AAE-E3120 Circular Economy for Energy Storage

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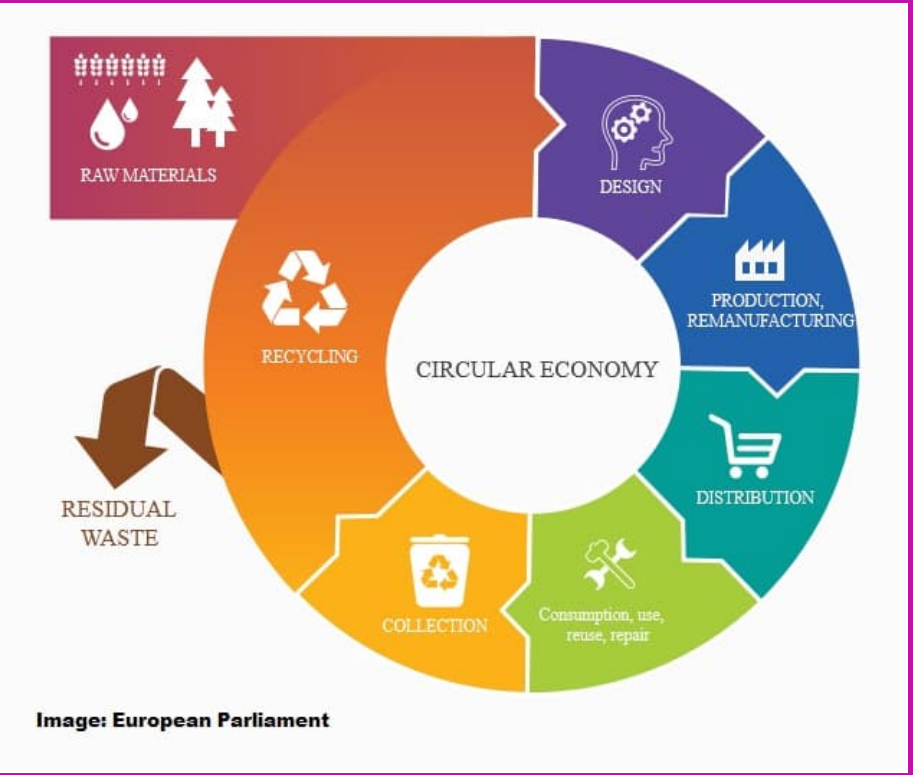

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Practicalities

Learning outcomes

- **Identify** circular economy concepts and the role of energy in recycling
- **Recognize** the material choice effect to degradation mechanisms of the system
- **Develop** new design for recycling approach for energy storage application and justify with scientific argumentation
- **Share** one's professional expertise in an online team

Module Based Learning

The course has 4 Modules

Module A - Circular Economy	Module B – New Material Solutions
Module C – Durability of the devices	Module D – Eco-Design

Timetable for modules and contact sessions at MyCourses

Module Based Learning

Each Modules has the same tasks (duration around 1,5 weeks)

2-3 **Video Module** Lectures
(available in the beginning of the module)

Find **individual reading material** related to your application and topic of the module

Personal task (Lecture journal) where you reflect the videos and readings

Group task (Poster preparation) you meet with your group (in person) reflect your learning from the module and prepare a poster of your application point of view

Contact Session (end of module):
Where group present and discuss posters, teaching staff address the questions posted
Possibility to ask/elaborate any questions

In Person, dates will be provided at the front page of MyCourses

Mandatory attendance at the contact sessions
(or replacing assignment)

Course tasks

Personal Tasks (50 p.)

- Pre-task	4 p.
- Lecture Journals (4 x 7 p.)	28 p.
- Task 1 – energy calculation (with a peer)	10 p.
- Peer evaluation of group work	5 p.
- Webropol Feedback	3 p.

Group tasks (50 p.)

- Posters (4 x 7 p.)	28 p.
- Final project – Eco-design	22 p.

In Total	**100 p.**

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You will require min. 60 points to pass the course
Grading table provided at the course end

Personal tasks

Reflecting your learning, finding material for your case study

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Questions at video modules

The blue boxes have questions, when appear at video lecture, please pause the video and write short notes to your journal

Reflect to your lecture journal

What do you think…

On your opinion…

These are questions that you can think during your learning process, but you do NOT need to address these on your journal

Lecture Journals

- There is a lecture journal template (please use that) – MyCourses
- Prepare this prior your team work
- Lecture journals are your personal reflective work:
  - Please address the questions from videos to this journal
  - Also – add “what was new to me” part for each video
  - Here you report also the reading material that you have found
  - Reflect the reading material with instructions

  - Provide “Questions for the Module” – at the end (that can be about the videos/reading material) -> there are discussed at contact online sessions – at least 1 question

Peer Task I: Return of energy investment
Iterative work

How long do you need to operate a device (own application) to obtain the energy that was needed to produce the raw materials of the device?

You will be divided into 2-3 person sets from your topic group.

Work with your peer/s together, meet to discuss

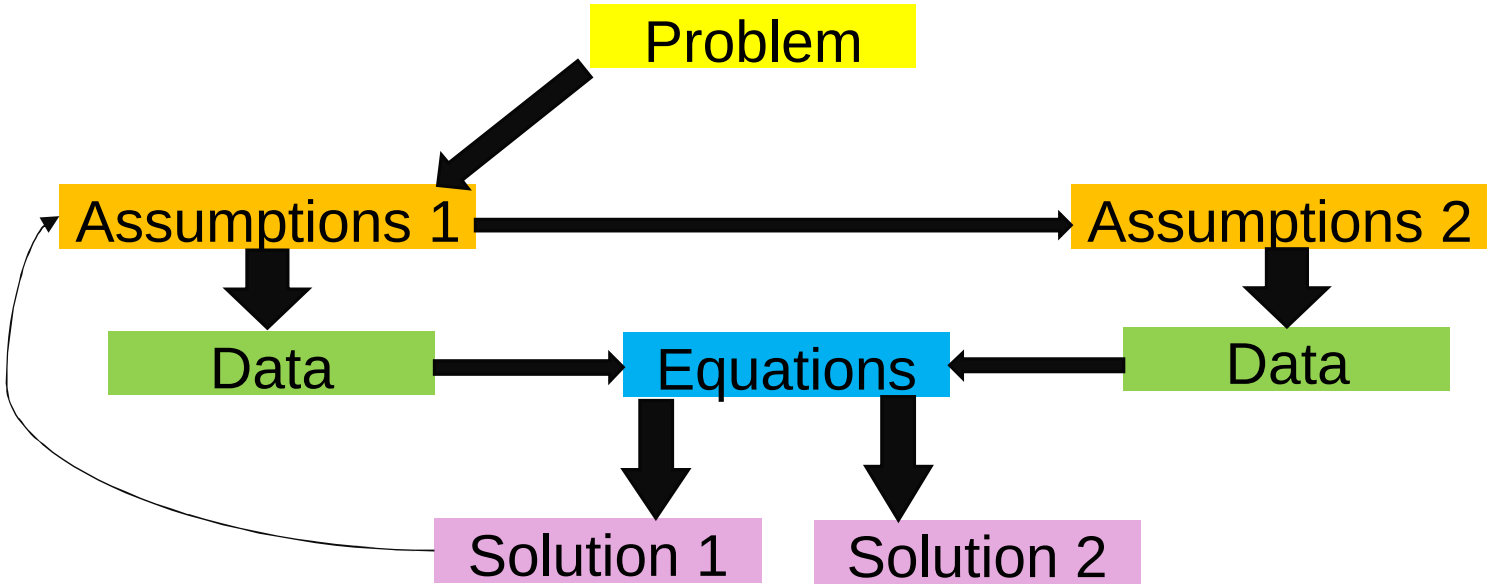
There will be a template provided at Mycourses.

Check the DL of tasks at MyCourses (end of 2nd module)

Task I: Return of energy investment *Iterative work*

- The main idea is dialogue (therefore, this is done with the team)
- Problem definition is very broad…
- How to start to tackle this type of a problem?
- There is NO right numerical answer, but to be able to justify your approach.

Task I: Return of energy investment
Iterative work



Team tasks

Reflecting the learnings for your case study

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Topics

1. **Fly wheels**
2. **Electrolysers – (Alkaline or PEM or SOEC)**
3. **Fuel Cells (PEMFC or SOFC)**
4. **Batteries**
    1. Li-ion (select the more specific chemistry, we can help)
    2. Flow battery
    3. Supercapacitors
    4. NaS (or other large-scale battery)
5. **Latent heat storage material (specify)**

You are also allowed to propose your own topic (send an email to), but please, make sure that there is enough research papers on your topics available.

Lecture Journals

Find Paper(s) relevant for you topic (state-of-art materials):

First look if your application can be found at the course book (Book index provided), Mycourses– Materials

Lecture Journal 1 – State-of-art materials for your application

- For the next lecture journals, coordinate that you read different papers (provide you more depth) – for instance at Teams channel

Group tasks: Posters

Group selects an application – where they then apply the knowledge from the modules

	Topic	Poster instructions
Poster1	Application and state-of-art Materials	1)What is the application 2) How does this application function? 3) What are the advantages/disadvantages of this application? 4) What are the state-of-materials used in this application?
Poster 2	Current material innovations	1) What are the most current material innovations on your application for different material types 2) What innovation would be most important for the increase of performance
Poster 3	Durability of your application	1) What are the most relevant durability issues in your application? 2) What is the time frame of “durability” in your application?
Poster 4	Life cycle of your application	1) What are the most energy intensive parts of preparing your applications. 2) The whole value chain of your application

Posters are prepared and presented

Poster sessions at the END of each module:

Poster 1 - 4th November - Deloitte (Otakaari 1)

Poster 2 - 16th November – M240 (Otakaari 1)

Poster 3 -25th November - Deloitte (Otakaari 1)

Poster 4 - 8th December – M240 (Otakaari 1)

You can begin the poster preparation also earlier –if you like (gather the material from assistant earlier)

Galery walk – the latter hour of the session + Closing the module (by teachers)

Task II: Eco-Design

Final task

Presenting Eco-Design of the application

(Reflection of the whole course)

The final tasks will be presented on the

Final Seminar 15th December

Welcome to the course

Any questions of the course practicalities?

Team formation

Sharing one's expertise in a multidisciplinary team

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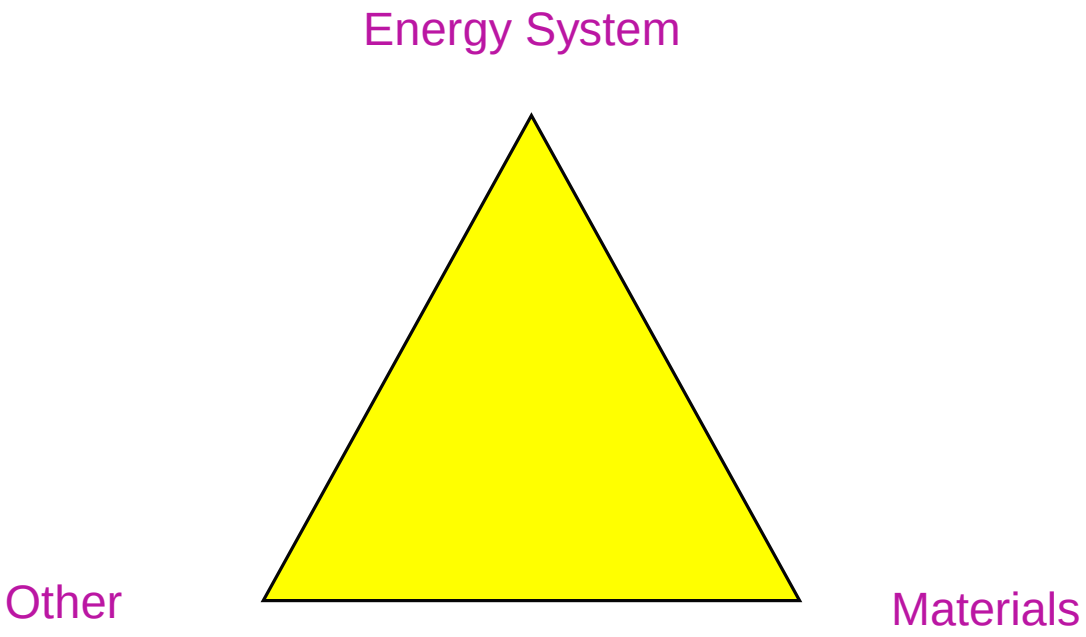
What is your strongest expertise?



Team topic division

Sit down with the team and discuss your interest

Obvious “most familiar” is not always the best solution

Topics

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Pre-task

Energy Storage Systems

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Background for the course

At this course, we do not go though **Energy Storage Systems,** therefore this is set as a pre-task for the course:

Before this A0 Module:

1) A.R. Dehghani-Sanij *et al.* **Study of energy storage systems and environmental challenges of batteries,** Renewable and Sustainable Energy Reviews 104 (2019) 192–208 (MyCourses)
2) Look the video module ”A0 Energy Storage Systems”

Pre-task

When you take a look the A0 Video - Reflect your knowledge in free format:

A0 Video

- the mind map (slide 3)
- answer the questions (slide 35)

and return them in a single file to MyCourses before the DL

-> All the students that return the pre-assignment will be appointed to the groups