Table 2: Number of participants who participated in the question „Is there anything you would like to change about the module you just finished?" of BP per module.

	participants			
	took part (n)	want to change sth./ have comments (n)	have no objec- tion (n)	no answer (n)
Module 1	36	25	9	2
Module 2	32	19	9	2
Module 3	27	16	10	1
Module 4	25	11	12	2
Module 5	27	14	10	3

These participants mentioned that they were dissatisfied with some aspects of the modules. These comments were summed up in categories concerning language, understanding the context, quizzes, visualization and others. The times these categories are mentioned for each module can be seen in figure 1.
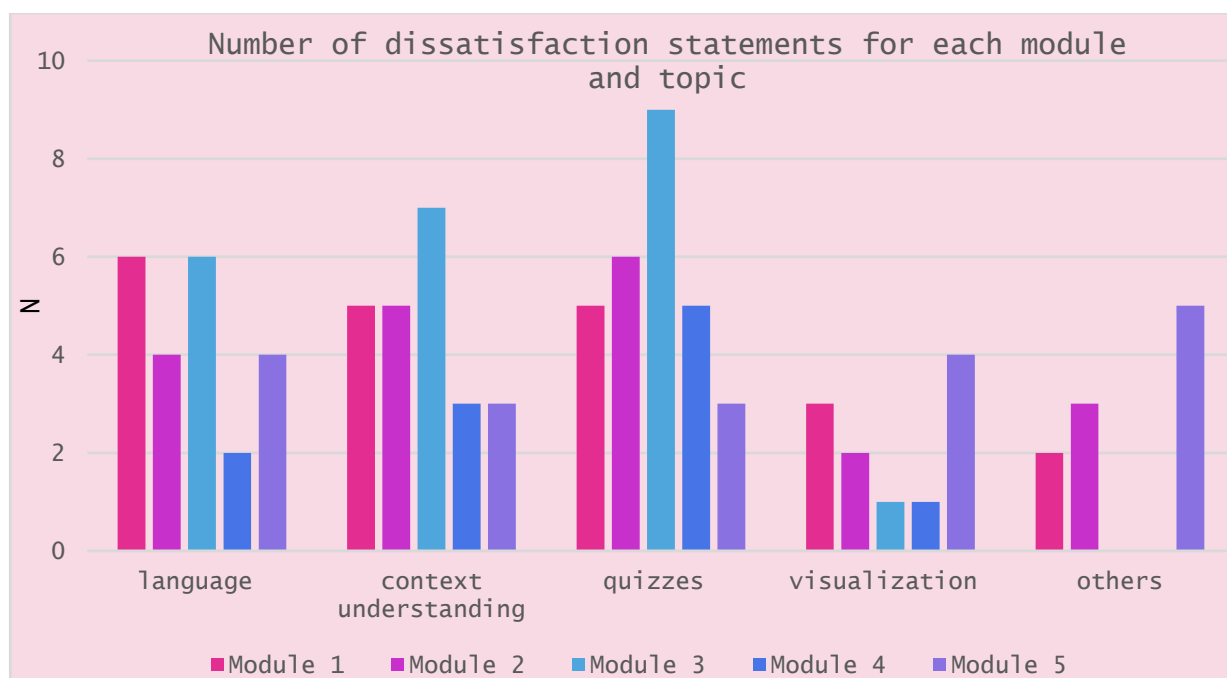
Figure 1: Distribution of dissatisfaction statements.

BP Module 1: Context and Challenges

Closed Questions: Module 1 was generally described as understandable (89,6 % agree or agree strongly), one person (1,5%) said that he/she did not understand the module. For 87,9 % the module was useful and 3 % (n = 2) disagreed that it was useful.

62 participants (92,5 %) strongly agreed and agreed that they have learned about the impacts of smart grid at different scales (home, building, city, territory) and 5 persons (7,5 %) were undecided about that.

94 % of the participants (n = 63) said that they learned about the role of smart grid in energy transitions. Four participants (6 %) were undecided if they have learned about the role of smart grid in energy transitions.

4,5 % (n = 3) found the quiz easy and 46 participants (68,7 %) found it moderate. 26,9 % (n = 18) found the quiz difficult or very difficult. None of the participants experienced the quiz as very easy.

For comparisons, see figures 2 and 3 for details. (For the correlation matrix between the five closed questions, see appendix, table 1.)

Open Question: As shown in figure 1, all categories were mentioned for improvement of module 1.

The category language was mentioned the most. The wording was described as too difficult, glossary was useful but not complete (– one person named a lot of suggestions in detail that can be seen in the appendix table 2).

The quizzes were perceived as quite difficult (this was also shown in the closed question). It seems that some questions are too specific and for some questions, the contents were missing in the course.

Recommendations for Module 1:

To improve Module 1 a few participants expressed the wish that the language of the course/module should be translated in their mother tongue.

In the category visualization participants wished that the graphical data should be presented a bit longer, because some mentioned that it was shown too fast. Furthermore the texts could be equipped with pictures from the videos, which would eliminate the need to re-watch the videos.

A suggestion for improvement of the quizzes is that it would help if there were more attempts, especially in the beginning.

For detailed suggestions of the participants table 2 can be found in the appendix.

Figure 2: Participants' views on BP Module 1.

"How did you experience the module quiz(zes) you passed within this module?" (BP Module 1; n = 67)

Figure 3: Participants' views on the knowledge quiz part of BP Module 1.

BP Module 2: Electric Networks & Infrastructure

Closed Questions: Module 2 was described as understandable (81,8 % agree or agree strongly), 7,6 % of the people (n = 10) said that they did not understand the module. For 89,4 % the module was useful and 4,5 % (n = 3) disagreed that it was useful.

87,9 % (n = 44) mentioned that they can identify technical elements that are part of the smart grid. 10,6 % (n = 7) were undecided and one participant (1,5 %) disagreed with that.

60 people (90,9 %) agreed or strongly agreed that they have learned about the main functioning modes of electric grids (transmission, distribution) and nobody (strongly) disagreed with that.

The knowledge quiz part of the module was mostly characterized as moderate (62,1 %, n = 41), 10,6 % (n = 7) of participants used the term very easy or easy. 27,3 % (n = 18) found the quizzes difficult or very difficult.

See figures 4 and 5 for details. (For the correlation matrix between the five closed questions see appendix table 3)

Open Question: As seen before in module 1, language problems were named mostly in module 2 because the module was not in the native language. Also it was mentioned some chosen words were quite hard/ difficult to understand.

Furthermore, better explanations were missing especially for certain devices (e.g. storage devices). Besides, it was very hard to follow when the participants had no background on the topic.

Relating to the quizzes, it was mentioned many times that the questions/ the needed information to pass the quiz was not covered in the materials at all.

For more details, see table 4 in the appendix.

Recommendations for Module 2: For passing and understanding module 2 it is necessary that all knowledge/ materials concerning the quizzes should be included

in the courses. In addition, it could help if the content would be explained in more detail.

Figure 4: Participants' views on BP Module 2.
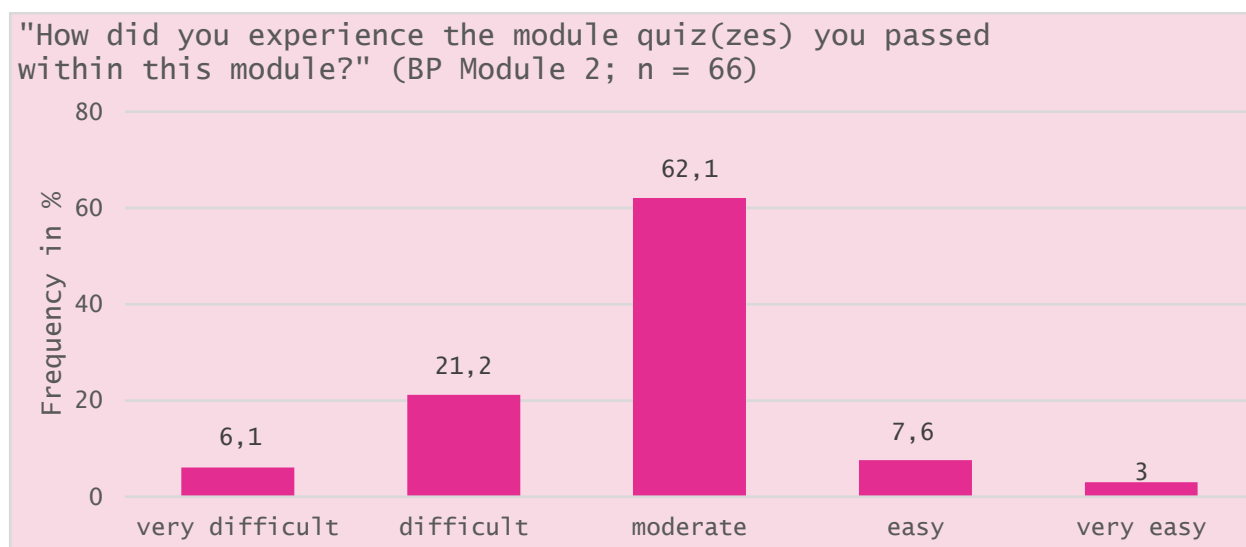
Figure 5: Participants' views on the knowledge quiz part of BP Module 2.

BP Module 3: Information System Dedicated to Energy

Closed Questions: Module 3 was described as understandable (46 % agree or agree strongly), 15,9 % of the participants (n = 10) said that they did not understand the module. Hence, this module is less understandable than module 1 and 2. For 69,8 % the module was useful and 7,9 % (n = 5) disagreed that it was useful. 77,9 % (n = 49) mentioned that they can identify technical elements that are part of the smart grid. 15,9 % (n = 10) were undecided and four participants (6,3 %) disagreed with that.

43 people (76,2 %) agreed or strongly agreed that they have learned about the main functioning modes of electric grids (transmission, distribution) and four participants (6,3 %) disagreed with that.
The knowledge quiz part of the module was mostly characterized as moderate or difficult (79,4 %), 9,5 % of participants used the term very easy or easy.
See figures 6 and 7 for details. (For the correlation matrix between the five closed questions see appendix table 5)

Open Question: Quite a few times it was mentioned that there are a lot of typos and grammatical mistakes in the lectures and quizzes.
For many participants this module was very hard to understand, mostly because of too many technical terms.
Concerning the quizzes it was mentioned that some answers were not clearly given in the lessons, also the quizzes themselves seemed to be confusing for some participants.
Another aspect that was mentioned was that videos for better understanding, clarity etc. were definitely missing.
For more details, see table 6 in the appendix.

Recommendations for Module 3: To improve Module 3 the language mistakes should be corrected which would result in a better understanding of the whole module. In addition, module 3 was without any videos and participants mentioned that it would have been a lot easier to understand the topic if there would had been a video at all. Thus it is recommended to add a video.
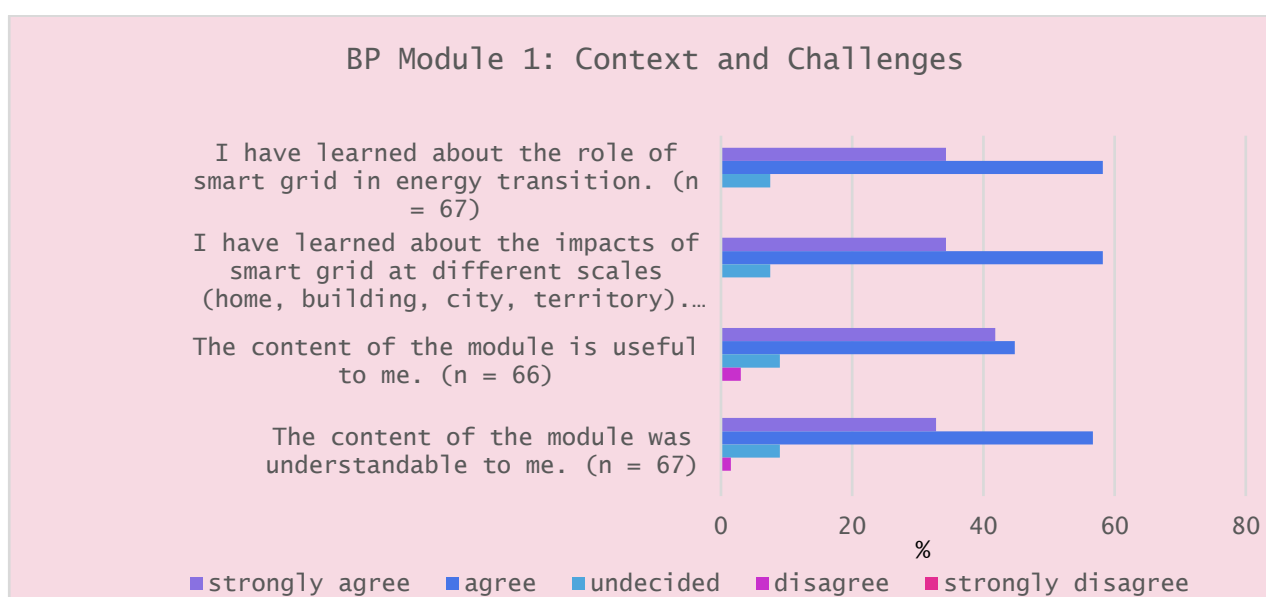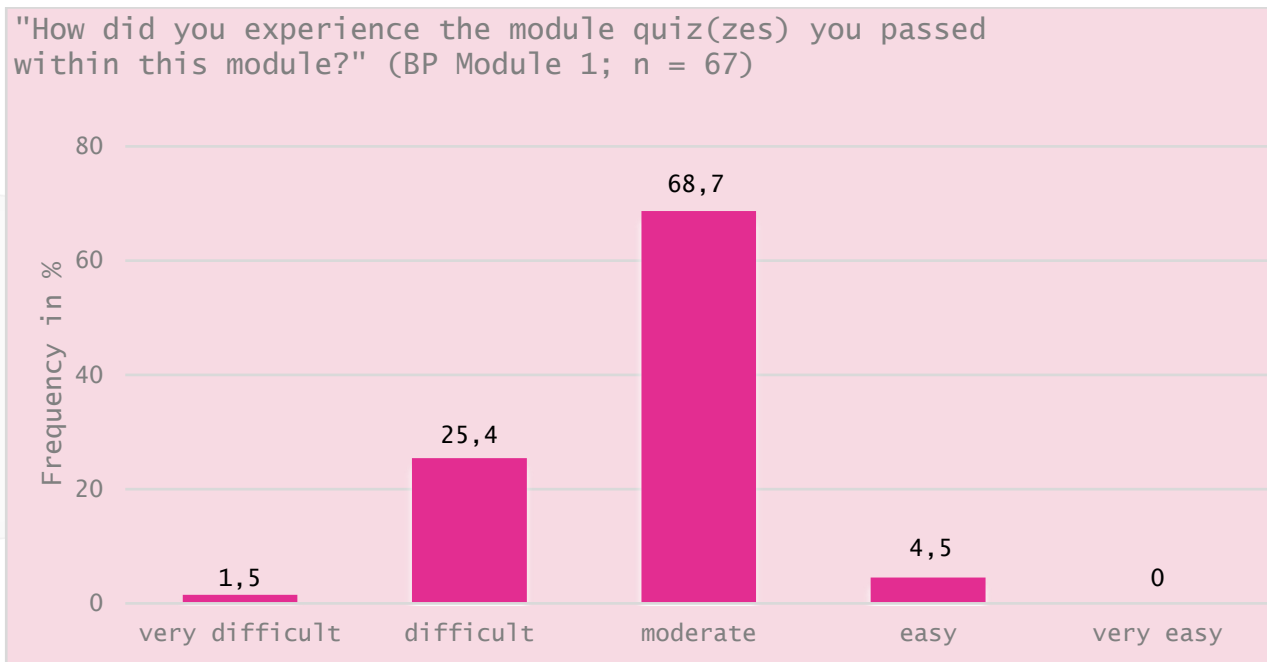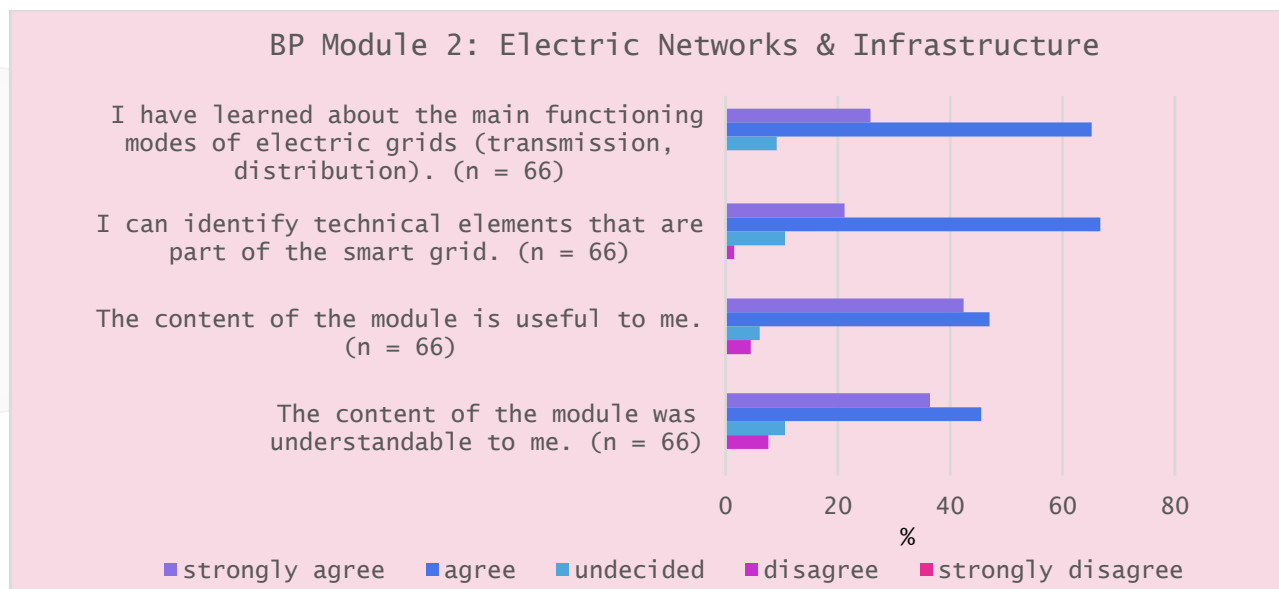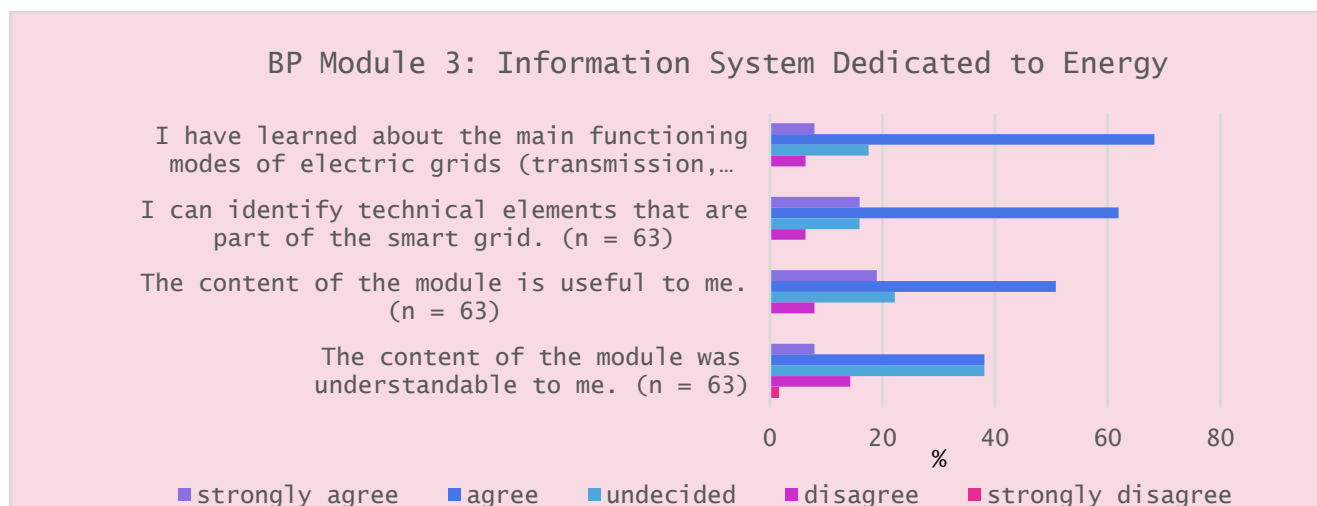

Figure 6: Participants' views on BP Module 3.
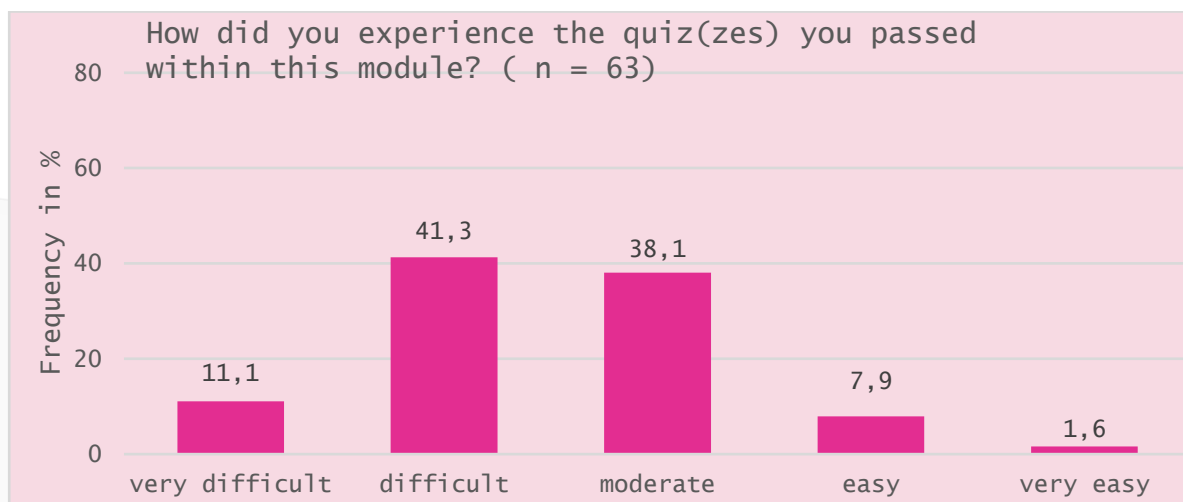
Figure 7: Participants' views on the knowledge quiz part of BP Module 3.

BP Module 4: Management & Decisional System

Closed Questions: Module 4 was described as understandable (77,4 % agree or agree strongly) and 19,4 % (n = 12) were undecided.
For 69,4 % (n = 43) the module was useful and 3,2 % (n = 2) disagreed that it was useful.
82,3 % (n = 51) of the participants mentioned that they learned about the usage of data analysis for optimization and network efficiency. Nobody totally disagreed with that.
The knowledge quiz part of the module was mostly characterized as moderate or difficult (72,5 %, n = 45), 16,1 % of participants (n = 10) used the term very easy or easy. For seven people (n = 11,3 %) the quizzes were very difficult.
See figures 8 and 9 for details. (For the correlation matrix between the four closed questions see appendix table 7)

Open Question: In the language section, participants stated that they had problems understanding the courses because of too many technical words which were used in English only.
It was also mentioned that the questions and answers can be quite confusing as the wording and expressions were perceived as "weird".
For more details, see table 8 in the appendix.

Recommendations for Module 4: To improve Module 4 it would help to implement more examples (especially to "power systems") for better understanding and to get the "bigger idea" as it was mentioned. Furthermore, it would be useful to revise the wording in the quizzes to not arise any confusion.

BP Module 4: Management & Decisional System

I have learned about the usage of data analysis for optimization and network efficiency. (n = 62)

The content of the module is useful to me. (n = 62)

The content of the module was understandable to me. (n = 62)

strongly agree   agree   undecided   disagree   strongly disagree

%

Figure 8: Participants' views on BP Module 4.

"How did you experience the module quiz(zes) you passed within this module?" (BP Module 4; n = 62)

Frequency in %

very difficult 11,3   difficult 29   moderate 43,5   easy 14,5   very easy 1,6
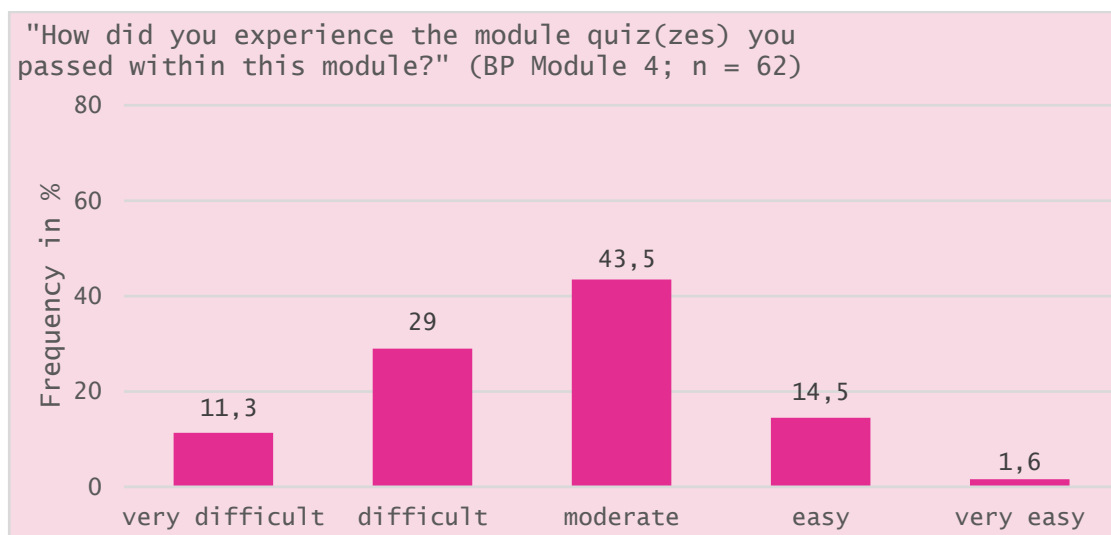
Figure 9: Participants' views on the knowledge quiz part of BP Module 4.

BP Module 5: Policy & Economy in Energy

Closed Questions: Module 5 was described as understandable (91,2 % (n = 52) agree or agree strongly) and useful (87,7 % (n = 50) agree or agree strongly) by the participants. Nobody totally disagreed that the module was understandable and useful.

91,2 % (n = 52) of the participants did strongly agree or agree that they have learned about the main trends of EU policy that influence smart grid territories.

53 participants (93 %) strongly agreed and agreed that they have learned about the EU development plan of smart grid.

49,1 % (n = 28) found the quizzes (very) easy, 36,8% (n = 21) said that it was moderate and 14.2 % (n = 8) mentioned that they experienced the quizzes as difficult or very difficult.

For comparisons, see figures 10 and 11 for details. (For the correlation matrix between the five closed questions, see appendix table 9.)

Open Question: In general, grammar and spelling mistakes were mentioned many times within the module. Also some terms and concepts were difficult to understand for the participants. It was also noted that some slides were double ("the same video and then the same text without any video"). A concrete error was mentioned: "Would there not be an error in the graph representing the "net present value" method. I seem to have seen a thumbs up when NPV <0 and down for NPV> 0". Also one person mentioned that it is possible to speed up the male voice but not the female. Another annotation was: "I noticed a difference between the text and what the video says (especially the share of the renewable energy in the power sector: 18% or 25% ? 2016/2017?)".
This module was perceived as easier as module 2 and 3 and participants wished that module 2 and 3 were as easy/moderate as this module 5. For more details, see table 10 in the appendix.

Recommendations for Module 5: To improve Module 5, grammar should be corrected in general. The specific quotes of the participants should be noted and used to revise module 5.
Moreover, in this module as in all modules before, it could help to implement more examples to explain the context and consequently for better understanding of this module.
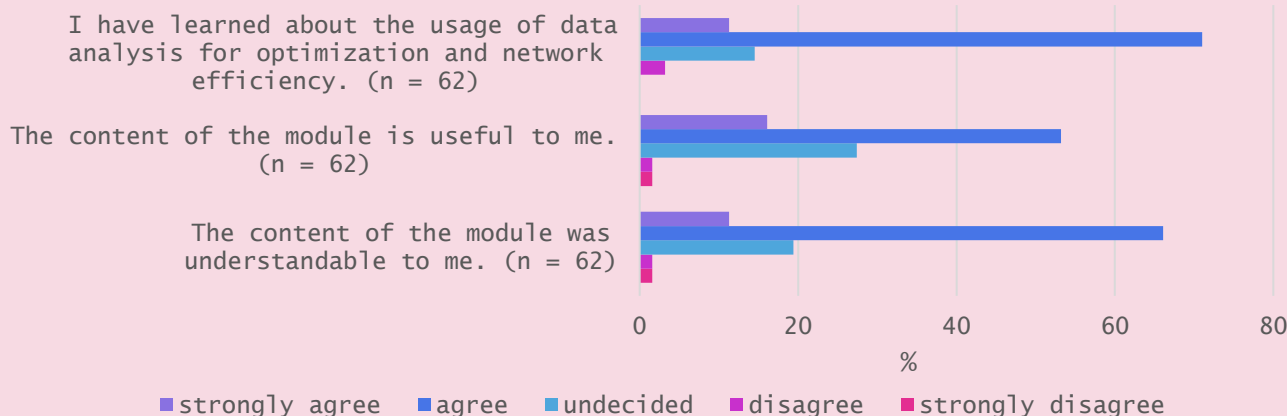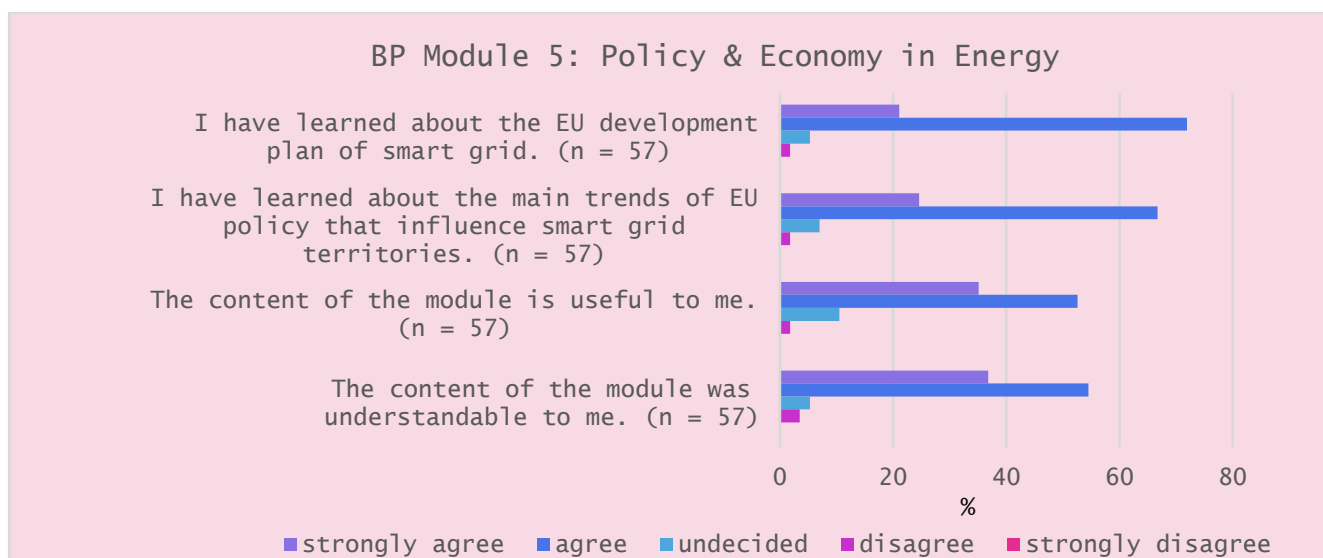

Figure 10: Participants' views on BP Module 5.
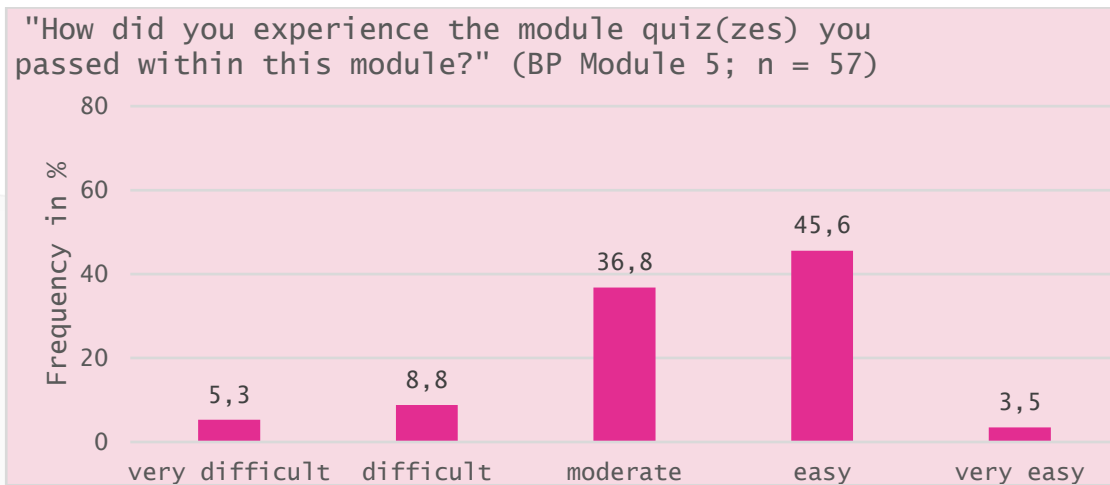
Figure 11: Participants' views on the knowledge quiz part of BP Module 5.

Further statistical analysis of comparisons between the 5 modules within the same questions

This chapter aims to show if there are significant differences between the five modules for the same asked questions to Broader Public. The sample size was sufficient to do this kind of analysis by using a single factor variance analysis with Bonferroni Post-Hoc-Tests. With this method, it is possible to compare the mean between the questions of the five modules (the descriptive statistic is seen in table 11 in the appendix, see also appendix table 12 for tests of homogeneity of variances).

The following questions were the same in each module:

- "The content of the module was understandable to me."
- "The content of the module is useful to me."
- "How did you experience the quiz(zes) you passed within this module?"

a) **Analysis question:** Are there any differences between the modules for the question „The content of the module is understandable to me?"

The analysis shows that the whole model of the question "The content of the module was understandable to me." relating differences between modules is highly significant with $F(4, 310) = 13.85$, $p = .000$.
15.2% of the construct of understanding the modules is explained by the five modules. That means that it significantly depends on the specific module a person joins how well or poorly the module is understood.
The next step is to have a look at these modules that show significant differences in this question. For this analysis, the Bonferroni Post-Hoc-Test is used (see appendix table 13).
The results of this analysis show that there are significant differences between module 3 and all other modules concerning the understanding of the module:

Results:
Module 3 (M = 2.63, SD = 0.89, N = 63) differs:
   - highly significant (p = .000) to module 1 (M = 1.79, SD = 0.66, N = 67)
   - highly significant (p = .000) to module 2 (M = 1.89, SD = 0.88, N = 66),

- o highly significant (p = .007) to module 4 (M = 2.16, SD = 0.71, N = 62)
  - o and highly significant (p = .000) to module 5 (M = 1.75, SD = 0.71, N = 57)

Furthermore there is a significant difference (p = .05) between module 4 (M = 2.16, SD = 0.71, N = 62) and module 5 (M = 1.75, SD = 0.71, N = 57) concerning the understanding of the module. Module 4 is significantly not so well understood as module 5.

Summary: In comparison to all other modules, module 3 is significantly understood the worst (see figure 12).
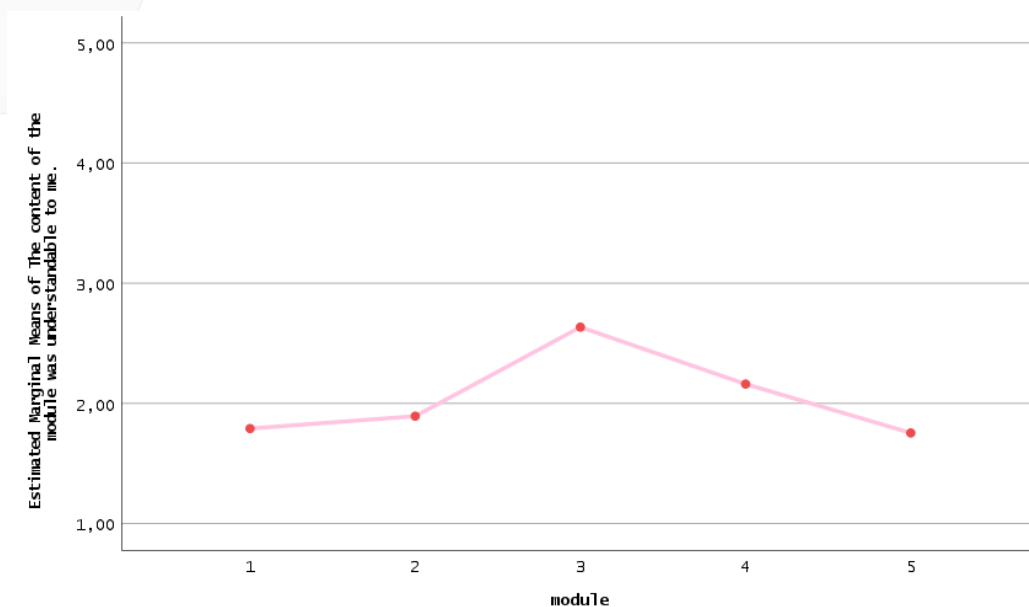
Figure 12: Estimated Marginal Means of "The content of the module is understandable to me." for each module.

b) **Analysis question:** Are there differences between the modules for the question "The content of the module is useful to me"?

The analysis shows that the whole model of the question "The content of the module is useful to me." relating differences between modules is highly significant with $F(4, 309) = 6.31$, $p = .000$.
7.6 % of the construct of usefulness of the modules is explained by the five modules. That means that the decision of usefulness significantly depends on the specific module a person joins.
The next step is to have a look which modules show significant differences in this question. For this analysis, the Bonferroni Post-Hoc-Test is used (see appendix table 14).
The results of this analysis show that there are significant differences between module 3 and all other modules (except module 4) and between module 4 and all other modules (except module 3) for understanding the module:

Results:
Module 3 (M = 2.19, SD = 0.84, N = 63) differs:

- o highly significant (p = .01) to module 1 (M = 1.73, SD = 0.76, N = 66)
- o highly significant (p = .01) to module 2 (M = 1.73, SD = 0.78, N = 66)
- o and significant (p = .05) to module 5 (M = 1.92, SD = 0.80, N = 57)

Module 4 (M = 2.19, SD = 0.79, N = 62) differs:
- o highly significant (p = .01) to module 1 (M = 1.73, SD = 0.76, N = 66)
- o highly significant (p = .01) to module 2 (M = 1.73, SD = 0.78, N = 66),
- o and significant (p = .05) to module 5 (M = 1.92, SD = 0.80, N = 57)

Summary: In comparison to all other modules (except module 4), module 3 is less useful. Furthermore in comparison to all other modules (except module 3), module 4 is less useful.

Annotation: There is no significant difference between module 4 (M = 2.16, SD = 0.71, N = 62) and module 3 (M = 2.19, SD = 0.84, N = 63). For visualization see figure 13.
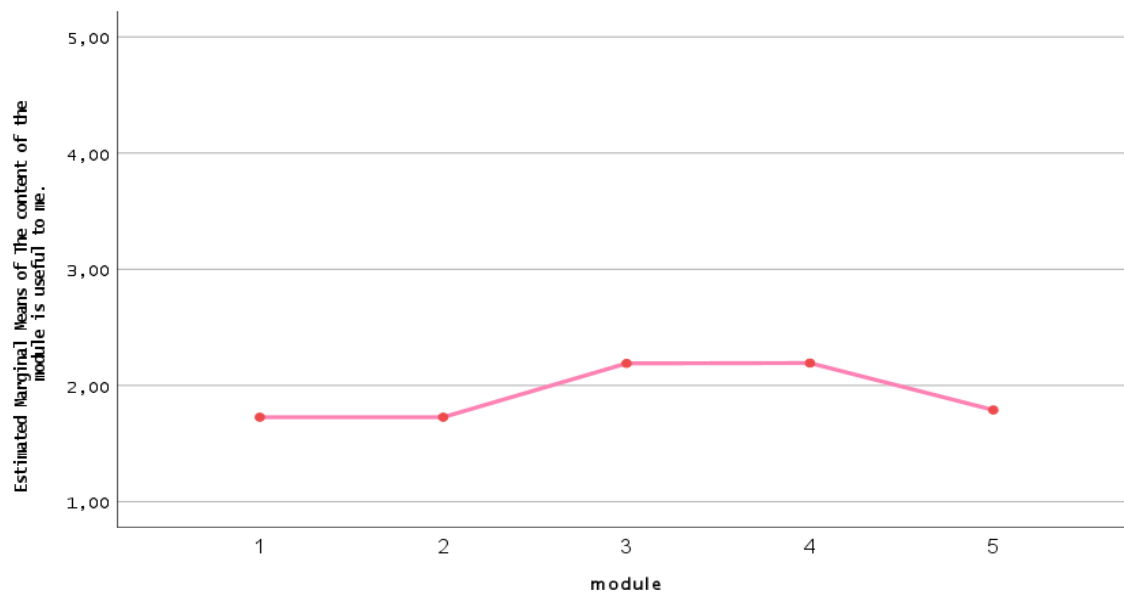
Figure 13: Estimated Marginal Means of "The content of the module is useful to me." for each module.

c) **Analysis question:** Is there a difference between the modules for the question "How did you experience the quiz(zes) you passed within this module?"

The analysis shows that the whole model of the question "Is there a difference between the modules for the question "How did you experience the quiz(zes) you passed within this module?" relating differences between modules is highly significant $F_{(4, 310)} = 6.03$, $p = .000$.

10.6% of the construct of experiences of the quiz(zes) of the modules is explained by the five modules. That means that it depends on the specific module a person joins how he/she experiences the quiz(zes) he/she passed within this module.

The next step is to have a look at which modules show significant differences in this question. For this analysis, the Bonferroni Post-Hoc-Test is used (see appendix table 15).
The results of this analysis show that there are significant differences between module 5 and all other modules for understanding the module:

Results:
Module 5 (M = 2.66, SD = 0.89, N = 57) differs:
- o highly significant (p = .001) to module 1 (M = 3.24, SD = 0.55, N = 67)
- o highly significant (p = .003) to module 2 (M = 3.20, SD = 0.79, N = 66)
- o highly significant (p = .000) to module 3 (M = 3.52, SD = 0.86, N = 63),
- o and significant (p = .000) to module 4 (M = 3.34, SD = 0.92, N = 62)

Summary: In comparison to all other modules, module 5 has significantly the easiest quiz(zes). There are no significant differences between the other modules. For visualization see figure 14.
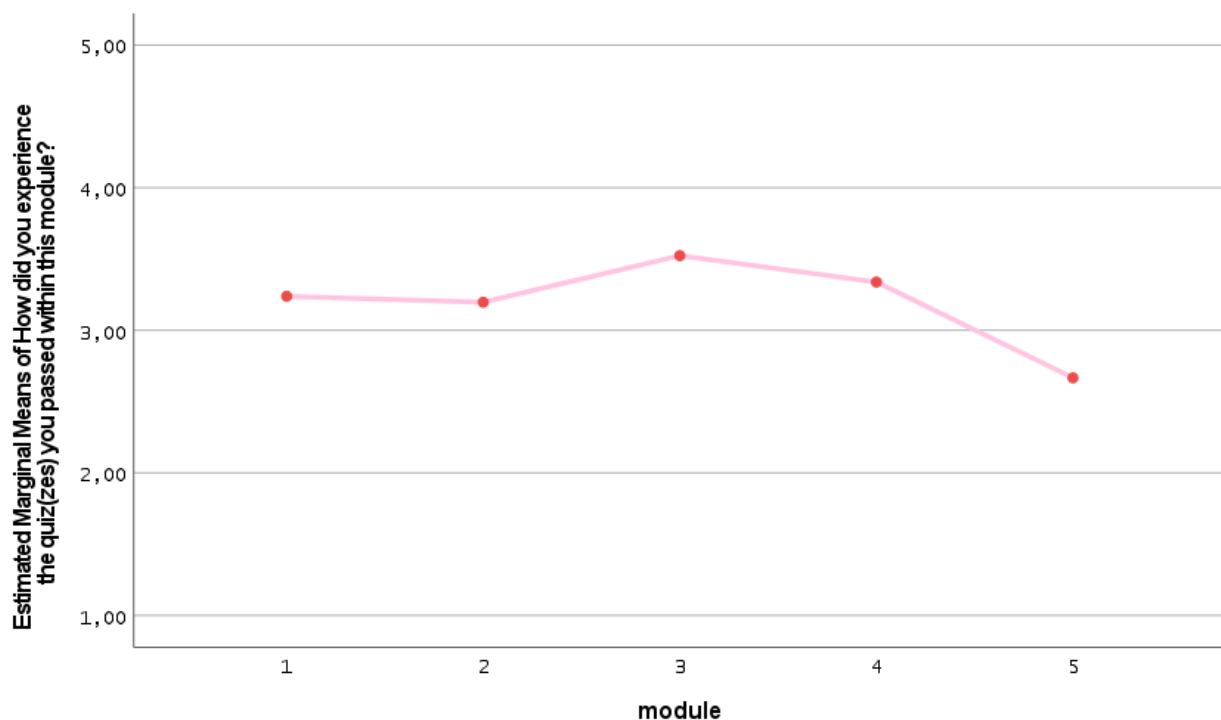
Figure 14: Estimated Marginal Means of "How did you experience the quiz(zes) you passed within this module?" for each module.

Recommendations for understanding, usefulness and quizzes:
The recommendation for module 5 is that it should be reworked for better understanding. This was also the conclusion in the analysis made at the beginning of chapter 1.1.1. that if the participants should have the effect of usefulness of a module, module 3 and 4 should be revised.

It is controversial if the quizzes of module 5 should be more difficult in order to adapt to the level of the other modules, or if the quizzes of the other modules need to be easier.

2.1.2.Early Stage Researchers Course (RSCH)

Due to the diverse timelines of the Early Stage Researchers Course (RSCH) in the partner institutions (because of the Coronavirus, course translations or a separate evaluation), the evaluation data of the first piloting round reported here is based on the courses organized by TUD-TUB, ULJUB, TalTech and ULOR. Consequently there is no data from KTU here.
Empty answers were excluded from the analysis. Importantly, the number of participants taking place in the evaluation surveys is not equal to the total number of participants, which is higher. Reporting of the open question results is clustered by mentions per category.

In comparison to the **closed questions,** in the section open question which was asked with „Is there anything you would like to change about the module you just finished?" fewer participants took part. In average over all modules, 3 participants left a comment for changing something within the modules (see figure 15).
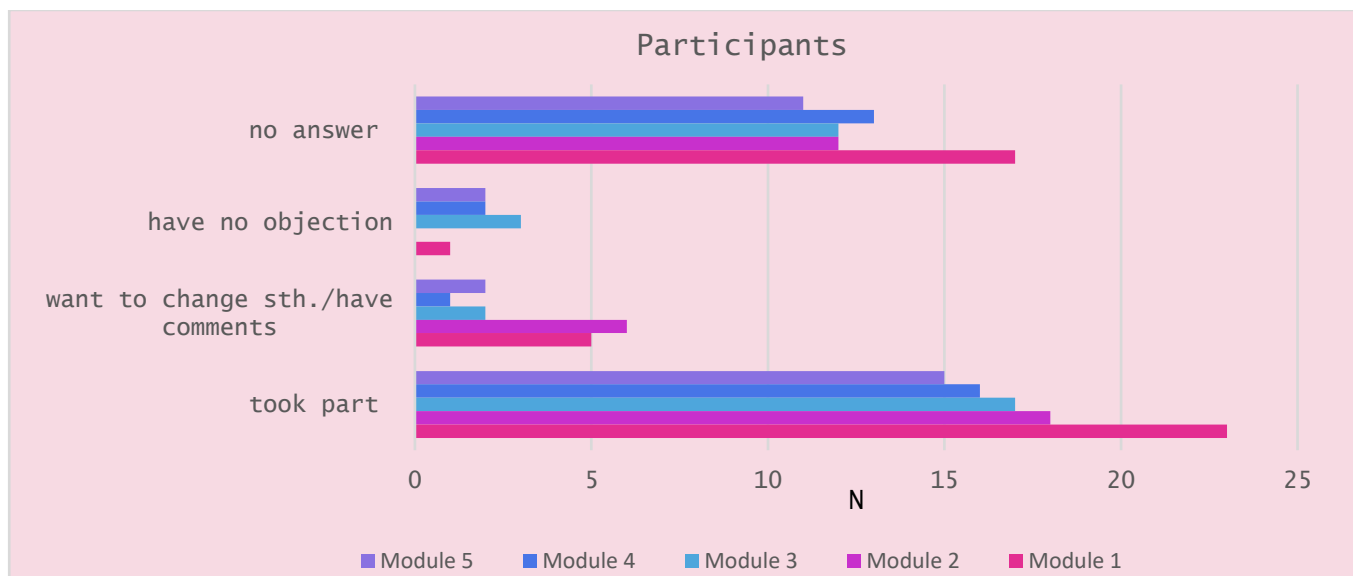
Figure 15: Number of participants who answered in the question „Is there anything you would like to change about the module you just finished?" of RSCH per module.

These participants mentioned that they were dissatisfied with things within some aspects of the modules. The comments were summed up in categories concerning language, understanding the context, quizzes, visualization and others. The number of mentions for these categories and each module can be seen in figure 16.
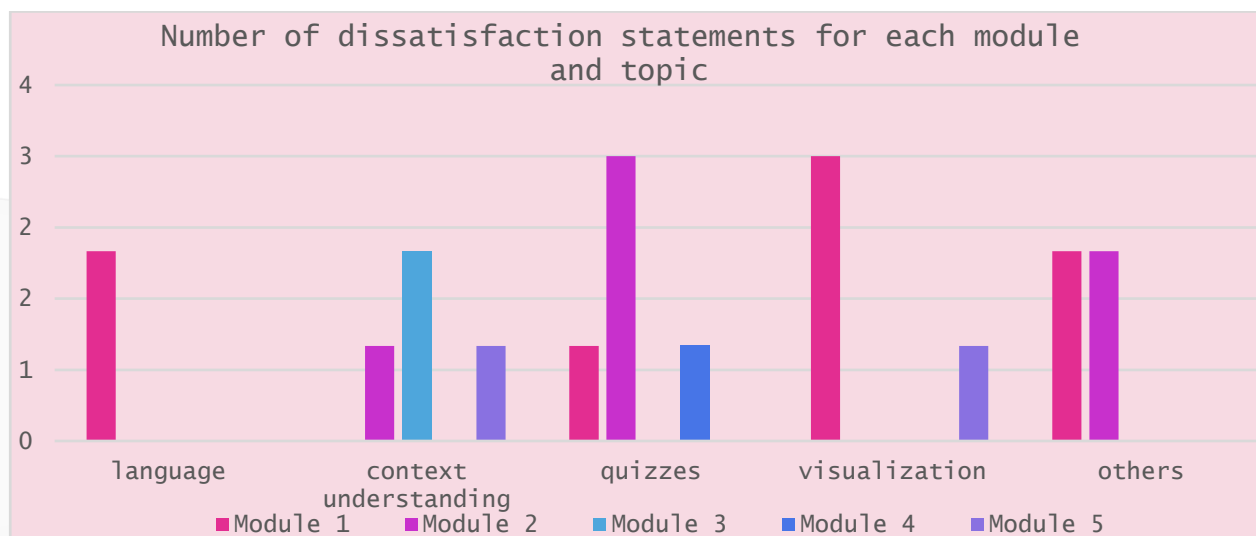
Figure 16: Distribution of dissatisfaction statements.

RSCH Module 1: Context and Challenges

Closed Questions: Module 1 was described as understandable (95,5 % agree or agree strongly) and useful (86,4 % agree or agree strongly) by the participants. Nobody totally disagreed that the modules were understandable and useful.
86,6 % of the participants (19 people out of 22 people) did strongly agree and agree that they have learned about the impacts of smart grid at different scales (home, building, city, territories).
21 (95,5 %) participants strongly agreed and agreed that they have learned about the role of smart grid in energy transitions. Only one person (4,5 %) admitted that they did not gain any learning effects regarding this question.
100 % (N = 22) found the quiz easy or moderate. None of the participants experienced the quiz as very easy or very difficult.
For comparisons, see figures 17 and 18 for details. (For the correlation matrix between the five closed questions see appendix table 12)

Open Question: As shown in figure 16, the categories language (2 times mentioned), quizzes (once mentioned) and visualization (three times mentioned) were mentioned for improvement in module 1. The text, especially the quiz, had a few language errors which led also to perceiving less sense in the quiz. Furthermore, the background music was irritating during the video and the basic wish was that there should be longer videos and less text (for detailed information see appendix table 16).

Recommendations for Module 1: To improve Module 1, visualization seems to be an important part and could be optimized, e.g. background music more quiet or no music in general. Participants also wished for less text and longer videos. This could be a large expense for changing, but the videos should be reworked.
In addition, language errors should be corrected, especially in the quiz part.
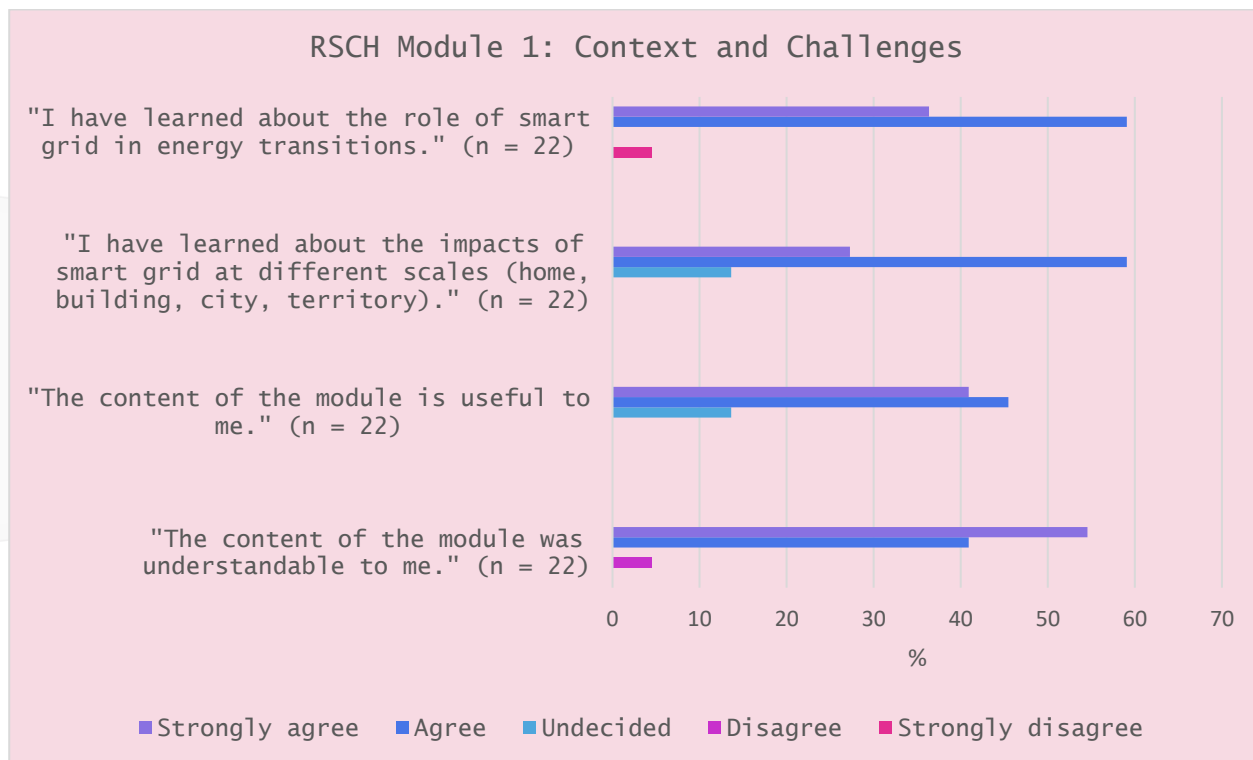
Figure 17: Participants' views on RSCH Module 1.
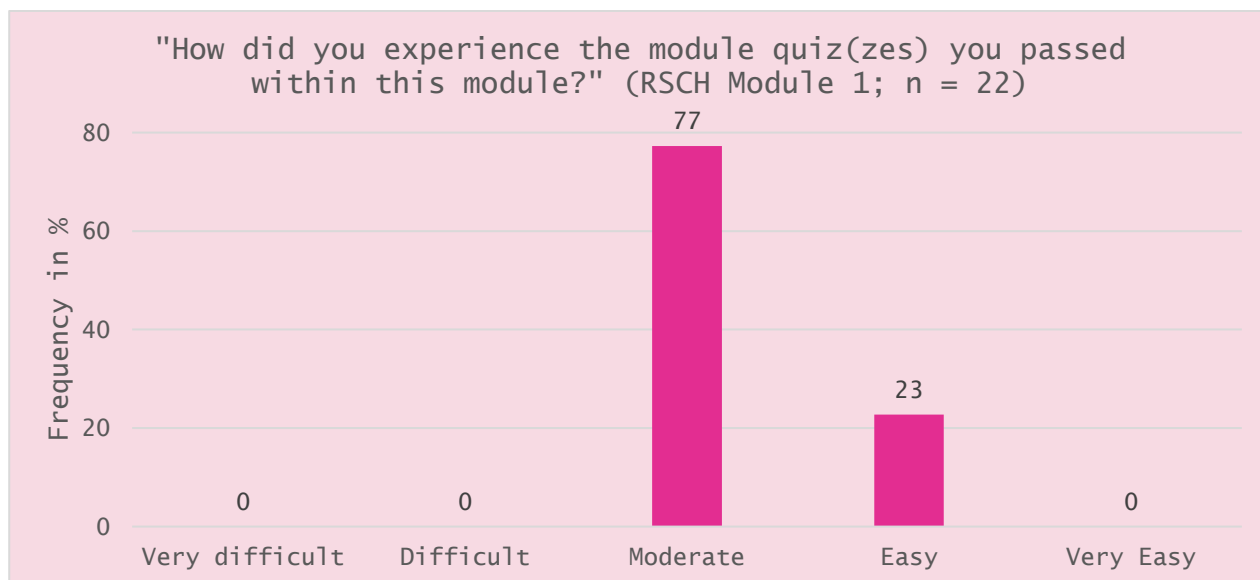
Figure 18: Participants' views on the knowledge quiz part of RSCH Module 1.

RSCH Module 2: Electrical Network Elements

Closed Questions: Module 2 was described as understandable (88,9 % agree or agree strongly) and useful (100 % agree or agree strongly) by the participants. Nobody disagreed or totally disagreed that the modules were understandable and useful. 17 (94,4 %) participants strongly agreed and agreed that they can identify tech-nical elements that are part of the smart grid. Only one person (5,6 %)

was not able to identify the technical elements that are part of the smart grid after this module.

100 % (N = 18) of the participants did strongly agree and agree that they have learned about the main function modes of electric grids (transmission, distribution).

77,8 % (n = 14) found the quiz easy and moderate. None of the participants experienced the quiz as very easy or very difficult.

For comparisons, see figures 19 and 20 for details. (For the correlation matrix between the five closed questions see appendix table 19.)

Open Question: As shown in figure 16, the categories understanding (once mentioned) and quizzes (three times mentioned) were stated for improvement in module 2. It was mentioned that the answers to some questions were not explained in the corresponding video or lecture and maybe because of this it is difficult to identify the answer. It was also criticized that it is impossible to see the points before submitting the quiz. Furthermore it was mentioned that some questions were ambiguous (for detailed information see appendix table 18).

Recommendations for Module 2: To improve Module 2, the rework of the quizzes seems to be an important part and could be optimized, e.g. chapter 2.3 should be more detailed for better understanding, also more clear questions instead of ambiguous questions.
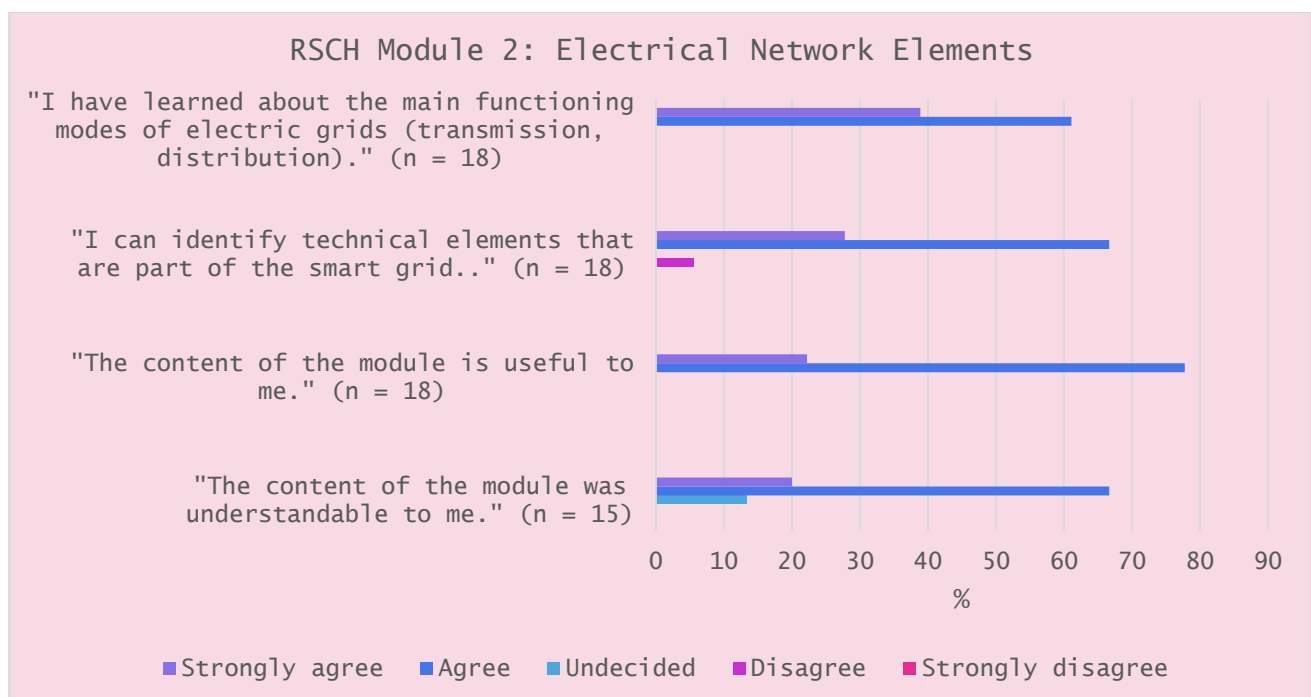
Figure 19: Participants' views on RSCH Module 2.

"How did you experience the module quiz(zes) you passed within this module?" (RSCH Module 2; n = 18)

Figure 20: Participants' views on the knowledge quiz part of RSCH Module 2.

RSCH Module 3: Information system dedicated to energy

Closed Questions: Module 3 was described as understandable (82,4 % agree or agree strongly) and useful (76,5 % agree or agree strongly) by the participants. Nobody disagreed nor totally disagreed that the modules were understandable and useful. 15 (88,2 %) participants strongly agreed and agreed that they learned about the digital components that contribute to smart grid. 2 people (11.8 %) were undecided if they learned something about digital components that contribute to smart grid. 88.2% (n = 15) of the participants said that they learned about the nature and the path of data involved in smart grid; two people (11,8 %) were undecided. One person (5,9 %) found the quiz easy, 11 participants (64,7 %) found it moderate and four people (23,5 %) found it difficult. None of the participants experienced the quiz as very easy or very difficult.
For comparisons, see figures 21 and 22 for details. (For the correlation matrix between the five closed questions see appendix table 20.)

Open Question: As shown in figure 16, the only category that was mentioned for improvement for module 3 was the section quiz (2 times mentioned). It was noted that some quizzes were difficult to pass and that the tests were not put together thoroughly.

Recommendations for Module 3: To improve Module 3, the rework of the quizzes seems to be an important part and could be optimized. It was mentioned that the quizzes should be reviewed and corrected regarding the language and the content. Also it was stated that sometimes it was not possible to find the required information within the course. This leads to the conclusion that the quizzes and the content of the course should be compared and reviewed to see if every asked element in the quizzes is included in the course.

RSCH Module 3: Information system dedicated to energy

Figure 21: Participants' views on RSCH Module 3.
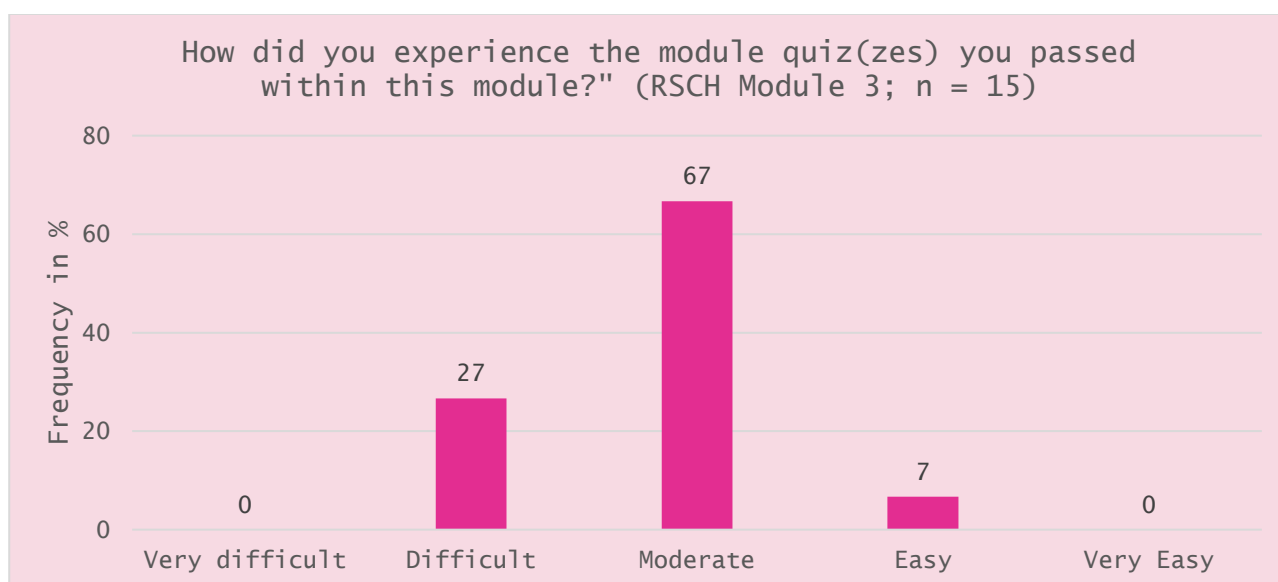
Figure 22: Participants' views on the knowledge quiz part of RSCH Module 3.

RSCH Module 4: Management and decisional system

Closed Questions: Module 4 was described as understandable (93,8 % agree or agree strongly) and useful (81,3 % agree or agree strongly) by the participants. Nobody disagreed or totally disagreed that the modules were understandable and useful.

16 participants (100 %) strongly agreed and agreed that they learned about the usage of data analysis for optimization and network efficiency in module 4.
7 people (43,8 %) found the quiz very easy or easy, 7 participants (43,8 %) found it moderate and two people (12,6 %) found it difficult or very difficult.
For comparisons, see figures 23 and 24 for details. (For the correlations matrix between the five closed questions see appendix table 21).

Open Question: As shown in figure 16, the only category that was mentioned for improvement for module 4 were the section quizzes respectively understanding (once mentioned). It was noted that question one was not very clearly worded.

Recommendations for Module 4: In general, module 4 seems to be quite understand-able and useful, also much less comments for improvement were mentioned. The only thing that suggestion was that maybe more specified questions would be suitable.
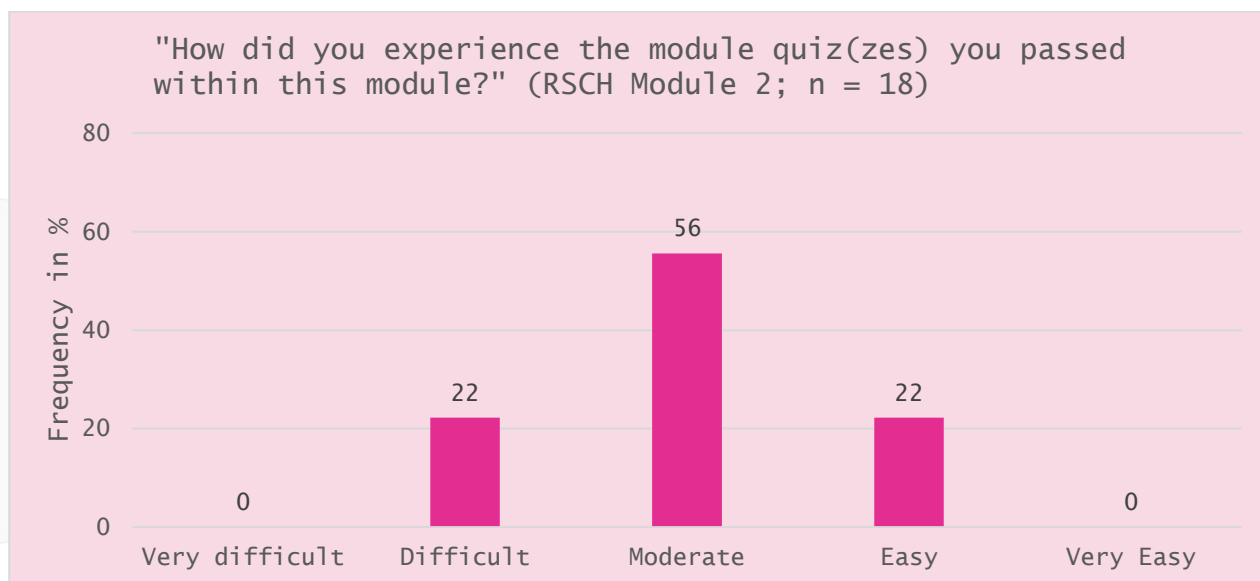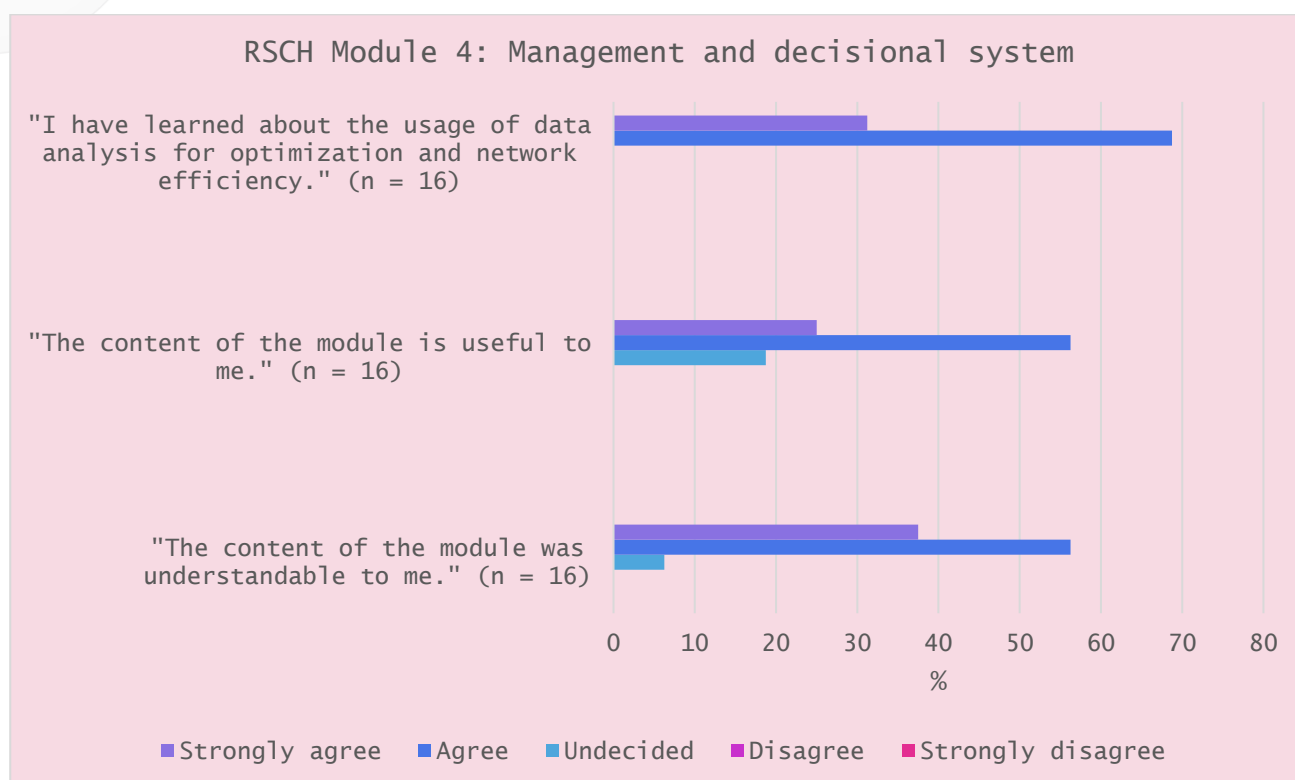

Figure 23: Participants' views on RSCH Module 4.
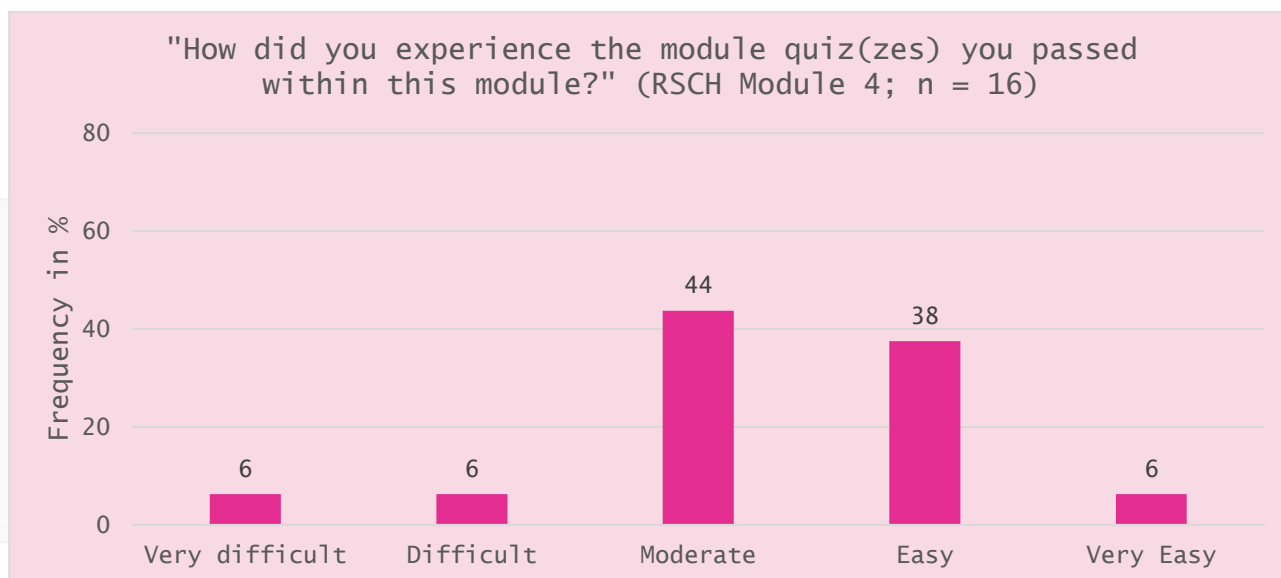
Figure 24: Participants' views on the knowledge quiz part of RSCH Module 4.

RSCH Module 5: Policy and Economy in Energy

Closed Questions: Module 5 was described as understandable (66,7 % agree or agree strongly), 20 % (n = 3) said that they did not understand the module. For 66,7 % the module was useful and 20% disagreed or strongly disagreed that it was useful. 12 participants (80 %) strongly agreed and agreed that have learned about the main trends of EU policy that influence smart grid territories and one person (6,7 %) strongly disagreed with that.
66,7 % (n = 10) of the participants said that they learned about the EU development plan of smart grid. Four participants (26,7 %) were undecided if they have learned about the EU development plan of smart grid and one person (6,7 %) strongly disagreed that he/she learned about the EU development plan of smart grid.
53,3 % (n = 8) found the quiz easy or very easy and 7 participants (46,7 %) found it moderate. None of the participants experienced the quiz as difficult or very difficult.
For comparisons, see figures 25 and 26 for details. (For the correlation matrix between the five closed questions see appendix table 22.)

Open Question: As shown in figure 16, the categories that were mentioned for improvement for module 5 were understanding and visualization. It was mentioned that the slides were not as informative as the videos (it was noted that even plain text and graphs are better prepared than the slides). Furthermore it was mentioned that some slides are cramped and difficult to read.

Recommendations for Module 5: To improve Module 5, the closed questions show that it would be better for understanding if the module would be reworked since 20 % of the participants did not understand the module. Especially the slides as mentioned in the open question are in need of a revision.
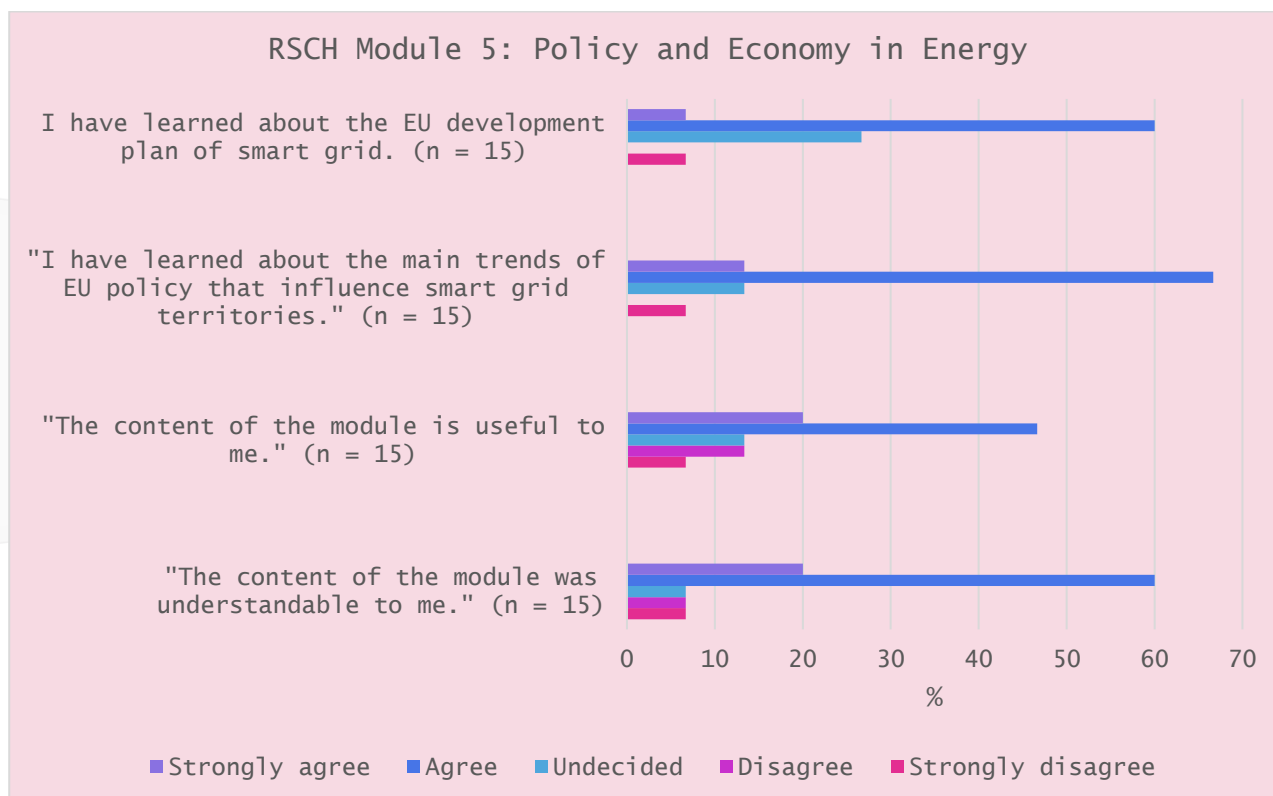
Figure 25: Participants' views on RSCH Module 5.
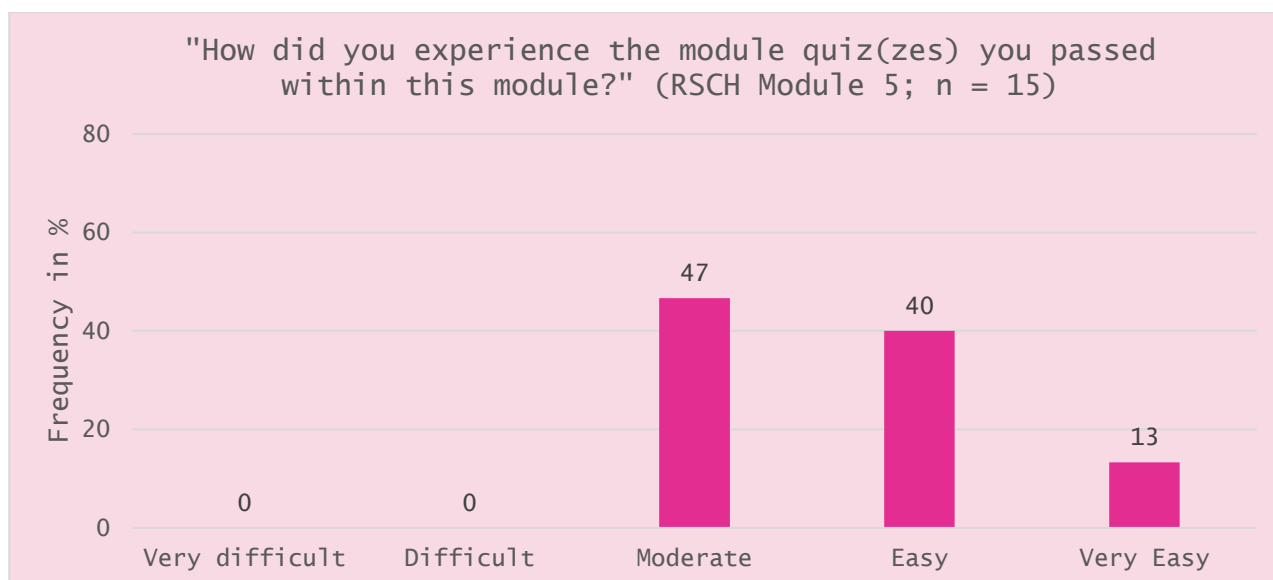
Figure 26: Participants' views on the knowledge quiz part of RSCH Module 5.

2.1.3. Electrical Engineering Workforce Course (WKFR)

Due to the diverse timelines of the Electrical Engineering Workforce course (WKFR) in the partner institutions (because of the Coronavirus, course translations or a separate evaluation), the evaluation data of the first piloting round reported here is based on the courses organized by TUD-TUB and ULJUB. For the same reason,

results from a questionnaire targeting the industry representatives from where the workforce participated in the pilots will be reported with the second wave of evaluation.

A shortened analysis is presented. Empty answers were excluded from the analysis. Importantly, the number of participants taking part in the evaluation surveys is not equal to the total number of participants, which is higher. Reporting of the open question results is clustered by mentions per category.

WKFR Module 1: Context and Challenges

Closed Questions: Module 1 was described as understandable and useful (> 80 % agree or agree strongly) by most participants. Also, the topics of the role of smart grids and its impacts at home, building, city or territory scale were perceived as sufficiently covered. The knowledge quiz part of the module was mostly characterized as moderate or difficult. In total, around 40 people filled out the evaluation survey. See figures 27 and 28 for details.

Open Question: The exact wording of the open question was "Is there anything you would like to change about the module you just finished? You may want to share your thoughts about difficulty, missing topics, language problems or any other aspect that holds a key to improving your learning experience and outcomes."

18 persons filled out the open questions, including phrases like "No/ No ideas for improvement" (8 mentions) or "thank you/ keep up the good work/ well prepared" (3 mentions). In general, participants wish for a visualization of the progress (1 mention) and note that the module takes them longer than expected (1 mention). Also, occasionally the module "sounds like an advertisement to smart grid" (quote; 1 mention). One participant wishes for an audio underlining the slides and for the learning videos having a short break after each bullet point to process the knowledge. Participants like the videos and that they can go back to seeing them again (2 mentions).

About the quiz part, participants would like the questions to be more balanced in difficulty/ less difficult (2 mentions) and to avoid repetition (1 mention).

Recommendations for Module 1: To improve Module 1, a progress bar could be implemented to increase motivation. The difficulty of the quiz questions should be discussed. While adding audio underlining the slides is a pretty large task to accomplish, longer breaks in the videos could be effective with less time needed to implement the change.
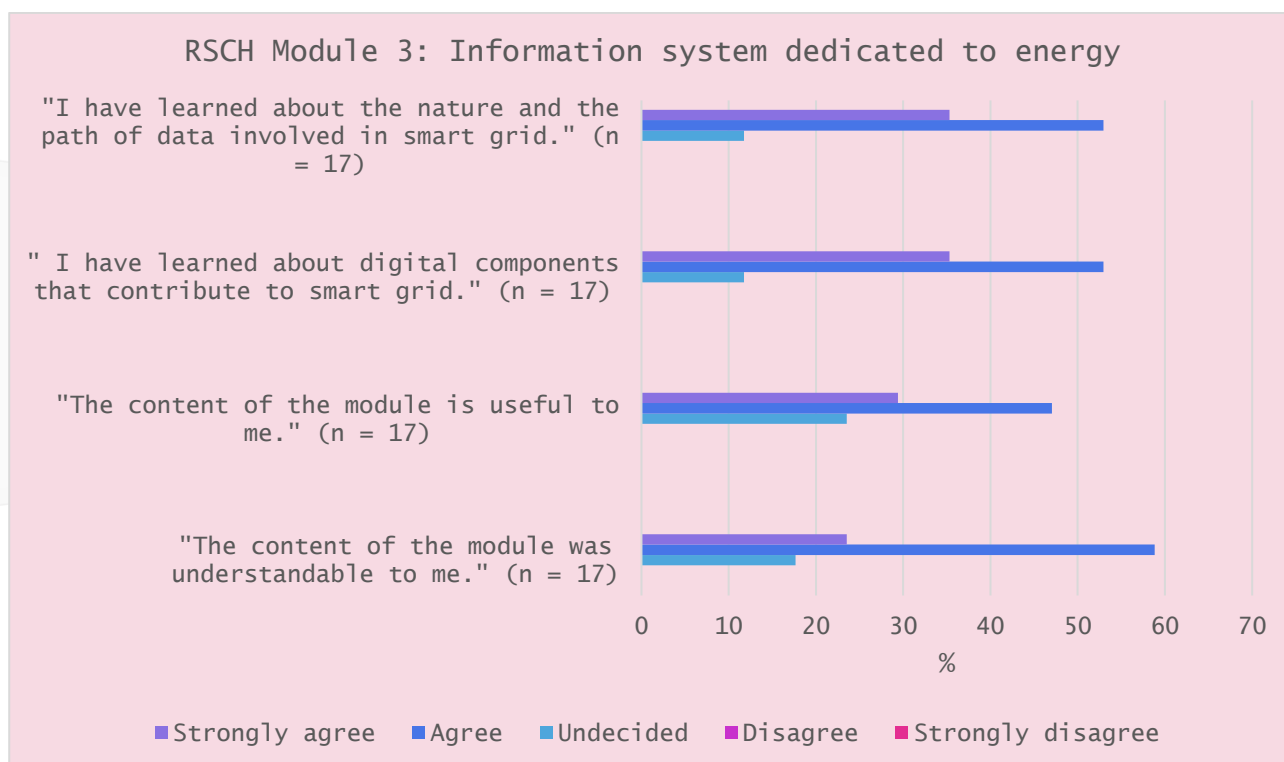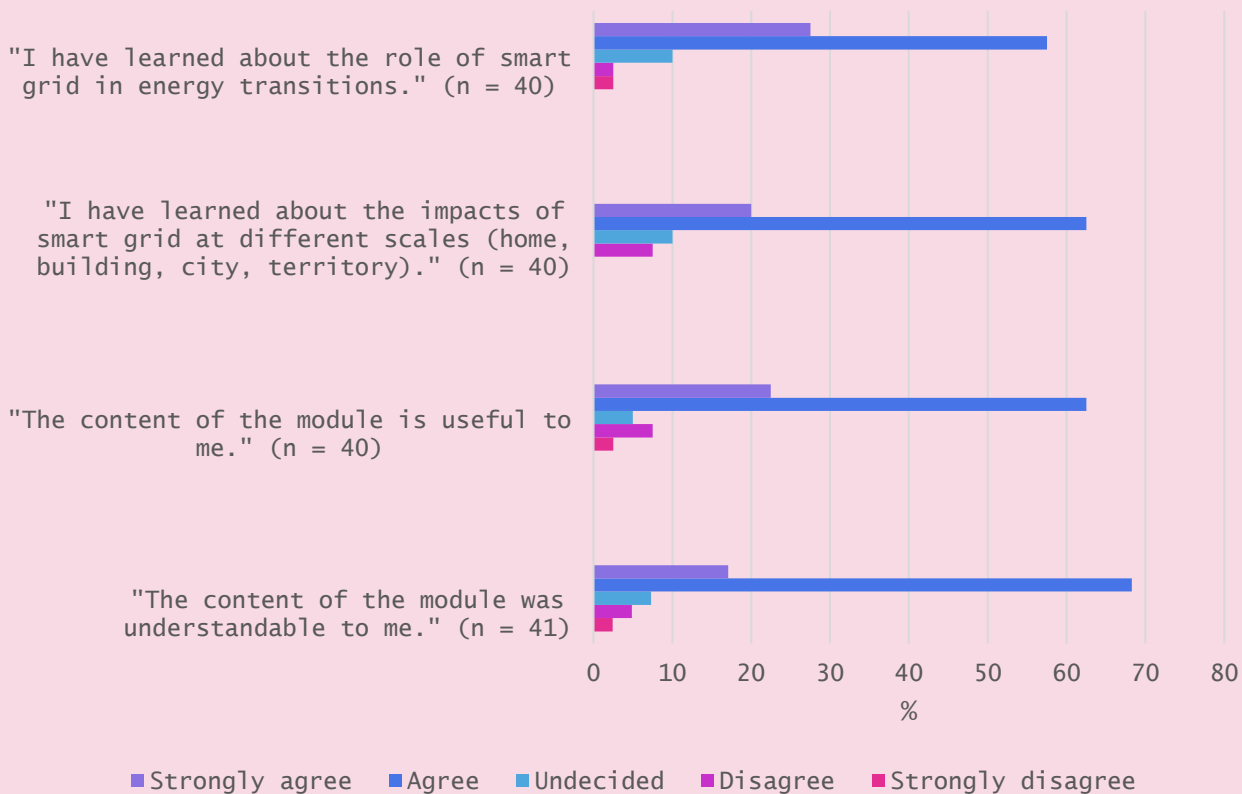
Figure 27: Participants' views on WKFR Module 1.

Figure 28: Participants' views on the knowledge quiz part of WKFR Module 1.

## WKFR Module 2: Electrical Network Elements

Closed Questions: Module 2 was described as understandable and useful (> 80 % agree or agree strongly) by most participants. Also, the topics of the role of elements and main functioning modes of smart grids were perceived as sufficiently covered. The knowledge quiz part of the module was mostly characterized as moderate or difficult, with only 5 % of participants using the term "easy". In total, 35 people filled out the evaluation survey. See figures 29 and 30 for details.

Open Question: The exact wording of the open question was "Is there anything you would like to change about the module you just finished? You may want to share your thoughts about difficulty, missing topics, language problems or any other aspect that holds a key to improving your learning experience and outcomes."

15 persons filled out the open questions, with 6 of them writing "No/ everything ok" or "useful for classes" (1 mention). In general, participants wish for real world calculation examples to show the benefits of green transformation (1 mention). Language problems were another topic (2 mentions).

About the quiz part, participants wish for it to be better synchronized with the lectures (1 mention). There were language problems in the word-fill tasks (1 mention). Fewer closed questions and to see the answers in all quizzes would be appreciated (1 mention each). When written answers needed to be graded, participants wished for a faster response time (1 mention). One participant provided a list of 3 questions that were perceived as problematic (misleading or incorrect).

Recommendations for Module 2: To improve Module 2, real world examples may be a valuable addition to the course. Language problems may be dealt with by using simple language where possible or providing a translation (as already being implemented by some partners). Depending on the future usage of the course, a community-supported translation of the course could also be an option that remains to be discussed. The quiz questions should be checked to be correct, in simple language and clearly stated in the learning material, as they are central to motivation. The grading of full written answers takes a toll on both the participants and the course responsibles and might be abolished in future versions.
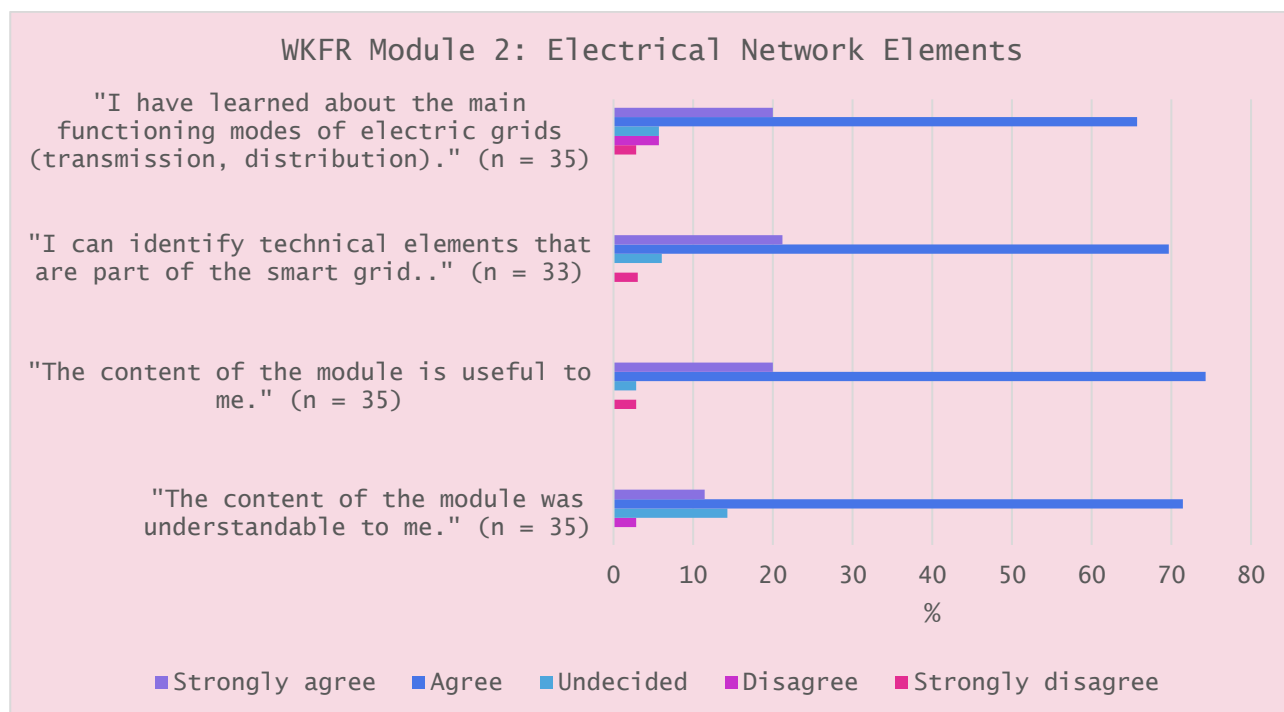
Figure 29: Participants' views on WKFR Module 2.
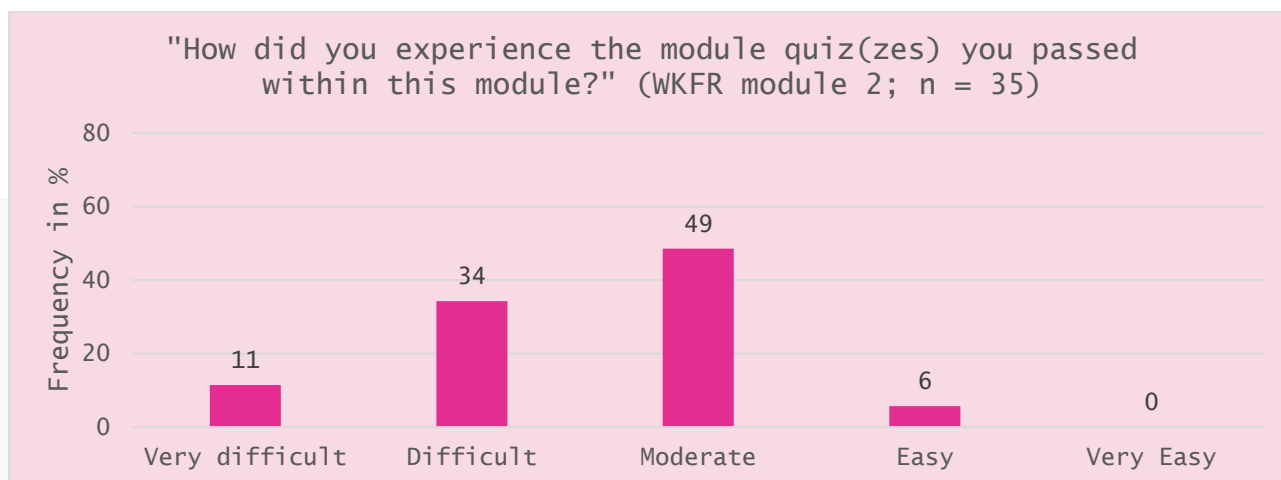
Figure 30: Participants' views on the knowledge quiz part of WKFR Module 2.

WKFR Module 3: Information system dedicated to energy

Closed Questions: Module 3 was mostly described as useful and understandable (> 60 % who agree or agree strongly; with the second largest group being undecided). Also, the topics of data and digital components in smart grids were perceived as sufficiently covered (> 69 % agree or agree strongly). The knowledge quiz part of the module was mostly characterized as moderate, difficult or even very difficult. In total, 29 people filled out the evaluation survey. See figures 31 and 32 for details.

Open Question: The exact wording of the open question was "Is there anything you would like to change about the module you just finished? You may want to share your thoughts about difficulty, missing topics, language problems or any other aspect that holds a key to improving your learning experience and outcomes."
13 persons filled out the open questions, with 6 writing "No" / "Nice overview". One person knew the topic from a previous job position. The topic was described as interesting and useful, but taking more time than previous modules (1 mention). The same person proposes to split the module into several modules for a higher degree of detail. One person wishes for a more basic vocabulary.
Several participants mentioned quiz questions being incorrect (4 mentions). One person mentioned a gap between study material and quizzes leading to a lower motivation.

Recommendations for Module 3: To improve Module 3, the vocabulary in use should be checked for unnecessarily complicated terms. The quiz questions should be checked to be correct, with adequate difficulty and clearly stated in the learning material.
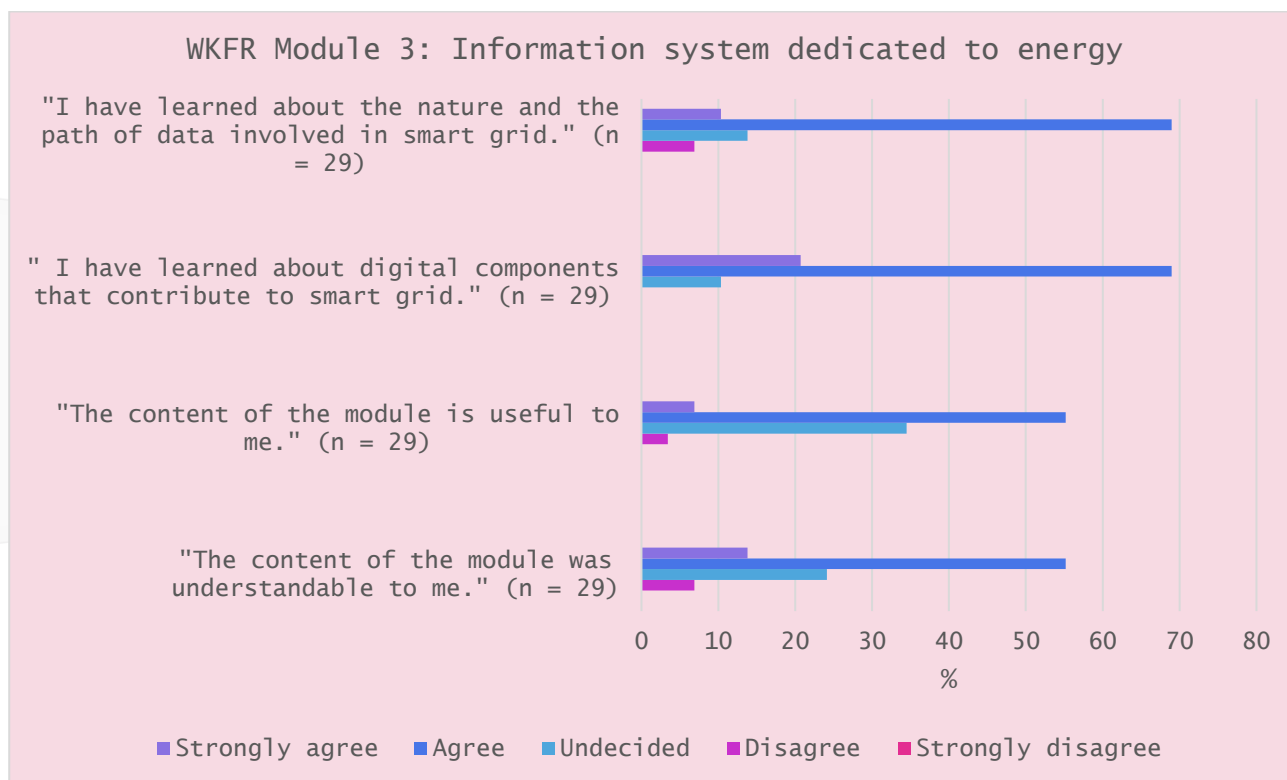
Figure 31: Participants' views on WKFR Module 3.
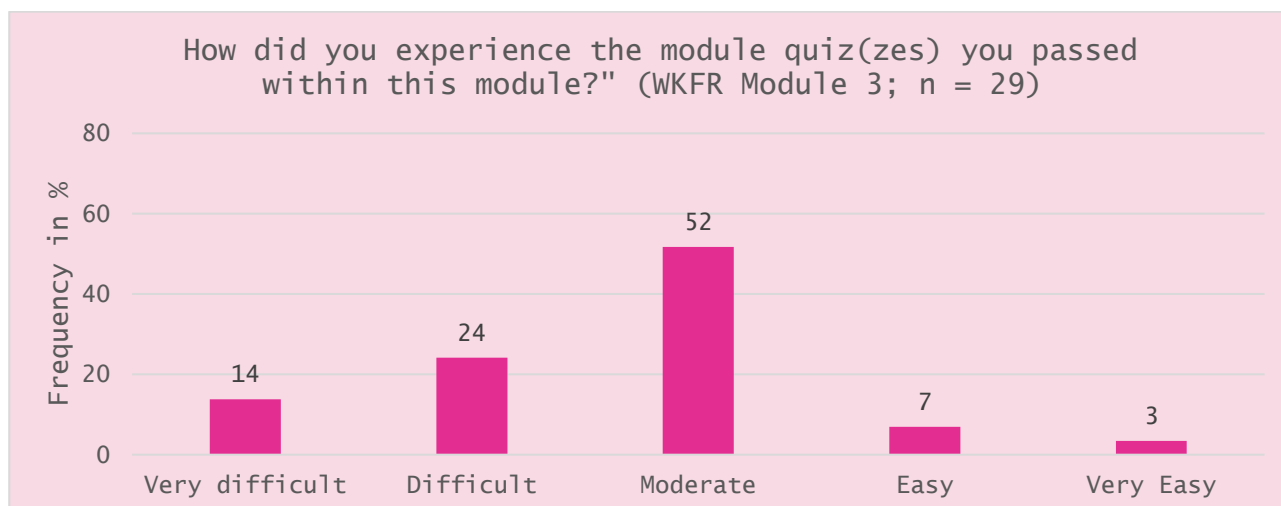
Figure 32: Participants' views on the knowledge quiz part of WKFR Module 3.

WKFR Module 4: Management and decisional system

Closed Questions: Module 4 was described as understandable (> 69 % agree) by most participants. However, it was stated being slightly less useful than the other modules (54 % agree or agree strongly, 31 % are undecided). The topic of data analysis for optimization and network efficiency was perceived as sufficiently covered. The knowledge quiz part of the module was mostly characterized as moderate, difficult or very difficult. In total, 26 people filled out the evaluation survey. See figures 33 and 34 for details.

Open Question: The exact wording of the open question was "Is there anything you would like to change about the module you just finished? You may want to share your thoughts about difficulty, missing topics, language problems or any other aspect that holds a key to improving your learning experience and outcomes."

12 persons filled out the open question, with 8 of them writing "No" or a question mark.

One person described lecture 4.3.1 as hard to understand with lecture 4.3.2. being slightly better. Two persons reported problems with the answers of specific quiz questions, one of them stating that the questions are too tricky, especially for English non-natives. Another person asked for more degrees of freedom with spelling mistakes in the quizzes.

Recommendations for Module 4: To improve Module 4, the usefulness of the module should be assessed in a short conversation with one or two participants. If more concrete and adequate suggestions arise from the conversation, these could be implemented. However, more than half of participants are still convinced that the module is useful so it is not a drastic problem. Lecture 4.3.1 should receive a short check for understandability. The quiz questions should be checked to be correct and with adequate difficulty. Possibly the format of filling in words is suboptimal for non-English natives. It could be an alternative to provide the words with correct spelling in the task description, which would also make it easier to fill in.

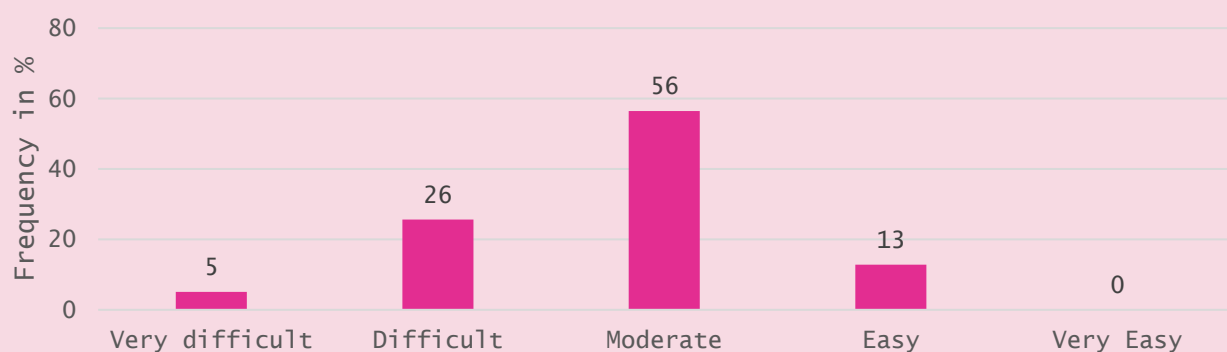**Figure 33: Participants' views on WKFR Module 4.**
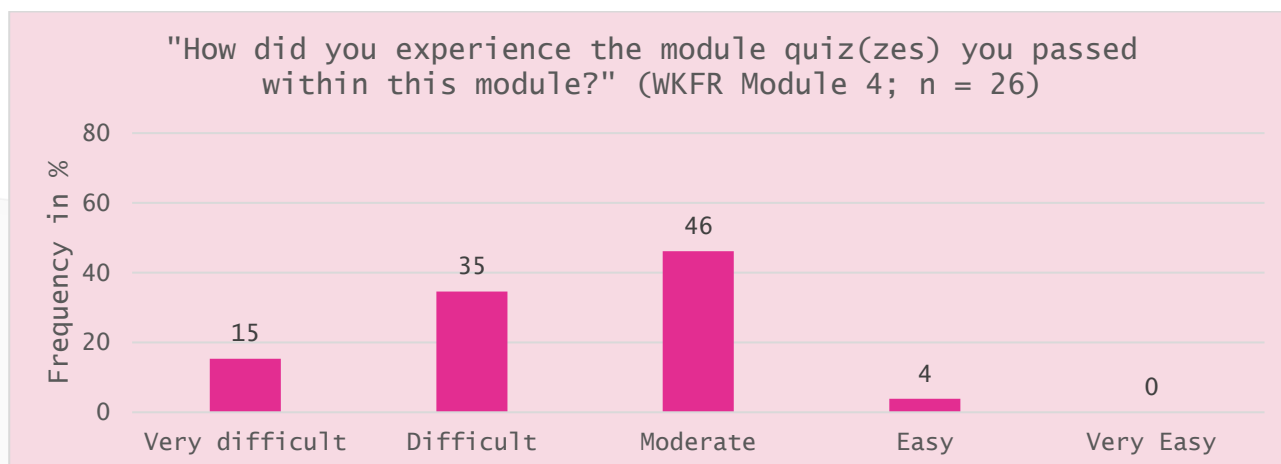
Figure 34: Participants' views on the knowledge quiz part of WKFR Module 4.

## WKFR Module 5: Policy and Economy in Energy

Closed Questions: Module 5 was described as understandable and useful (> 72 % agree or agree strongly) by most participants. Also, the topics of the EU policies and development plan were perceived as sufficiently covered. The knowledge quiz part of the module was mostly characterized as moderate or easy. In total, 25 people filled out the evaluation survey. See figures 35 and 36 for details.

Open Question: The exact wording of the open question was "Is there anything you would like to change about the module you just finished? You may want to share your thoughts about difficulty, missing topics, language problems or any other aspect that holds a key to improving your learning experience and outcomes."
11 persons filled out the open question, with 9 of them writing "No/ ok/ super". One person reports trouble with understanding English economical terms. One person stated that they didn't like the quiz questions in this module.

Recommendations for Module 5: To improve Module 5, the vocabulary in use should be checked for unnecessarily complicated terms. The quiz questions should be checked for clarity and for being clearly stated in the learning material.

WKFR Module 5: Policy and economy in energy

I have learned about the EU development plan of smart grid. (n = 24)

"I have learned about the main trends of EU policy that influence smart grid territories." (n = 25)

"The content of the module is useful to me." (n = 25)

"The content of the module was understandable to me." (n = 25)

0   10   20   30   40   50   60   70   80
%

■ Strongly agree   ■ Agree   ■ Undecided   ■ Disagree   ■ Strongly disagree
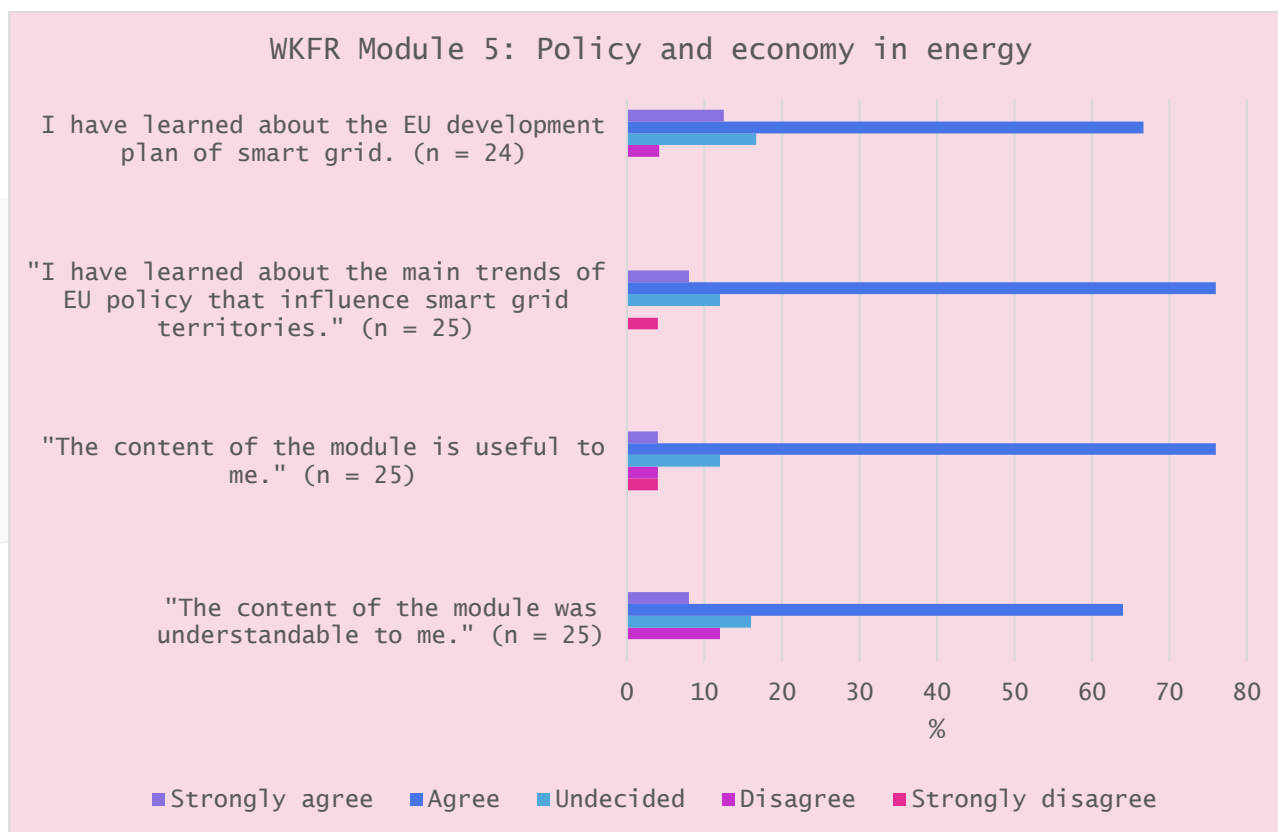
Figure 35: Participants' views on WKFR Module 5.

"How did you experience the module quiz(zes) you passed within this module?" (WKFR Module 5; n = 25)

Frequency in %

| Very difficult | Difficult | Moderate | Easy | Very Easy |
| 8 | 12 | 52 | 24 | 4 |
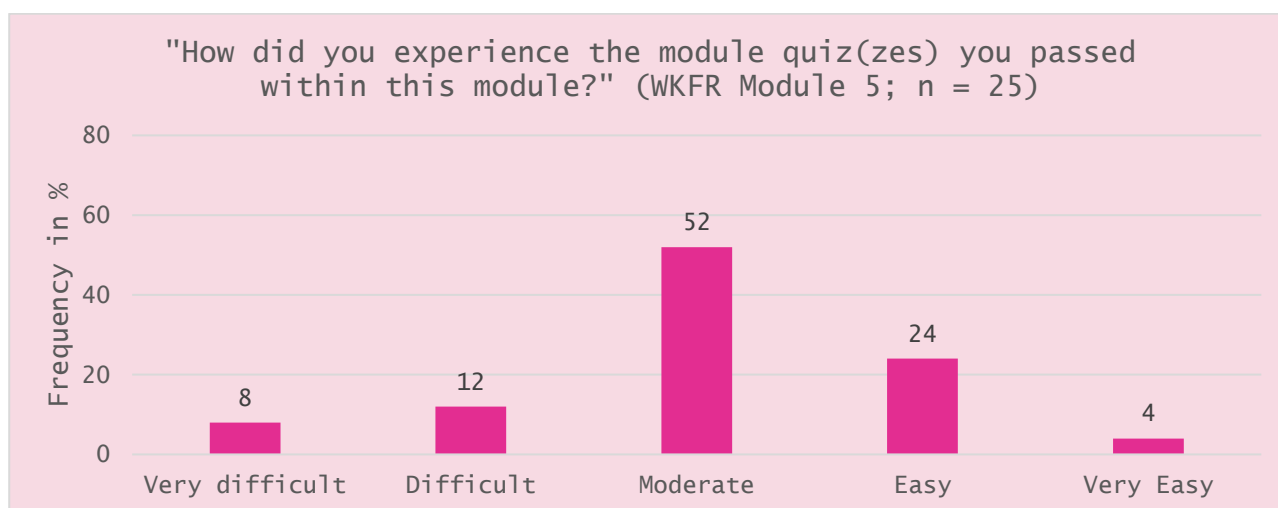
Figure 36: Participants' views on the knowledge quiz part of WKFR Module 5.

2.2. Course developers' perspective

As mentioned before, the evaluation is set up in two parts addressing different target groups: Next to the participants of the pilot courses, the course developers of the consortium were invited to provide their opinion. The questionnaire was run via a professional online survey software called SoSciSurvey (https://www.soscisurvey.de/).

The goal was to find out how developers experienced their work on this short term program. Therefore three **closed questions** were asked:
1) "I worked on this/these course(s)." – Answer: BP, RSCH, WKFR and mixed.
2) "How was it for you to develop the course(s)?" – Answer: very difficult, difficult, medium/average, easy, very easy.
3) "In your opinion, is this program more conventional or more innovative in general?" – Answer: very conventional, conventional, equal (conventional and innovative), innovative, very innovative.

One **open question** was asked:
"Do you have any specific suggestions to improve the course(s) - e. g. missing elements, learning speed, pedagogical needs, cutting-edge technologies etc.? (Please don't forget to specify the relevant target group(s) - Broader Public, Early Stage Researchers, Current Workforce.)"

16 out of 16 people participated in designing/developing content for the SMAGRINET short-term programmes („Smart Grid from A –Z"). 43.8 % (n = 7) developers worked on all three courses. 18.8 % (n = 3) developers worked only on one course (see table 3).

Table 3: Developers worked on these course(s).

	N	Percent	Cumulative Percent
Broader Public	2	12,5	12,5
RSCH	1	6,3	18,8
BR, RSCH	1	6,3	25
RSCH, WKFR	1	6,3	31,3
BP, RSCH, WKFR	7	43,8	75
I don't know/uncertain	4	25	100
Total	16	100	

For 12,5 % it was easy to develop the course(s), for 68,8 % it was moderate and for 18,8% it was difficult. None of the developers experienced the development of the course(s) as very easy or very difficult.

Most of the developers found the course in general innovative (68,8 %, n = 11). Nobody found the course very conventional (see figure 37).

In your opinion, is this program more conventional or more innovative in general? (developers, n = 16)
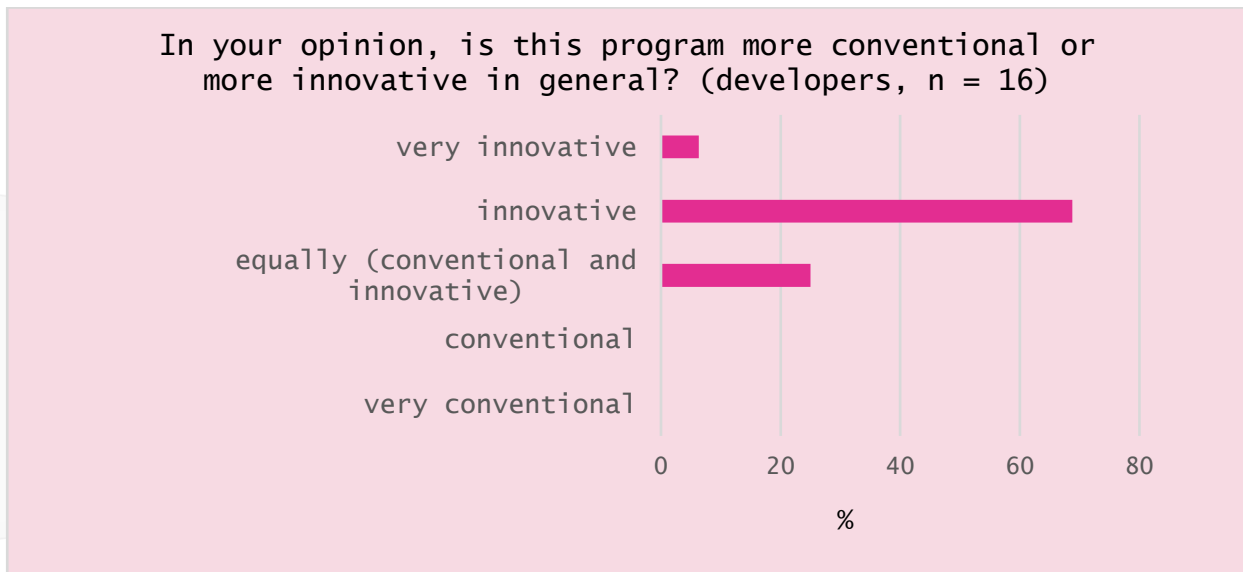
Figure 37: "In your opinion, is this program more conventional or more innovative in general?".

Some suggestions were made in the open question part:

a) Three suggestions for Broader Public (BP):

- Additional content concerning auto consumption could be interesting.
- Maybe betting on a lighter tone campaign for promoting Smagrinet can help to get more support and acknowledgement from the general public. Sometimes the content can be a bit technical and overwhelm.
- Add focus to the customer perspective (e.g., demand response).

b) One suggestion for Current Workforce (WKFR):

- Provide some more practical cases form the field (e.g. solutions to problems in distribution grids).

c) One suggestion for Early Stage Researchers (RSCH):

- Additional content concerning auto consumption could be interesting.

d) One suggestion for all three groups:

- In order to bring more "gamification" and shareability, it would be interesting to integrate open badge for each level.

3. Adjustment of the short-term programs

Based on the evaluation (Part 2), we developed a list of proposals for the adjustments (see Table 4). Proposals were discussed, approved and accepted with consortium. The programs will be adjusted taking into consideration the needs of the target groups and sustainability and replicability of the courses and discussed with the competence hub and project Advisory Board.

The second developed tool which we use to improve the programs is comments from participants (list of the most relevant feedback for every module within every target group), see Appendix for the Part 3.

Table 4: Evaluation proposals for the adjustments

Evaluation proposals for the adjustments	Adjustments
BROADER PUBLIC COURSE (BP)	
BP Recommendations for Module 1: Context and challenges of power grid and smart grid	
To improve Module 1 a few participants expressed the wish that the language of the course/module should be translated in their mother tongue.	UROL included the subtitles in French language to the videos in YouTube. ULOR is planning also to include French voice-over. Subtitles in Estonian language will be also included by TalTech. Each partner is trying to achieve the sustainability of the project materials and is looking for opportunities to translate these materials into local languages (i.e. extra funding etc.)
In the category visualization participants wished that the graphical data should be presented a bit longer, because some mentioned that it was shown too fast. Furthermore the texts could be equipped with pictures from the videos, thus would eliminate the need to re-watch the videos.	Accepted (UROL is responsible partner)
A suggestion for improvement of the quizzes is that it would help if there were more attempts, especially in the beginning	Accepted. UROL will check if it is possible according with LMS Canvas settings
BP Recommendations for Module 2: Electric Network & Infrastructure	
For passing and understanding module 2 it is necessary that all knowledge/ materials concerning the quizzes should be included in the courses. In addition, it could help if the content would be explained in more detail	Accepted (TUB is responsible partner)
BP Recommendations for Module 3: Information System Dedicated to Energy	
To improve Module 3 the language mistakes should be corrected which would result in	Accepted. We can't add the videos, but text should be rework

a better understanding of the whole module. In addition, module 3 was without any videos and participants mentioned that it would have been a lot easier to understand the topic if there would have been a video at all. Thus it is recommended to add a video	
BP Recommendations for Module 4: Management & Decisional System	
To improve Module 4 it would help to implement more examples (especially to "power systems") for better understanding and to get the "bigger idea" as it was mentioned. Furthermore, it would be useful to revise the wording in the quizzes to not arise any confusion	Accepted (TUD is responsible partner)
BP Recommendations for Module 5: Policy & Economy in Energy	
To improve Module 5, grammar should be corrected in general. The specific quotes of the participants should be noted and used to revise module 5	Accepted (TalTech is responsible partner)
Moreover, in this module as in all modules before, it could help to implement more examples to explain the context and consequently for better understanding of this module	
BP SPSS results:	
The recommendation for module 5 is that it should be reworked for better understanding. That if the participants should have the effect of usefulness of a module, module 3 and 4 should be revised*	Accepted
*It is controversial if the quizzes of module 5 should be more difficult in order to adapt to the level of the other modules, or if the quizzes of the other modules need to be easier	TalTech together with TUD and TUB will solve these issues
EARLY STAGE RESEARCHERS COURSE (RSCH)	
RSCH Recommendations for Module 1: Context and challenges of power grid and smart grid	
To improve Module 1, visualization seems to be an important part and could be optimized, e.g. background music more quiet or no music in general. Participants also wished for less text and longer videos	This could be a large expense for changing and the videos should not be reworked, but the texts could be equipped with pictures from the videos
In addition, language errors should be corrected, especially in the quiz part	Accepted
RSCH Recommendations for Module 2: Electric Network & Infrastructure	
To improve Module 2, the rework of the quizzes seems to be an important part and could be optimized, e.g. chapter 2.3 should be more detailed for better under-	Accepted (TUB is responsible partner)

standing, also more clear questions instead of ambiguous / controversial questions	
RSCH Recommendations for Module 3: Information System Dedicated to Energy	
To improve Module 3, the rework of the quizzes seems to be an important part and could be optimized. It was mentioned that the quizzes should be reviewed and corrected regarding the language and the content. Also it was stated that sometimes it was not possible to find the required information within the course.	Accepted (UROL is is responsible partner). This leads to the conclusion that the quizzes and the content of the course should be compared and reviewed to see if every asked element in the quizzes is included in the course
RSCH Recommendations for Module 4: Management & Decisional System	
In general, module 4 seems to be quite understandable and useful, also a lot less comments for improvement were mentioned. The only thing that was suggested was that maybe more specified questions would be suitable	Accepted (TUD is responsible partner)
RSCH Recommendations for Module 5: Policy & Economy in Energy	
To improve Module 5, the closed questions show that it would be better for understanding if the module would be reworked since 20 % of the participants did not understand the module. Especially the slides as mentioned in the open question are in need of a revision	Accepted (TalTech is responsible partner)
ELECTRICAL ENGINEERING WORKFORCE COURSE (WKFR)	
WKFR Recommendations for Module 1: Context and challenges of power grid and smart grid	
To improve Module 1, a progress bar could be implemented to increase motivation. The difficulty of the quiz questions should be discussed	Accepted. Difficulties in quizzes will be changed. While adding audio underlining the slides is a pretty large task to accomplish, longer breaks in the videos could be effective with less time needed to implement the change
WKFR Recommendations for Module 2: Electric Network & Infrastructure	
To improve Module 2, real world examples may be a valuable addition to the course. Language problems may be dealt with by using simple language where possible or providing a translation (as already being implemented by some partners). The quiz questions should be checked to be correct, in simple language and clearly stated in the learning material, as they are central to motivation.	Accepted TalTech and UROL have translated their courses for WKFR Depending on the future usage of the course, a community-supported translation of the course could also be an option that remains to be discussed with competence hub and advisory board

The grading of full written answers takes a toll on both the participants and the course responsibles and might be abolished in future versions	UROL will try to solve this issue
WKFR Recommendations for Module 3: Information System Dedicated to Energy	
To improve Module 3, the vocabulary in use should be checked for unnecessarily complicated terms. The quiz questions should be checked to be correct, with adequate difficulty and clearly stated in the learning material	Accepted. The proofreading should be done
WKFR Recommendations for Module 4: Management & Decisional System	
To improve Module 4, the usefulness of the module should be assessed in a short conversation with one or two participants. If more concrete and adequate suggestions arise from the conversation, these could be implemented. However, more than half of participants are still convinced that the module is useful so it is not a drastic problem. Lecture 4.3.1 should receive a short check for understandability. The quiz questions should be checked to be correct and with adequate difficulty. Possibly the format of filling in words is suboptimal for non-English natives. It could be an alternative to provide the words with correct spelling in the task description, which would also make it easier to fill in	Accepted. TalTech together with TUD will solve this issue
WKFR Recommendations for Module 5: Policy & Economy in Energy	
To improve Module 5, the vocabulary in use should be checked for unnecessarily complicated terms. The quiz questions should be checked for clarity and for being clearly stated in the learning material	Accepted
COURSE DEVELOPERS' PERSPECTIVE	
Suggestions for Broader Public (BP):	
Additional content concerning auto consumption could be interesting	TalTech could provide an input (materials)
Maybe betting on a lighter tone campaign for promoting Smagrinet can help to get more support and acknowledgement from the general public. Sometimes the content can be a bit technical and overwhelm	Accepted
Add focus to the customer perspective (e.g., demand response)	Accepted
Suggestion for Early Stage Researchers (RSCH):	
Additional content concerning auto consumption could be interesting	TalTech could provide an input (materials)
Suggestion for Current Workforce (WKFR):	

Provide some more practical cases form the field (e.g. solutions to problems in distribution grids)	The topic "energy community" could be added

4. Conclusion

Evaluation of the pilots is an important part to finalise the first pilot, as evaluation must lead an adjustment/improvement of the programmes and the second pilot. In general developed programmes evaluated as "useful course", "effective course", "great course", "innovative course", "different, unusual" etc.

Every participant in every pilot course was invited to take part in the evaluation. It was implemented directly into the LMS Canvas. Feedback was collected from the course developers (consortium members), participants and it was planned to reach also the industry representatives from where the workforce has attended the course.The questionnaire for industry representatives only makes sense at least in 3 months after people from the industry finished the course for electrical engineering workforce. That's why decided to use it during the second pilot implementation.

Content analyses of the pilots was done using both qualitative and quantitative methodology.

Based on the evaluation proposals for the adjustments the improvement of the programmes will be done and discussed with the competence hub, members of the Advisory Board and consortium. After increasing the quality of the existed course content and updating the course, consortium will consider developing a new content, based on the suggestions of course developers.

5. Appendix

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5.1. Appendix for Part 1: Evaluation of the pi-lots

Appendix table 1: Module 1 – Correlation between the 5 closed questions module Broader Public.

		The content of the module was understandable to me.	The content of the module is useful to me.	I have learned about the impacts of smart grid at different scales (home, building, city, territory).	I have learned about the role of smart grid in energy transitions.	How did you experience the quiz(zes) you passed within this module?
The content of the module was understandable to me.	Pearson Correlation	1	,280*	,125	,181	,221
	Sig. (2-tailed)		,023	,314	,143	,073
	N	67	66	67	67	67
The content of the module is useful to me.	Pearson Correlation	,280*	1	,311*	,253*	,196
	Sig. (2-tailed)	,023		,011	,041	,114
	N	66	66	66	66	66
I have learned about the impacts of smart grid at different scales (home, building, city, territory).	Pearson Correlation	,125	,311*	1	,586**	,060
	Sig. (2-tailed)	,314	,011		,000	,629
	N	67	66	67	67	67
I have learned about the role of smart grid in energy transitions.	Pearson Correlation	,181	,253*	,586**	1	,142
	Sig. (2-tailed)	,143	,041	,000		,253
	N	67	66	67	67	67
How did you experience the quiz(zes) you passed within this module?	Pearson Correlation	,221	,196	,060	,142	1
	Sig. (2-tailed)	,073	,114	,629	,253	
	N	67	66	67	67	67

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

- There is a positive significant correlation between understanding and use-fulness of the module. If the content of the module is understandable, then the content of the module is also useful (and the other way around), r = .28, p = .02, N = 66. The analysis showed a medium effect size with r = .28.

- There is a positive high significant correlation between usefulness of the module and learning about the impacts of smart grid at different scales. If the usefulness of the module is given then the person also learned a lot about the impacts of smart grid at different scales;); r = .31, p = .01, N = 66. The analysis showed a medium effect size with r = .31.

- There is a positive high significant correlation between learning about the impacts of smart grid at different scales and learning about the role of smart grid in energy transitions. If the learning about the impacts is strong than the learning about the role of smart grid in energy transition is also strong, r = .59, p = .00, N = 67. The analysis showed a large effect size with r = .59.

Appendix table 2: Module 1 – Open Question BP.

Topics	
language (6 times mentioned)	suggestion for improvement
difficult understanding for non-native speakers	translation into other languages - the mother tongue language (3 persons named that)
wording (words that were chosen)*	
difficult words**	
The glossary was useful but not complete	
Examples	

* (maybe linked with laguageI have a couple of problems with quizzes. I understand the need to change things up, but sometimes a certain wording doesn't seem correct to me. Maybe because English isn't my first language but a couple of examples: 1.2.1 Quiz question 4: What holds true for a smart grid? Smart grid is an upgrade of.... (correct) To me; reinforce seems to be the same with upgrading. I understood the meaning and goals to achieve smart grid but ""reinforce"" doesn't seem like drastic/expensive changes. 1.2.3 Quiz question 1: Choose the statements which describe the vertically integrated energy system correctly. The generators directly sell the energy to the end user. (false Â The retailer sells the energy to the end user). Again I understand the difference between vertically integrated system and unbundled system but from description I thought that all 4 actors are involved and count as 1. Therefore it doesn't matter who is selling the energy if it comes from the same system. This might be on me but I find it confusing. Same quiz question 2: What are the benefits of an unbundled energy system? Generators are directly linked to transmission companies. (false They are operating separately.) In this case, I didn't register that linked and operating meant the same thing. I understood that linked meant connected which to me seems more logical. But there is that it might just be my English skills, but I was left confused with these 3 answers. Mostly because the reasoning why my choice was wrong was the same reason why I made the decision.

**"equilibrium" for example	

 i.e. 1.3.3 test where smart grid helps to eliminate the constraint of energy supply=demand. I mean, SG does help in relieving the constraints so i guess it can be understood both ways.

understanding too difficult (5 times mentioned)	**suggestion for improvement**
technical terms new words	
to understand the text better	texts could be equipped with the pictures from the videos (or similar), thus eliminating the need to re-watch the videos
	Add more practical examples
aspects of Smarts Grids, as it is a technical subject and I have no knowledge[1]	

[1] J'ai eu du mal à comprendre certains aspects des Smarts Grids, car c'est un sujet technique et je dispose d'aucunes connaissances.

quizzes/test too difficult/problem (5 times mentioned)	**suggestion for improvement**
difficult	could be more (at least 2) attempts in the quiz - especially at the beginning
question from next topics	
Some questions are really specifics and for some i don't see them in the course at all	

problem with quizzes	examples: 1.2.1 Quiz question 4: What holds true for a smart grid? Smart grid is an upgrade of.... (correct) To me; refinforce seems to be the same with upgrading. I understood the meaning and goals to achieve smart grid but ""reinforce"" doesn't seem like drastic/expensive changes. 1.2.3 Quiz question 1: Choose the statements which describe the vertically integrated energy system correctly. The generators directly sell the energy to the end user. (false Â The retailer sells the energy to the end user). Again I understand the difference between vertically integrated system and unbundled system but from description I thought that all 4 actors are involved and count as 1. Therefore it doesn't matter who is selling the energy if it comes from the same system. This might be on me but I find it confusing. Same quiz question 2: What are the benefits of an unbundled energy system? Generators are directly linked to transmission companies. (false They are operating separately.) In this case, I didn't register that linked and operating meant the same thing. I understood that linked meant connected which to me seems more logical. But there is that it might just be my English skills, but I was left confused with these 3 answers. Mostly because the reasoning why my choice was wrong was the same reason why I made the decision.
visualization (3 times mentioned)	**suggestion for improvement**
Graphical data in the videos are presented too fast.	
visualization could be better in the videos	
	more pictures mb
suggestion without any category (4 times mentioned)	
Maybe more questions that would require us to derive answers from the materials provided - right now most of them are easily found from the presentations or text based materials directly.	
You should add to list of energy organization also Provider of EES (Energy Storage System) next to Producer, TSO, DSO, Regulator, Retail and Consumer, Second: Transmission Network is HV and very high voltage, Distribution network in MV (20 kV) and 0,4 kv (LV). Why is first only mesh and second only tree topology?	

electrcity' instead of 'electricity'	
I think there is political choice from the Europe side against the monopoly of state in generation and retail. You don't explain the good side of it and essentially in the long term effect of having low price for the consumer. We now know that the low price is not a solution because it doesn't reflect the long term price of electricity energy. Thanks for considering this comment.	
no category (2 times mentioned)	
The term reinforced was misinterpreted by me. On most mistakes made in the quizzes it was a reading error. Everything was actually quite clear. In quiz 1.2.3 on the vertical system, basically due to it being a Monopoly, the statement of the Generator selling the power directly to the end user seemed to me a bit debatable. Overall, the module was clearly understandable and when taking more time to read everything, then the results will be better."	
statements and context suggestions (1 time mentioned)	
[Capture.PNG] (https://canvas.instructure.com/users/29216323/files/125262826/preview?verifier=sFBHGakUXMWHasChVIBhqCi5vaDfqeZPCUyK8PmG)I do not agree, that the first option is correct.	
thank you notes e.g.:	
I've enjoyed these courses a lot. I've learned many things and I've even downloaded the smart grid app to change my way of consumption.	
Not too difficult, not too easy.	
Module information is presented in a very nice and easy to understand way.	
Nothing to add.	
..., but overall very good	

Appendix table 3: Module 2 — Correlation between the 5 closed questions module Broader Public.

		The content of the module was understandable to me.	The content of the module is useful to me	I can identify technical elements that are part of the smart grid.	I have learned about the main functioning modes of electric grids (transmission, distribution).	How did you experience the quiz(zes) you passed within this module?
The content of the module was understandable to me.	Pearson Correlation	1	,386**	,497**	,301*	,297*
	Sig. (2-tailed)		,001	,000	,014	,016
	N	66	66	66	66	66
The content of the module is useful to me	Pearson Correlation	,386**	1	,504**	,556**	,165
	Sig. (2-tailed)	,001		,000	,000	,187
	N	66	66	66	66	66
I can identify technical elements that are part of the smart grid.	Pearson Correlation	,497**	,504**	1	,533**	,158
	Sig. (2-tailed)	,000	,000		,000	,205
	N	66	66	66	66	66
I have learned about the main functioning modes of electric grids (transmission, distribution).	Pearson Correlation	,301*	,556**	,533**	1	,074
	Sig. (2-tailed)	,014	,000	,000		,555
	N	66	66	66	66	66
How did you experience the quiz(zes) you passed within this module?	Pearson Correlation	,297*	,165	,158	,074	1
	Sig. (2-tailed)	,016	,187	,205	,555	
	N	66	66	66	66	66

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

- There is a positive high significant correlation between understanding and usefulness of the module. If the content of the module is understandable then the content of the module is also useful, r = .39, p = .001, N = 66. The analysis showed a medium effect size with r = .39.

- There is a positive high significant correlation between understanding and identification of technical elements (that are part of the smart grid). If the content of the module is understandable than the identification of technical elements is given, r = .50, p = .000, N = 66. The analysis showed a large effect size with r = .50.

- There is a positive significant correlation between understanding and positive learning effects about the main functioning modes of electric grids, r = .30, p = .01, N = 66. The analysis showed a medium effect size with r = .30.

- There is a positive significant correlation between understanding and experiences of the quiz(zes). The more a person understood, the easier he/she experinces the quizzes, r = .30, p = .02, N = 66. The analysis showed a medium effect size with r = .30.

- There is a positive high significant correlation between usefulness and identification of technical elements (that are part of the smart grid). If the content of the module is useful than the identification of technical elements is given, r = .50, p = .000, N = 66. The analysis showed a large effect size with r = .50.

- There is a positive high significant correlation between usefulness and positive learning effects about the main functioning modes of electric grids, r = .56, p = .00, N = 66. The analysis showed a large effect size with r = .56.

- There is a positive high significant correlation between identification of technical elements that are part of the smart grid and learning effects about the main functioning modes of electric grids. If a person can identify technical elements that are part of the smart grid then they also learned about the main functioning modes of electric grids. r = .53, p = .00, N = 66. The analysis showed a large effect size with r = .53.

Appendix table 4: Module 2 – Open Question BP.

Topics	
language (4 times mentioned)	suggestion for improvement

CHP is incorrect naming. Every Termo power plant (also Nuclear) has a result in Electricity (power) and Heat (useless, loss). Except modern "cogeneration" power plants can sell electricity and most of heat. So the difference is not producing, but selling or efficient use..	
also think that the formulation of some questions in the quizzes are tricky.	Maybe it would be good to re-furmulate some of the questions to make it easier to understand for those who don't speak English very well.
Difficult words/hard to understand questions.	Would be a lot easier in Estonian..
There are quite a few typo's (in many places in video, there was written "eletrical" not "Electrical").	
understanding (5 times mentioned)	**suggestion for improvement**
missing explanation for better	I would like the content to be explained by one person, with examples.
Add more explanations about special devices (storage devices for example), Always allow 2 attempts for quiz"	
the explanations are complicated.*	Maybe adding preliminary explanations could help (only for those who might need it) ...
The mechanisms are difficult to understand when we have no base	
Some questions were ambiguous (for exemple there was a question about the wind energy where none of the answers were correct. In the video, they said that "From this point forward, the power output increases EXPONENTIALLY with rising wind speed until reaching the nominal or rated power and hence the nominal wind speed." and the good answer of the question was "proportionally")	

* in detail: I mean when you have absolutely no experience/knowledge in one area, it is difficult to understand the concepts. I had to search for a lot of information online before taking the course. I	
quizzes (6 times mentioned)	**suggestion for improvement**
	Always allow 2 attempts for quiz
Quizzes contain questions that are not covered in the materials.	
I would say that half of the quizzes, the first half at least, had a bunch of question that had absolutely no answer in the video nor the text before the quit. This is confusing, because generally the quizzes' answers are in fact found in the videos. This caused confusion and necessity to search outside of this page. If this was on purpose, then okay. If not, I'd say some of the questions need revision.	
sort of hard to understand some differences between the given answers.	
Some of the quizzes contained questions which answers can not be found in the material.	
It's difficult to answer to some questions because no information in the course.	
visualization (2 times mentioned)	
Expectation of better quality of pictures, sometimes photo	
Again, the pictures in videos are changed a way too fast.	
suggestion without any category (2 times mentioned)	
Explain more about carbone capture technologie. Explain about the ecological and social footprint of each solution of storage.	
Add to main parts of Energy Systems also STORAGE, not only PRODUCERS, CONSUMERS, TRANSMISSION, DISTRIBUTEN, RETAIL and REGULATOR.	

no category/comments (3 times mentioned)	
One of chapters after test appears to be empty/without content.	
I question the "small footprint" of the batteries to store electricity, as the lithium is needed and the way is it extracted is really polluting and unethical to me, but maybe I'm wrong and then I would like to know more about it	
Some questions were not very well arranged	
thank you notes e.g.:	
Very instructive module that makes me want to learn more	
interesting	
But overall it was very interesting! :)	

Appendix table 5: Correlation between the 5 closed questions module 2 Broader Public.

		The content of the module was understandable to me.	The content of the module is useful to me	I can identify technical elements that are part of the smart grid.	I have learned about the main functioning modes of electric grids (transmission, distribution).	How did you experience the quiz(zes) you passed within this module?
The content of the module was understandable to me.	Pearson Correlation	1	,290*	,338**	,216	,404**
	Sig. (2-tailed)		,021	,007	,088	,001

	N	63	63	63	63	63
The content of the module is useful to me	Pearson Correlation	,290*	1	,421**	,291*	,150
	Sig. (2-tailed)	,021		,001	,021	,240
	N	63	63	63	63	63
I can identify technical elements that are part of the smart grid.	Pearson Correlation	,338**	,421**	1	,573**	,220
	Sig. (2-tailed)	,007	,001		,000	,083
	N	63	63	63	63	63
I have learned about the main functioning modes of electric grids (transmission, distribution).	Pearson Correlation	,216	,291*	,573**	1	,183
	Sig. (2-tailed)	,088	,021	,000		,150
	N	63	63	63	63	63
How did you experience the quiz(zes) you passed within this module?	Pearson Correlation	,404**	,150	,220	,183	1
	Sig. (2-tailed)	,001	,240	,083	,150	
	N	63	63	63	63	63

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

- There is a positive significant correlation between understanding and usefulness of the module, r = .29, p = .02, N = 63. The analysis showed a medium effect size with r = .02.

- There is a positive high significant correlation between understanding and identification of technical elements (that are part of the smart grid). If the content of the module is understandable then the identification of technical elements is given, r = .34, p = .01, N = 63. The analysis showed a medium effect size with r = .34.

- There is a positive high significant correlation between understanding and experiences of the quiz(zes). The more a person understood. The easier he/she experienced the quizzes, r = .40, p = .01, N = 63. The analysis showed a medium till large effect size with r = .40.

- There is a positive high significant correlation between usefulness and identification of technical elements (that are part of the smart grid). If

the content of the module is useful than the identification of technical elements is given, r = .42, p = .001, N = 63. The analysis showed a medium till large effect size with r = .42.

- There is a positive significant correlation between usefulness and positive learning effects about the main functioning modes of electric grids, r = .29, p = .02, N = 63. The analysis showed a small till medium effect size with r = .02.

- There is a positive high significant correlation between identification of technical elements that are part of the smart grid and learning effects about the main functioning modes of electric grids. If a person can identify technical elements that are part of the smart grid then they also learned about the main functioning modes of electric grids. r = .57, p = .00, N = 63. The analysis showed a large effect size with r = .57.

Appendix table 6: Module 3 – Open Question BP.

Topics	
language (6 times mentioned)	**suggestion for improvement**
The wording of questions and answers is really bad at times.	
In quiz 3.2.1, the first comparison word is in French, not in English as it should be.	
There is quite a number of typos and misspelling in lectures and quizzes.	
English is not my first language, and it felt like a lot of questions were about "finding the correct word" more than about comprehension of the chapters	
In Quiz 3.2.1 the question 1 was hard because you had to insert words and if you are not native and don't distinguish words with a/an/the this was hard.	
I wouldn't say that the quizzes were very difficult, but they were definitely confusing at times and some had grammatical mistakes which added to the confusion. Some answers were really hard to fish out due to the strange wording of the question or the answer.*	

* complement: I don't mean to say here that the questions and answers are supposed to be very simple and straight-forward, that would be boring and it wouldn't teach so much BUT at times the confusion and misleading aspect is a bit too much. Especially since this is info that I am very new to.

understanding (7 times mentioned)	**suggestion for improvement**
At the beginning of this module, the terms were a bit too technical but towards the end (blockchain) they were understandable	
	I need real examples to understand better, videos, objects, etc.
It was too technical for me so it was understandable.	
I think it is harder to understand the lessons without videos...	
the text is hardly comprehensible because the sentences are too long with many mistakes	The text should be restructured and concrete examples should be added
It's too bad, the content seemed interesting but I had to look for other sources to understand the concepts covered.	
The chapter were more difficult to understand when there were no video to explain it.	
quizzes (8 times mentioned)	**sugesstion for improvement**
Very difficult questions.	
Those finish the sentence questions were horrible. No idea what to put there even.	
some answers to the quizzes were not given clearly in the lessons (or they were given in the following lessons...)	
there are mistakes in the quizzes with wrong answer categories	
Quiz 3.2.1 error: First answer correct answer: connexion was probably meant connection	

Quiz 3.2.1 error: in answer 2 client should be correct answer as it describes all correct answers in one word	
I wouldn't say that the quizzes were very difficult, but they were definitely confusing at times and some had grammatical mistakes which added to the confusion.	
I think that in first question of Quiz 3.2.1 answer "connection" may be right. On the web resource Quora I've found information, that "connexion" and "connection" have the same meaning (https://www.quora.com/What-is-the-difference-between-connection-and-connexion). All information is interesting for me.	
Some questions need to be set up properly	
visualization (1 time mentioned)	
I think it is harder to understand the lessons without videos...	
suggestion without any category (0 times mentioned)	
no category/comments (0 time mentioned)	
thank you notes e.g.:	
No, I wouldn't change anything. I learned a lot of new things. Best regards.	
But very interesting future topics and futuristical problems.	

Appendix table 7: Correlation between the four closed questions module 4 Broader Public.

	The content of the module was understandable to me.	The content of the module is useful to me	I have learned about the usage of data analysis for	How did you experience the quiz(zes) you passed within

				optimiza-tion and network effi-ciency.	this mod-ule?
The content of the module was understandable to me.	Pearson Cor-relation	1	,623**	,563**	,368**
	Sig. (2-tailed)		,000	,000	,003
	N	62	62	62	62
The content of the module is useful to me	Pearson Cor-relation	,623**	1	,466**	,134
	Sig. (2-tailed)	,000		,000	,298
	N	62	62	62	62
I have learned about the usage of data analy-sis for optimi-zation and net-work effi-ciency.	Pearson Cor-relation	,563**	,466**	1	,200
	Sig. (2-tailed)	,000	,000		,119
	N	62	62	62	62
How did you ex-perience the quiz(zes) you passed within this module?	Pearson Cor-relation	,368**	,134	,200	1
	Sig. (2-tailed)	,003	,298	,119	
	N	62	62	62	62

**. Correlation is significant at the 0.01 level (2-tailed).

- There is a high positive significant correlation between understanding and usefulness of the module, r = .62, p = .000, N = 62. The analysis showed a large effect size with r = .62.

- There is a positive high significant correlation between understanding and learning about the usage of data analysis for optimization and network efficiency. r = .56, p = .000, N = 63. The analysis showed a large effect size with r = .56.

- There is a positive high significant correlation between understanding and experiences of the quiz(zes). The more a person understood the easier he/she

experienced the quizzes, r = .37, p = .003, N = 62. The analysis showed a medium effect size with r = .37.

- There is a positive high significant correlation between usefulness and learning about the usage of data analysis for optimization and network efficiency. r = .47, p = .000, N = 62. The analysis showed a large effect size with r = .47.

Appendix table 8: Module 4 – Open Question BP.

Topics	
language (2 times mentioned)	**suggestion for improvement**
English makes some question hard to answer	
Even I think I speak and understand English quite good, I had problems to understand many technical words, which were not ex-plained. it was quite difficult to study in English everything about it because I un-derstand power engineering very well. some question and answers were unclear or to complicated and discussable results frus-trated me, especially i can discuss about them (what they mean an what I meaned.)	
understanding (3 times mentioned)	**suggestion for improvement**
	Again, there could be more examples related to power systems.
	It would be appreciated if the parts were explained through a bit more.
I don't feel like I truly understood or grasped a lot of the content.	Perhaps some of the more com-plex termins can be explained more in-depth to understand the bigger ideas that they're used to describe.
quizzes (5 times mentioned)	**suggestion for improvement**
i don't get why "criteria" is not an ele-ment of "multi-CRITERIA decision analy-sis"...	

Last quiz was strange. Just 2 questions and those are misleading.	
The questions and answers can be quite confusing as the wording and expressions are weird.	
Quiz 4.1.1, Question 4: Very weird wording on these options.*	
quizzes are difficult because it is very hard to understand the wording on some of those. it made it difficult to get to the point.	

* What is/are the correct assertion(s) concerning the distributed generators? They are distributed generators connected to distribution network. They have no effect to the distribution network operation. They might cause higher voltages in the network with insufficient observability and controllability. They are modern loads of higher nominal power with a very stochastic consumption.

visualization (1 time mentioned)	**suggestion for improvement**
In "4.1.2 - Video - Demand-Side Management" video is represented "Peak Climbing" DMS objective. It should be "Peak clipping".	
suggestion without any category (1 times mentioned)	
Plus from 3: Information System Dedicated to Energy (I already did feedback but now I corrected some tests with 2 attempts: 3.2.1 - Quiz, Answer 1:You Answered, connection, Correct Answer, connexion,	
no category/comments (0 time mentioned)	
thank you notes e.g.:	
there is a lot of relevant information	
The content is passionating though	
The vocabulary is familiar to me now. I find it easier to follow lectures and quizzes. Thanks for the shared information. Best regards.	
quizzes were somewhat easy to do	

Appendix table 9: Module 5 – Correlation between the 5 closed questions module Broader Public.

		The content of the module was understandable to me.	The content of the module is useful to me	learned_trends_eu_policy_3	I have learned about the EU development plan of smart grid.	How did you experience the quiz(zes) you passed within this module?
The content of the module was understandable to me.	Pearson Correlation	1	,573**	,616**	,583**	,457**
	Sig. (2-tailed)		,000	,000	,000	,000
	N	57	57	57	57	57
The content of the module is useful to me	Pearson Correlation	,573**	1	,807**	,651**	,228
	Sig. (2-tailed)	,000		,000	,000	,088
	N	57	57	57	57	57
learned_trends_eu_policy_3	Pearson Correlation	,616**	,807**	1	,772**	,175
	Sig. (2-tailed)	,000	,000		,000	,194
	N	57	57	57	57	57
I have learned about the EU development plan of smart grid.	Pearson Correlation	,583**	,651**	,772**	1	,023
	Sig. (2-tailed)	,000	,000	,000		,863
	N	57	57	57	57	57
How did you experience the quiz(zes) you passed within this module?	Pearson Correlation	,457**	,228	,175	,023	1
	Sig. (2-tailed)	,000	,088	,194	,863	
	N	57	57	57	57	57

**. Correlation is significant at the 0.01 level (2-tailed).

- There is a high positive significant correlation between understanding and usefulness of the module with r = .57, p = .000, N = 57. The analysis showed a large effect size with r = .57.

- There is a positive high significant correlation between understanding and learning effects about the trends of EU policy with r = .62, p = .000, N = 57. The analysis showed a large effect size with r = .62.

- There is a positive high significant correlation between understanding and learning effects about the EU development plan of smart grid with r = .58, p = .000, N = 57. The analysis showed a large effect size with r = .58.

- There is a positive high significant correlation between understanding and experiences of the quiz(zes). The more a person understood the easier he/she experienced the quizzes, r = .46, p = .000, N = 57. The analysis showed a medium until large effect size with r = .46.

- There is a positive high significant correlation between usefulness and learning effects about the trends of EU policy with r = .81, p = .000, N = 57. The analysis showed a very large effect size with r = .81.

- There is a positive high significant correlation between usefulness and learning effects about the EU development plan of smart grid with r = .65, p = .000, N = 57. The analysis showed a large effect size with r = .65.

- There is a positive high significant correlation between learning effects about the trends of EU policy and learning effects about the EU development plan of smart grid with r = .77, p = .000, N = 57. The analysis showed a very large effect size with r = .81.

Appendix table 10: Module 5 – Open Question BP.

Topics	
language (4 times mentioned)	suggestion for improvement
I noticed some spelling mistakes	
Language problems	
Some words were unknown, which made it really hard to understand the questions.	
Also the grammar mistakes or missing words were a bit unprofessional to look at.	
understanding (3 times mentioned)	suggestion for improvement

Some terms and concepts were difficult to understand**	
	As in previous modules, there could be more examples regarding energy sector (e.g. concerning GDPR).
Also I think some questions were too difficult because the answer was not in the previous lesson or because the statement/the proposed answers were misleading...	
**complement: but it's mainly because i come from an architecture field and the hole topic is new for me	
quizzes (3 times mentioned)	**suggestion for improvement**
Also some answers were debatable in my opinion.	
The quizzes were much better compared to 3rd or 4th chapter. So many quizzes with just three simple questions. I think this module had a lot of interesting information that could've been represented in the questions thus helping to better learn/reinforce this info for the student who partakes this course. It almost seems as if these quizzes were done a bit "lazily".	
Some of the quizzes might be even too short and with only 1 possible correct answer, they went fast and rather quickly.	
visualization (4 time mentioned)	**suggestion for improvement**
Some slides are doubled in last modules, first time with video and on next is the same text without video.	
Would there not be an error in the graph representing the "net present value" method. I seem to have seen a thumbs up when NPV <0 and down for NPV> 0*	
You can listen to male voices with speed but not the female ones.	
I noticed a difference between the text and what the video says (especially the share of the renewable energy in the power sector : 18% or 25% ? 2016/2017 ?)	

*N'y aurait-il pas une erreur dans le graphique représentant la méthode "net present value". Il me semble avoir vu un pouce levé lorsque NPV<0 et baissé pour NPV>0	
suggestion without any category (1 time mentioned)	
The 2nd and 3rd module should have been easier like this one, i mean the questions were soo easy	
no category/comments (5 time mentioned)	
It is strongly liberal-oriented, but as in the other sectors, aren't there some issues with a fully privatised field, furthermore if the field is a citizen's basic need?	
Simplify content.	
Could better explain how in traditional business model different actors interact each other.	
Quite difficult. A lot of questions and a lot of materials to work through…	
But out of three options (others were to engineer students and to workers) it might be a bit too advanced for broader public? But at the same time I don't know who the target audience is.	
thank you notes e.g.:	
Very interesting and complete module. Makes me want to learn more about all the topics	
But it was still really interesting, thank you!	
The quizzes were much better compared to 3rd or 4th chapter.	
Videos and texts were great.	
Overall great course!	

Appendix table 11: Descriptive statistics for the same three questions in each module BP.

			N	Mean	Std. Devia-tion	Std. Error	95% Confidence Interval for Mean		Min	Maximum	Be-tween-Compo-nent Vari-ance
							Lower Bound	Upper Bound			
The con-tent of the mod-ule was under-standa-ble to me.	1,00		66	1,7879	,66830	,08226	1,6236	1,9522	1,00	4,00	
	2,00		66	1,8939	,87931	,10824	1,6778	2,1101	1,00	4,00	
	3,00		63	2,6349	,88539	,11155	2,4119	2,8579	1,00	5,00	
	4,00		62	2,1613	,70580	,08964	1,9821	2,3405	1,00	5,00	
	5,00		57	1,7544	,71416	,09459	1,5649	1,9439	1,00	4,00	
	Total		314	2,0478	,83892	,04734	1,9546	2,1409	1,00	5,00	
	Model	Fixed Effects			,77760	,04388	1,9614	2,1341			
		Random Effects				,16344	1,5940	2,5016			,12359
The con-tent of	1,00		66	1,7273	,75540	,09298	1,5416	1,9130	1,00	4,00	

			N								
the module is useful to me.	2,00		66	1,7273	,77550	,09546	1,5366	1,9179	1,00	4,00	
	3,00		63	2,1905	,83968	,10579	1,9790	2,4019	1,00	4,00	
	4,00		62	2,1935	,78592	,09981	1,9940	2,3931	1,00	5,00	
	5,00		57	1,7895	,70043	,09277	1,6036	1,9753	1,00	4,00	
	Total		314	1,9236	,79969	,04513	1,8348	2,0124	1,00	5,00	
	Model	Fixed Effects			,77386	,04367	1,8376	2,0095			
		Random Effects				,10987	1,6185	2,2286			,05068
How did you experience the quiz(zes) you passed within this module?	1,00		66	3,2424	,55638	,06849	3,1056	3,3792	2,00	5,00	
	2,00		66	3,1970	,78876	,09709	3,0031	3,3909	1,00	5,00	
	3,00		63	3,5238	,85868	,10818	3,3076	3,7401	1,00	5,00	
	4,00		62	3,3387	,92228	,11713	3,1045	3,5729	1,00	5,00	
	5,00		57	2,6667	,89310	,11829	2,4297	2,9036	1,00	5,00	
	Total		314	3,2038	,85153	,04805	3,1093	3,2984	1,00	5,00	
	Model	Fixed Effects			,81019	,04572	3,1139	3,2938			
		Random Effects				,13881	2,8184	3,5892			,08565

Appendix table 12: Tests of Homogeneity of Variances same three question in each module BP.

		Levene Statistic	df1	df2	Sig.
The content of the module was understandable to me.	Based on Mean	2,988	4	309	,019
	Based on Median	3,104	4	309	,016
	Based on Median and with adjusted df	3,104	4	304,075	,016
	Based on trimmed mean	3,389	4	309	,010
The content of the module is useful to me.	Based on Mean	,323	4	309	,862
	Based on Median	,275	4	309	,894
	Based on Median and with adjusted df	,275	4	304,029	,894
	Based on trimmed mean	,271	4	309	,896
How did you experience the quiz(zes) you passed within this module?	Based on Mean	5,113	4	309	,001
	Based on Median	4,697	4	309	,001
	Based on Median and with adjusted df	4,697	4	296,492	,001
	Based on trimmed mean	5,044	4	309	,001

- The tests of homogeneity of variances show in question one and three inhomogeneity ($F(4,309) = 2.99$, $p = .02$ and $F(4,309) = 5.11$, $p = .001$), but the groups are large enough and have nearly the same group size – in this case the analysis of variance is considered robust against that requirements are violated.

Appendix table 13: Bonferroni Post-Hoc-Test – Multiple Comparisons between the five modules concerning the question "The content of the module was understandable to me." BP.

(I) module	(J) module	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1,00	2,00	-,10289	,13465	1,000	-,4836	,2778
	3,00	-,84388*	,13626	,000	-1,2291	-,4586
	4,00	-,37025	,13683	,072	-,7571	,0166
	5,00	,03666	,13991	1,000	-,3589	,4322
2,00	1,00	,10289	,13465	1,000	-,2778	,4836
	3,00	-,74098*	,13676	,000	-1,1276	-,3543
	4,00	-,26735	,13732	,525	-,6556	,1209
	5,00	,13955	,14039	1,000	-,2574	,5365
3,00	1,00	,84388*	,13626	,000	,4586	1,2291
	2,00	,74098*	,13676	,000	,3543	1,1276
	4,00	,47363*	,13890	,007	,0809	,8663
	5,00	,88053*	,14193	,000	,4792	1,2818
4,00	1,00	,37025	,13683	,072	-,0166	,7571
	2,00	,26735	,13732	,525	-,1209	,6556
	3,00	-,47363*	,13890	,007	-,8663	-,0809
	5,00	,40690*	,14248	,046	,0041	,8097
5,00	1,00	-,03666	,13991	1,000	-,4322	,3589
	2,00	-,13955	,14039	1,000	-,5365	,2574
	3,00	-,88053*	,14193	,000	-1,2818	-,4792
	4,00	-,40690*	,14248	,046	-,8097	-,0041

*. The mean difference is significant at the 0.05 level.

Appendix table 14: Bonferroni Post-Hoc-Test – Multiple Comparisons between the five modules concerning the question "The content of the module was useful to me." BP.

(I) module	(J) module	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1,00	2,00	,00000	,13471	1,000	-,3809	,3809
	3,00	-,46320*	,13631	,008	-,8486	-,0778
	4,00	-,46628*	,13687	,007	-,8532	-,0793
	5,00	-,06220	,13993	1,000	-,4578	,3334
2,00	1,00	,00000	,13471	1,000	-,3809	,3809
	3,00	-,46320*	,13631	,008	-,8486	-,0778
	4,00	-,46628*	,13687	,007	-,8532	-,0793
	5,00	-,06220	,13993	1,000	-,4578	,3334
3,00	1,00	,46320*	,13631	,008	,0778	,8486
	2,00	,46320*	,13631	,008	,0778	,8486
	4,00	-,00307	,13844	1,000	-,3945	,3883
	5,00	,40100*	,14146	,049	,0010	,8010
4,00	1,00	,46628*	,13687	,007	,0793	,8532
	2,00	,46628*	,13687	,007	,0793	,8532
	3,00	,00307	,13844	1,000	-,3883	,3945
	5,00	,40407*	,14200	,047	,0026	,8056
5,00	1,00	,06220	,13993	1,000	-,3334	,4578
	2,00	,06220	,13993	1,000	-,3334	,4578
	3,00	-,40100*	,14146	,049	-,8010	-,0010
	4,00	-,40407*	,14200	,047	-,8056	-,0026

*. The mean difference is significant at the 0.05 level.

Appendix table 15: Bonferroni Post-Hoc-Test – Multiple Comparisons between the five modules concerning the question "How did you experience the quiz(zes) you passed within this module?" BP.

(I) module	(J) module	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1,00	2,00	,04184	,14030	1,000	-,3548	,4385
	3,00	-,28500	,14197	,456	-,6864	,1164
	4,00	-,09990	,14256	1,000	-,5030	,3032
	5,00	,57214*	,14577	,001	,1600	,9843
2,00	1,00	-,04184	,14030	1,000	-,4385	,3548
	3,00	-,32684	,14249	,225	-,7297	,0760
	4,00	-,14174	,14308	1,000	-,5463	,2628
	5,00	,53030*	,14628	,003	,1167	,9439
3,00	1,00	,28500	,14197	,456	-,1164	,6864
	2,00	,32684	,14249	,225	-,0760	,7297
	4,00	,18510	,14472	1,000	-,2241	,5943
	5,00	,85714*	,14789	,000	,4390	1,2753
4,00	1,00	,09990	,14256	1,000	-,3032	,5030
	2,00	,14174	,14308	1,000	-,2628	,5463
	3,00	-,18510	,14472	1,000	-,5943	,2241
	5,00	,67204*	,14845	,000	,2523	1,0918
5,00	1,00	-,57214*	,14577	,001	-,9843	-,1600
	2,00	-,53030*	,14628	,003	-,9439	-,1167
	3,00	-,85714*	,14789	,000	-1,2753	-,4390
	4,00	-,67204*	,14845	,000	-1,0918	-,2523

*. The mean difference is significant at the 0.05 level.

Appendix table 16: Module 1– Open Question Early Stage Researchers (RSCH).

Topics	

language (2 times mentioned)	suggestion for improvement
texts and especially the tests have quite a few languages errors in them	
In some cases the questions do not make much sense due to the language errors.	
understanding too difficult (0 times mentioned)	**suggestion for improvement**
quizzes/test too difficult/problem (1 time mentioned)	**suggestion for improvement**
The written answers or fill in the blanks in Quiz expects only certain words.	
	Regarding the tests it would also be nice if it were clearer to recognize which answers were wrong after submitting them for the first time.
visualization (3 times mentioned)	**suggestion for improvement**
background music is a bit irritating for informational content within the video	
the videos are all very good regarding the language	
	longer videos and less text; At least maybe for economical topic as it is a dry subject..
suggestion without any category (1 time mentioned)	
maybe split 1.3.3 in two smaller pack-ages	
no category (1 time mentioned)	
Some materials' usefulness is questionable.	

statements and context suggestions (0 time mentioned)	
thank you notes e.g.:	
short videos are great for giving a good overview of the topics	
But altogether the size and difficulty of the information was most of the time on point. Great Job!	
The video illustrations are great and well-made.	
No, everything was perfect and well explained.	

Appendix table 17: Module 1 – Correlations between the 5 closed questions RSCH.

		The content of the module was understandable to me.	The content of the module is useful to me.	I have learned about the impacts of smart grid at different scales (home, building, city, territory).	I have learned about the role of smart grid in energy transitions.	How did you experience the quiz(zes) you passed within this module?
The content of the module was understandable to me.	Pearson Correlation	1	,209	,266	,128	,410
	Sig. (2-tailed)		,352	,232	,570	,058
	N	22	22	22	22	22
The content of the module is useful to me.	Pearson Correlation	,209	1	,443*	,518*	-,215
	Sig. (2-tailed)	,352		,039	,014	,335
	N	22	22	22	22	22

I have learned about the impacts of smart grid at different scales (home, building, city, territory).	Pearson Correlation	,266	,443*	1	,456*	,229
	Sig. (2-tailed)	,232	,039		,033	,306
	N	22	22	22	22	22
I have learned about the role of smart grid in energy transitions.	Pearson Correlation	,128	,518*	,456*	1	,110
	Sig. (2-tailed)	,570	,014	,033		,625
	N	22	22	22	22	22
How did you experience the quiz(zes) you passed within this module?	Pearson Correlation	,410	-,215	,229	,110	1
	Sig. (2-tailed)	,058	,335	,306	,625	
	N	22	22	22	22	22

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix table 18: Module 2 – Open Question RSCH.

Topics	
language (0 times mentioned)	suggestion for improvement
understanding (1 time mentioned)	suggestion for improvement
answer to very few questions is not explained in the corresponding video or lecture. Or maybe it is difficult to identify the answer when not being familiar with the topic.	It would be nice if the chapter 2.3 is a bit more detailed as I had some problems understanding everything"

quizzes (3 times mentioned)	suggestion for improvement
Some quizzes are more difficult than others with questions a bit ambiguous	
in some quizzes i can't see my points before submitting the quiz	
The way written quiz questions are evaluated	
visualization (0 times mentioned)	
suggestion without any category (1 time mentioned)	
It would be nice if the questions in the test where you can write answers yourself were graded within a few days of the completion of the tests.	
no category/comments (1 time mentioned)	
Some bugs in exercises.	
thank you notes e.g.:	
Everything was good	

Appendix table 19: Module 2 – Correlations between the 5 closed questions RSCH.

		The content of the module was understandable to me.	The content of the module is useful to me	I can identify technical elements that are part of the smart grid.	I have learned about the main functioning modes of electric grids (transmission, distribution).	How did you experience the quiz(zes) you passed within this module?
The content of the module was understandable to me.	Pearson Correlation	1	,449	,429	,262	,530*
	Sig. (2-tailed)		,062	,076	,294	,024
	N	18	18	18	18	18
The content of the module is useful to me	Pearson Correlation	,449	1	,259	,122	,200
	Sig. (2-tailed)	,062		,299	,630	,425
	N	18	18	18	18	18
I can identify technical elements that are part of the smart grid.	Pearson Correlation	,429	,259	1	,470*	,000
	Sig. (2-tailed)	,076	,299		,049	1,000
	N	18	18	18	18	18
I have learned about the main functioning modes of electric grids (transmission, distribution).	Pearson Correlation	,262	,122	,470*	1	,000
	Sig. (2-tailed)	,294	,630	,049		1,000
	N	18	18	18	18	18

How did you experience the quiz(zes) you passed within this module?	Pearson Correlation	,530*	,200	,000	,000	1
	Sig. (2-tailed)	,024	,425	1,000	1,000	
	N	18	18	18	18	18

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix table 20: Module 3 – Correlations between the 5 closed questions RSCH.

		The content of the module was understandable to me.	The content of the module is useful to me	I have learned about digital components that contribute to smart grid.	I have learned about the nature and the path of data involved in smart grid	How did you experience the quiz(zes) you passed within this module?
The content of the module was understandable to me.	Pearson Correlation	1	,373	,681**	,538*	,388
	Sig. (2-tailed)		,140	,003	,026	,138
	N	17	17	17	17	16
The content of the module is useful to me	Pearson Correlation	,373	1	,348	,600*	-,447
	Sig. (2-tailed)	,140		,171	,011	,083
	N	17	17	17	17	16
I have learned about digital components that contribute to smart grid.	Pearson Correlation	,681**	,348	1	,858**	,105
	Sig. (2-tailed)	,003	,171		,000	,698
	N	17	17	17	17	16

I have learned about the nature and the path of data involved in smart grid	Pearson Correlation	,538*	,600*	,858**	1	-,269
	Sig. (2-tailed)	,026	,011	,000		,314
	N	17	17	17	17	16
How did you experience the quiz(zes) you passed within this module?	Pearson Correlation	,388	-,447	,105	-,269	1
	Sig. (2-tailed)	,138	,083	,698	,314	
	N	16	16	16	16	16

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix table 21: Module 4 – Correlations between the 4 closed questions RSCH.

		The content of the module was understandable to me.	The content of the module is useful to me	I have learned about the usage of data analysis for optimization and network efficiency.	How did you experience the quiz(zes) you passed within this module?
The content of the module was understandable to me.	Pearson Correlation	1	,600*	,564*	,402
	Sig. (2-tailed)		,014	,023	,123
	N	16	16	16	16

The content of the module is useful to me	Pearson Correlation	,600*	1	,550*	-,032
	Sig. (2-tailed)	,014		,027	,905
	N	16	16	16	16
I have learned about the usage of data analysis for optimization and network efficiency.	Pearson Correlation	,564*	,550*	1	,064
	Sig. (2-tailed)	,023	,027		,813
	N	16	16	16	16
How did you experience the quiz(zes) you passed within this module?	Pearson Correlation	,402	-,032	,064	1
	Sig. (2-tailed)	,123	,905	,813	
	N	16	16	16	16

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix table 22: Module 5 – Correlations between the 5 closed questions RSCH.

		The content of the module was understandable to me.	The content of the module is useful to me	learned_trends_eu_policy_3	I have learned about the EU development plan of smart grid.	How did you experience the quiz(zes) you passed within this module?
The content of the module was understandable to me.	Pearson Correlation	1	1,000**	,885**	,769**	-,167
	Sig. (2-tailed)		,000	,000	,001	,552
	N	15	15	15	15	15

The content of the module is useful to me	Pearson Correlation	1,000**	1	,885**	,769**	-,167
	Sig. (2-tailed)	,000		,000	,001	,552
	N	15	15	15	15	15
learned_trends_eu_policy_3	Pearson Correlation	,885**	,885**	1	,901**	-,315
	Sig. (2-tailed)	,000	,000		,000	,253
	N	15	15	15	15	15
I have learned about the EU development plan of smart grid.	Pearson Correlation	,769**	,769**	,901**	1	-,325
	Sig. (2-tailed)	,001	,001	,000		,237
	N	15	15	15	15	15
How did you experience the quiz(zes) you passed within this module?	Pearson Correlation	-,167	-,167	-,315	-,325	1
	Sig. (2-tailed)	,552	,552	,253	,237	
	N	15	15	15	15	15

**. Correlation is significant at the 0.01 level (2-tailed).

1.5 - Survey - Evaluation of Module "Context & Challenges"

⚠ This is a preview of the published version of the quiz

Started: Apr 26 at 3:17pm

Quiz Instructions

MODULE EVALUATION

Dear participant,

Congratulations on finishing this module!

This is a short evaluation of the module which will help us with further adaptation to participants' learning needs. It should take you no longer than 5 minutes to complete the questionnaire.

What happens to the data provided by evaluation?

All your answers are anonymized directly. The data collected through evaluation will provide the basis to adapt the courses in the future, if necessary. Results will be published in an evaluation report. If you do not wish to contribute to the evaluation under these conditions, you may skip the questions by not ticking any answer and submitting an empty survey.

There are no wrong answers and no time limit. Just pick whichever answer feels the most accurate to describe your experience with the module.

Thank you for your input!

You can find the evaluation questionnaire below:

Question 1	1 pts

The content of the module was understandable to me.

○ Strongly disagree

○ Disagree

○ Undecided

○ Agree

○ Strongly agree

Question 2   1 pts

The content of the module is useful to me.

○ Strongly disagree

○ Disagree

○ Undecided

○ Agree

○ Strongly agree

Question 3   1 pts

I have learned about the impacts of smart grid at different scales (home, building, city, territory).

○ Strongly disagree

○ Disagree

○ Undecided

○ Agree

○ Strongly agree

Question 4   1 pts

I have learned about the role of smart grid in energy transitions.

○ Strongly disagree

○ Disagree

○ Undecided

○ Agree

○ Strongly agree

Question 5   1 pts

How did you experience the quiz(zes) you passed within this module?

○ Very easy

○ Easy

○ Moderate

○ Difficult

○ Very difficult

Question 6   1 pts

Is there anything you would like to change about the module you just finished?

You may want to share your thoughts about difficulty, missing topics, language problems or any other aspect that holds a key to improving your learning experience and outcomes.

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Appendix Figure 1: Exemplary Questionnaire from Broader Public Course, Module 1

5.2.Appendix for Part 3: Adjustments of the short-term programs

The second tool which we use to improve the programs is comments from participants (list of the most relevant feedback for every module within every target group):

BROADER PUBLIC COURSE (BP)

Recommendations for Module 1: Context and challenges of power grid and smart grid

1. You should add to list of energy organization also Provider of EES (Energy Storage System) next to Producer, TSO, DSO, Regulator, Retail and Consumer, Second: Transmission Network is HV and very high voltage, Distribution network in MV (20 kV) and 0,4 kv (LV). Why is first only mesh and second only tree topology?

2. "electrcity' instead of 'electricity'

3. Some English words are new ("equilibrium" for example) which made questions harder - had to Google the meaning of the words. Could use easier words or be in "Mother language".

4. The term reinforced was misinterpreted by me. On most mistakes made in the quizzes it was a reading error. Everything was actually quite clear. In quiz 1.2.3 on the vertical system, basically due to it being a Monopoly, the statement of the Generator selling the power directly to the end user seemed to me a bit debatable.

5. As my English is non-native it is sometimes impossible to understand some word phrases that are used in sentences i.e. 1.3.3 test where smart grid helps to eliminate the constraint of energy supply=demand. I mean, SG does help in relieving the constraints so I guess it can be understood both ways.

Recommendations for Module 2: Electric Network & Infrastructure

1. CHP is incorrect naming. Every Termo power plant (also Nuclear) has a result in Electricity (power) and Heat (useless, loss). Except modern "cogeneration" power plants can sell electricity and most of heat. So the difference is not producing, but selling or efficient use. 2. Add to main parts of Energy Systems also STORAGE, not only PRODUCERS, CONSUMERS, TRANSMISSION, DISTRIBUTEN, RETAIL and REGULATOR.

2. Add more explanations about special devices (storage devices for example).

3. I question the "small footprint" of the batteries to store electricity, as the lithium is needed and the way is it extracted is really polluting and unethical to me, but maybe I'm wrong and then I would like to know more about it.

4. Explain more about carbone capture technologie. Explain about the ecological and social footprint of each solution of storage.

5. There are quite a few typo's (in many places in video, there was written "eletrical" not "Electrical").

Recommendations for Module 3: Information System Dedicated to Energy

1. I think that in first question of Quiz 3.2.1 answer "connection" may be right. On the web resource Quora I've found information, that "connexion" and "connection" have the same meaning (https://www.quora.com/What-is-the-difference-between-connection-and-connexion). All information is intresting for me.

2. In quiz 3.2.1, the first comparison word is in French, not in English as it should be.

3. In quiz 3.2.1, the first comparison word is in French, not in English as it should be.

4. In Quiz 3.2.1 the question 1 was hard because you had to insert words and if you are not native and don't distinguish words with a/an/the this was hard. And I beleave that there are 2 errors. First answer correct answer: connexion was probably meant connection, and in answer 2 client should be correct answer as it describes all correct answers in one word.

Recommendations for Module 4: Management & Decisional System

1. Quiz 4.1.1, Question 4, What is/are the correct assertion(s) concerning the distributed generators? They are distributed generators connected to distribution network.

2. In "4.1.2 – Video – Demand-Side Management" video is represented "Peak Climbing" DMS objective. It should be "Peak clipping".

3. Last quiz was strange. Just 2 questions and those are misleading.

4. Even I think I speak and understand English quite good, I had problems to understand many technical words, which were not explained. It was quite difficult to study in English everything about it because I undestand power engineering very well. Some question and answers were uncleare or to complicated and discussable results frustrated me, especially I can discuss about them (what they meam an what I meaned).

Recommendations for Module 5: Policy & Economy in Energy

1. It is strongly liberal-oriented, but as in the other sectors, aren't there some issues with a fully privatised field, furthermore if the field is a citizen's basic need?

2. I noticed some spelling mistakes and a difference between the text and what the video says (especially the share of the renewable energy in the power sector: 18% or 25% ? 2016/2017 ?). Also I think some questions were too difficult because the answer was not in the previous lesson or because the statement/the proposed answers were misleading...But it was still really interesting, thank you!

3. Some slides are doubled in last modules, first time with video and on next is the same text without video.

4. The quizzes were much better compared to 3rd or 4th chapter. Some of them might be even too short and with only 1 possible correct answer they went fast and rather quickly. Videos and texts were great. You can listen to male voices with speed but not the female ones. Overall great course!

5. Could better explain how in traditional business model different actors interact each other.

6. Quite difficult. A lot of questions and a lot of materials to work through. Some words were unknown which made it really hard to understand the questions. Also some answers were debatable in my opinion.

7. As in previous modules, there could be more examples regarding energy sector (eg concerning GDPR).

EARLY STAGE RESEARCHERS COURSE (RSCH)

Recommendations for Module 1: Context and challenges of power grid and smart grid

1. As the quality of the videos is very nice and as they are very informative, maybe you could take longer videos and less text. At least maybe for economical topic as it is a dry subject. At least for me. And maybe split 1.3.3 in two smaller packages. But altogether the size and difficulty of the information was most of the time on point. Great Job!

Recommendations for Module 2: Electric Network & Infrastructure

1. It would be nice if the questions in the test where you can write answers yourself were graded within a few days of the completion of the tests.

2. It seems that the answer to very few questions is not explained in the corresponding video or lecture. Or maybe it is difficult to identify the answer when not being familiar with the topic. It would be nice if the chapter 2.3 is a bit more detailed as I had some problems with understanding everything.

3. Some bugs in exercises.

Recommendations for Module 3: Information System Dedicated to Energy

1. The tests were not put together thoroughly. They should be reviewed, corrected regarding the language and the content (sometimes it is not possible to find the required information within the course) and the answers should be reviewed as well. They are not always correct. It should be possible to retake the tests, e.g. the last test could only be taken once.

Recommendations for Module 4: Management & Decisional System

4.3.1 Quiz Question 1 wasn´t quite clear for me, maybe a more precise Question would be suitable.

Recommendations for Module 5: Policy & Economy in Energy

1. Some slides are cramped and difficult to read

2. The slides were in my opinion not as informative as the videos. Even plain text and graphs are better, as the slides are not always self-explanatory. But altogether it is a very informative course and a cool concept.

ELECTRICAL ENGINEERING WORKFORCE COURSE (WKFR)

Recommendations for Module 1: Context and challenges of power grid and smart grid

1. The range of difficultness between the questions in a quiz is very high. In my opinion the quizzes should sometimes be better balanced. The last quiz contained 3 clozes, which were way to hard in my opinion. If you in general not well talented in resolving clozes you a very fast below the threshold for passing the test. In my opinion one or two clozes would be enough and would give people the chance to pass without solving them.

2. Some lecture slides in the first chapters where sometimes not self-explained, especially some graphics. If possible underlining the slides with audio would have been nice. Regarding videos: After explaining the last bullet points 1-3 sec. more time would have been good to process the knowledge depending on the length of the bullet points. But in general interesting and very well structured training, especially the videos are a great learning tool.

3. When doing test in three steps it is suggested to remain with answers form previous step thus avoid the repetition.

4. I was told that this course takes 3-4 hours per week. I have spent 8 hours. Video in chapter 1.1 takes 1.5 hour. It is not needed to complete chapter... but it is very interesting! Videos in chapter 1.2 are on playlist... I realized at video 18/36 that it won't go this way anymore. I continued with the text and quiz. While working on following chapters I found out that I already saw those videos. Half of this playlist took a lot of my time.

Recommendations for Module 2: Electric Network & Infrastructure

1. I would add more calculate examples on real electric network net on which the participants can show the benefits of green transformation.

2. Quiz 2.2.2, Question 2: I assume that incorrect answer is marked as correct. [Quiz 2.2.2-Q2]

Recommendations for Module 3: Information System Dedicated to Energy

1. There were no major problems, only one answer is chosen incorrectly in quiz: What does URL mean. Correct answer is Uniform Resource Locator and not Unified Resource Locator which is considered to be correct in QUIZ.

2. Once again there is a big gap between study material and quizzes. This is having a bad impact on motivation and gives a feeling of a badly prepared course. Specialty please pay attention to 3.4.2 - Quiz - Cyberattacks, question 5.

3. I think this module took me more time than the previous ones. More than I expected, but the topics were very interesting and useful. The module could also be divided in multiple modules to go more into details. There was an incorrect

solution of the second question in the quiz "3.3.1 - Quiz - Communication Technologies".

4. Why this is wrong? [3.2.1-Q2]

5. I would recommend to use a lower vocabulary level for this section. Some words where really unique. As you aim is to give a short overview, there is no need for advanced vocabulary in this section.

Recommendations for Module 4: Management & Decisional System

1. Please check these two questions: Quiz 4.3.1 Question 1: official answer Alternatives. But in the lecture it says „"herefore the main elements of any MCDA problem include values alternatives criteria and their weighting" and DMs [12]. Quiz 4.3.2 Question 6: possible answers are to narrow or at least they should be more explicit in the lecture.

2. TO QUIZ 4.3.1 : Question 1 What are the elements of MCDA? : You are writing in subparagraph ELEMENTS OF MCDA: Therefore the main elements of any MCDA problem include values alternatives criteria and their weighting and DMs [12]." But in the solution is only ""Alternatives"" Correct. So I would guess this question should be: What are the ESSENTIAL elements of MCDA? or the question should be a single answere question. TO QUIZ 4.3.2 Question 6: Also some other words would fit in perfectly.

Recommendations for Module 5: Policy & Economy in Energy

1. I have trouble understanding several terms from economics in my native language so in English is even worse. I am technician not economist

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