***USE THIS WORD-FILE AS A TEMPLATE WHEN WRITING THE HOMEWORK TO BE SUBMITTED IN RETURN BOX. CONVERT THE FILE TO PDF-FORMAT BEFORE SUBMISSION***

**LIST OF ASSIGNMENTS** (You can answer in English, Finnish or Swedish)

**Welcome chapter**

Before you start studying the course, pause to reflect on the following questions. Make some notes so you can get back to them at the end of the course, in the final assignment.

1. Do you already know something about the Hydrogen Economy? What do you want to learn from this course?
2. If you are in working life, how is your work related to the hydrogen economy value chains as presented in the above picture? Or if you are still studying, thinking of a career change, or just interested in the hydrogen economy in general, how would you like to position yourself in the future?

Next, take a look at the Six Strategies for Effective Learning. Contemplate for a moment how to ensure your learning path during the hydrogen economy course.

* [Six Strategies for Effective Learning](https://static1.squarespace.com/static/56acc1138a65e2a286012c54/t/57d03e669de4bbd3567d57a6/1473265254536/All-Color-Posters.pdf) (in English)
* [Kuusi tehokkaan oppimisen strategiaa](https://static1.squarespace.com/static/56acc1138a65e2a286012c54/t/5dfb79c9f8effb79c8bc0694/1576761802233/Finnish%2BSix%2BStrategies%2Bfor%2BEffective%2BLearning%2Bposters.pdf) (in Finnish)
* [Sex strategier för effektivt lärande](https://static1.squarespace.com/static/56acc1138a65e2a286012c54/t/5a00af2c71c10b3722192f66/1509994284816/Swedish%2BSix%2BStratgies%2Bfor%2BEffective%2BLearning.pdf) (in Swedish)
1. Which strategies are you going to use during the course? Choose an optimal time range for your course completion and concisely plan your work.

**MODULE I Assignments**

**1. Why is Hydrogen discussed so much right now?**

* Find 3-5 recent articles about hydrogen in news media. Write a short essay (1-2 pages) on the topic. Reflect on the news based on the module lectures. Indicate which news articles you read.

**2. Fossil reserves and energy markets**

Study the "Fossil reserves and energy markets" material and write (1-2 pages) covering the below topics:

2a. Describe the fundamental differences between oil, gas ad coal markets, including the role that their energy density plays in this.

2b. Watch the video about the 1973 oil crisis. Then answer these questions:

* Why do you think that the oil crisis did not lead to a long term transition away from fossil fuels/energy inefficiency, at least in the US?
* Was the oil crisis a missed opportunity to make a clean energy transition or was it not enough of a shock? (or can you think of other reasons why the lessons of the crisis were not learnt)

2c. Answer these questions based on individual research on the topic

* In the period 2019-2025, key additions in oil supply are foreseen from US, Brazil, Guyana, Iraq, UAE and Canada. Choose two of these, make some of your own research, and briefly summarise/compare how the supply from this country is being increased)
* Discuss at least 3 of the 10 measures outlined by the IEA in March 2022 for reducing oil use, and whether you think they would be feasible in Finland.

2d. The key gas hub price benchmark in Europe in the TTF. Look up some information about that benchmark. What efforts at EU level are currently being made to control it in the current crisis?

**3. The EU H2 strategy**
Download the strategy and write a short essay (1-2 pages) about the importance of this strategy, as guided by Pami Aalto in his lecture. If you are working for some company, take the perspective of this company. Otherwise, take some aspect important to the Finnish economy, that you think appropriate. In your written assignment, cover the following three points

* Assess which of the goals and aims of the EU strategy correspond to the goals/aims of your own company/organization
* What is the role of my company/organisation or unit in company/organization (choose which one) in the implementation of the EU hydrogen strategy? Specify also the main business/activities of your company/unit.
* How will the implementation of the strategy influence the operating environment of my company? Specify also the main features of the operating environment.

**MODULE II Assignments**

**1. Power markets and hydrogen**

Study the lecture materials "Power markets and power generation" and "Power system and transmission" and summarise the main points from each lecture. After this, reflect on the following questions:

* How are the power system, markets and transmission related to the hydrogen economy?
* What are the main challenges for the power system in the hydrogen transition? Choose a point-of-view or a statement.

**2. Essay based on lecture "Smart grid, sector coupling"**

Study the lecture material and then write a small essay about your ideas regarding the discussion topics:

* How to ensure enough transmission capacity to exchange power, hydrogen and CO2
* What is the role of flexible demand and supply together with storage
* How should the energy markets be developed: energy market à power market, due to high share of zero marginal cost electricity production (in your opinion...)

**3.  Assignments related to the lecture “Energy Storage**”

 3a. Prepare the Mind-map that is instructed in the beginning of the lecture. It’s not the idea that the mind-map is full, but rather your own first idea of the mind-map will be perfect.

 3b. What role do you see that energy storage, overall, will play in the energy transition?

 3c. What do you see as the strenghts of storing electricity as hydrogen (or it’s derivatives), list 1-2 examples where you think it could be the most useful  as an energy storage.

**MODULE III Assignments**

**1. Questions on hydrogen chemistry**Answer the questions based on the lecture "Introduction to hydrogen chemistry and "Sustainable hydrogen production".

* What is the basic building block of matter?
* How blue and green hydrogen differ from each other?
* Why should we and how can we produce green and blue hydrogen?
* Why does the production of grey hydrogen enhance the climate change?
* What are the two half reactions that take place during the water splitting and where do they take place? Which one of the reactions control the overall performance of the reaction?

**2. Sustainable routes to hydrogen**
Based on the lecture "Sustainable hydrogen production", describe what are the most sustainable routes to hydrogen, how mature they are and how their sustainability can be described? You can create a mind map, or other picture or write.

**3. Essay**
Study the given thesis and write an essay (1-2 pages) where you

* Compare the overall efficiency in different electrolyser-storage- transportation-end use chains. Compare liquid and gas forms of storage tanks and pipelines.  Give some examples of cases and their overall efficiency from electricity to the end use of energy.
* Make an estimate in different cases, how big a share of losses is in form on heat. Give your opinion about what shall we do with this extra heat.

**MODULE IV Assignments**

**1. Essay**

Based on the thesis by Maria Hanako, write a sort essay that answers these questions:

* What is the role of hydrogen and different hydrogen based fuels in energy system and energy use de-carbonization. Give your own estimation.
* What are pros and cons of different fuels.

**2. Fuel cell types**

What are the different applications of fuel cells? Which do you find interesting or potential from your point-of-view? Write a short answer (max 1 page).

**COURSE CLOSURE AND FINAL ASSIGNMENT**

**Final assignment: Road to the Finnish Hydrogen Economy – My point of view**

**4.After finalizing the speech Outi Ervasti, you have reached the final assignment of this course. Write a summative essay where you round-up your perceptions using three key arguments on why and how we should promote the Finnish hydrogen economy in the future.**

**5. After you have finished all the course assignments, take a look at the notes you made at the beginning of the course (Welcome chapter). Write a short feedback where you reflect**

* Your expectations at the beginning of the course
* Did you learn what you expected to learn
* Did you learn something you did not expect
* What was the most important takeaway for you from this course
* What do you want to learn more about