

# AAE-E1000 – Introduction to Advanced Energy Solutions

Exam questions / 14.12.2017

*Please return the examination material together with the answers unless stated otherwise!*

Name: \_\_\_\_\_

Student number: \_\_\_\_\_

## **PART I: All students answer these questions [30 points]**

1. Answer briefly the following questions. Use up to two sentences for questions a), b), c), and d). (total of 6p):
  - a) What is the key innovation of Fortum HorsePower business? [1p]
  - b) What is carbon lock-in, a term discussed by Unruh (2000)? [1p]
  - c) When excluding combustion, what kind of energy generation is possible using algae? [1p]
  - d) What is the East-West dilemma of geothermal energy in China? [1p]
  - e) From the perspective of a power company, what are the three main problems in temporal management of energy planning that could result major additional costs or losses in the implementation of energy infrastructure to a newly planned urban area? Let us assume that the newly planned area is at a state of “green field”. (Use no more than 150 words) / [2p]
2. From material point of view, what obstacles do the electric vehicles and fuel cell vehicle face if they are scaled up in the volume of current combustion engine vehicles? (Use no more than 400 words) / [6p]
3. Answer briefly the following questions about energy systems and services (total of 6p)
  - a) Identify at least four basic descriptions that describe key characteristics of any system. These descriptions were given at the very first lecture of the course. Give examples of how the presence of these characteristics manifest in energy systems (Use no more than 250 words) / [3p]
  - b) What are the main sources of lock-in in any socio-technical system? How does that apply to energy systems? / (Use no more than 250 words) / [3p]

4. Answer briefly the following questions on renewable power generation (total of 6 p):
- a) What are the main sources of uncertainty concerning the future of wind energy? In your answer, please reflect on the findings of the expert elicitation survey by Wisser et al. (Use no more than 250 words) / [3p]
  - b) What are the main reasons, according to Hirth (2013), for the value of solar or wind power to decrease in an electricity market when their overall share on the market increases? (Use no more than 200 words) / [3p]
5. Answer briefly the following miscellaneous selection of questions (total of 6 p):
- a) Why large, MW-scale engine power plants can be valuable in electricity market where the market price typically fluctuates strongly on within each day? When used correctly in such system, how do they contribute positively to the environment? (Use no more than 200 words) / [3p]
  - b) Please explain briefly what kind of technology improvements are involved in the smartening process of electricity grid. Please note, that some of these improvements might be already ongoing. Identify at least four main themes. (Use no more than 150 words) / [2p]
  - c) Explain with two sentences the basic idea behind the concept “vehicle to grid” [1p]

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## **PART II: Questions for students who take the full examination [6 points]**

This part of the exam is for the students who **do not want to submit the home assignment** essay and have its points to be included in the grading of their course. If you answer these questions, you are not expected to submit the home assignment essay attached to the examination. **So do not answer these questions if you wish to utilize the home assignments essay towards your course grade.** Students that did not do home assignments should answer these questions.

A. Answer briefly the following questions (total of 6 points):

- A1) According to the analysis and case study by Kapsali and Kaldellis, what are the key parameters that need to be analyzed to identify the favorable size of pumped hydro storage implemented into a wind energy dominated (>15% of total energy delivery) power system typical to Greek islands? Provide at least six main parameters with brief explanations. (Use no more than 200 words) / [3p]
  
- A2) Østergaard et al. gives a detailed description about how use of low temperature geothermal district heating could help the city of Fredrikshavn to become a 100% renewable energy city. Describe briefly the main points of the present and future energy scenario of Fredrikshavn and how the implementation of geothermal energy would contribute to this scenario. What are the main forms of energy generation the geothermal energy would be replacing? (Use no more than 200 words) / [3p]



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Essay instructions / 14.12.2017

## Instructions for the essay [6 points]

This home assignment task is for the students who **do not wish to take the exam PART II (6p)**. You can take these essay instructions with you from the exam. The DEADLINE for the essay is 7.1.2018.

Write an essay about your learning experience at the course. Your essay should answer to the following question:

*“How your learning on the course has changed your understanding about renewable energy generation and the impact of renewable energy generation on the society as a whole.”*

Focus on up to three selected main themes in your writing. Motivate and connect your selection of themes. Give also a topic for your essay. The essay should be compact in its style and you should not use more than 2000 words in your essay. You should also consider the audience for the essay to be your teacher. Further, generic instructions about writing an essay are given at the resources listed below.

The essay should be returned as PDF via email to [jukka.paatero@aalto.fi](mailto:jukka.paatero@aalto.fi) latest by 7.1.2018. The email title MUST BE “AAE-E1000\_ESSAY\_LASTNAME”. Attach the essay to the email using a filename “AAE-E1000\_ESSAY\_LASTNAME.pdf”. Above, the LASTNAME equals your own family name. Failure to submit the essay in correct format may result in me neglecting the submission.

Step-by-step instructions on writing essays:

<https://www.time4writing.com/writing-resources/step-by-step-guide-to-writing-an-essay/>

Good generic essay instructions:

<https://www.fastweb.com/student-life/articles/essay-tips-7-tips-on-writing-an-effective-essay>

The homepage below gives a detailed guide on writing essays, even if the context for the instructions is different.

<https://www.utu.fi/en/units/soc/units/conthist/studying/methods/essay-instructions/Pages/home.aspx>

Some clarifying commentary concerning the utu.fi page:

1. The essay required from you is really much smaller than the standard expected at the page.
2. I do not expect you to use quotations, while you may still choose to use them. Instead, I expect references to sources using at least the course materials (not lecture slides).