Guidelines for course grading, group projects, debates

MSE-433 Towards Sustainable Materials

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Spring 2025

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Objectives and approach

- Throughout this course, you will work in a group and assume the role of a “Sustainable Materials Analyst” in a company with a specific focus on a product that you will select.
- Your task will be to explore design, material selection, manufacturing, supply chains and operations for a product, while considering end-of-life and circular strategies to achieve minimal environmental and societal impacts, taking a NetPositive / regenerative approach (defined in the lectures).
- Each week, the course introduces new concepts and techniques: you will be expected to integrate these insights into your group project and in the debates, continually refining and enhancing your work.
- This will help you to build research skills, and aid systemic thinking.

This project based learning experience was prepared by the course instructors to serve as a basis for a student report, presentation, and class discussion, rather than to demonstrate the effective or ineffective handling of a business situation.

Objectives and approach

- Your group is responsible for sustainability management of the product you select.
- Your primary responsibilities will include:
  - **Understanding and Applying Sustainability Concepts**
  - **Analyzing and Quantifying Impacts**
  - **Developing Decarbonization Strategies**
  - **Communicating Sustainable Initiatives**

Objectives and approach

- Understanding and Applying Sustainability Concepts
  - You will be responsible for demonstrating key concepts in sustainability and applying them to your product and supply chain strategies.
  - This includes evaluating the environmental, social, and economic impacts of your decisions and ensuring that sustainability principles are integrated into every aspect of your product's lifecycle.
- Analyzing and Quantifying Impacts
  - A critical part of your role will involve analyzing and quantifying the impacts of your product and supply chain.
  - You will assess the product circularity, carbon footprint, resource usage, and other environmental and societal impacts, utilizing tools and techniques learned in the course to provide measurable insights.

Objectives and approach

- Developing Decarbonization Strategies
  - You will propose and implement strategies to decarbonize your product and supply chain, aiming to minimize its environmental impact.
  - This will involve identifying opportunities for reducing emissions, enhancing resource efficiency, and transitioning to sustainable materials and processes.
- Communicating Sustainable Initiatives
  - You will also be responsible for effectively communicating your sustainable materials initiatives to stakeholders.

Objectives and approach

The group project comprises 5 milestones

#	When	What
1	March 3, 2025	Form groups of 5-6 students, with mixed backgrounds and propose a topic based on a company and a product
2	March 10, 2025	Signatures
3	April 7, 2025	Mid-term review
4	May 19, 2025	Presentation in front of the class
5	June 9, 2025	Send the report in the form of a scientific manuscript to YL and MDW

Objectives and approach

Ideas for topics (product underlined) / Cover hard to abate materials and critical materials

1. Laptop computer 2050 with reverse logistics and best carbon footprint materials
2. SMART phone 2030
3. Mobile hydrogen fuel cells versus batteries for lorry power trains in the EU
4. Sustainable mining heavy plant power train
5. NetPositive / carbon neutral data center structures/buildings
6. Exploring the limits of wood and rammed earth structures versus concrete for a school building (200 students)
7. Use of blockchain and RF ID tags enabling reverse logistics for advanced flying wing civilian aircraft designed for 80% recovery and re-use of flying weight
8. Helium air balloon for heavy lift transportation
9. Advanced CCUS concepts at minimal CAPEX
10. Towards NetPositive raw materials extraction and materials circularity for EVs: a case study of a Hyundai EV6 battery module
11. Automotive demand for green aluminum in EV body-in-white structures to 2050
12. Green steel for high speed rail network rails in the United Kingdom
13. Meeting the EU 25+25% end of life legislation for polymers: case study of the BMW use of carbon fiber reinforced plastic body-in-white structures
14. Meeting the EU 25+25% end of life legislation for polymers: case study of under the hood polyamide components: proposal for recycling infrastructure and reverse logistics for under the hood PA parts in the EU
15. The potential of bio-attributed mass-balanced polymer derivatives to reduce upstream scope 3 impacts in engineering thermoplastic and thermoset resins for automotive cross-car beams (Lucid Air)
16. A study of stakeholder investment and conflict materials used in luxury goods focused on wrist watches
17. Replacement of petro-chemical feedstock with non-food bio-mass versus chemical recycling: impact assessment for an automotive seat structure
18. ..
19. ..

Group project proposal (milestone #1 on March 3, 2025)

- Form groups of 5-6 students, with mixed backgrounds and propose a topic based on a company and a product
- Group project proposal document as 1 page PowerPoint file
- Submission deadline is 3rd March 2025 18:00

Signatures

- March 10, 2025: each group will have to upload a powerpoint table with the signatures of all group members and the name of the group administrator.
- Simapro software is only for use in MSE-433 and it is not permitted under the EPFL license agreement to use this software for any other purpose including but not limited to: semester projects, masters projects, MAKE projects, PhD projects, commercial research
- By signing, you confirm that you have fully read and attentively understood the instructions and materials for the group project and limitations on the use of SimaPro and Ecoinvent.

SimaPro registration

SimaPro PhD

Contract no: PTC-2018-170716

Temporary license for 6 Month(s) (from 01/02/2025 to 01/08/2025)

Registration name: **STI Wakeman**

Registration code:

YQkAAADcmgIAxY+ZJ5upAAgiAAA=#

ZoY+1aRt1rrDvkHEbAY+pJqAT1EYBZ+ByQsqVnbchlYAy/41ho

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EN15804 system model

EN15804 system model

You can download the EN15804 data package via this unique link https://pre-support.sharefile.com/d-saa49ff6e213a458f8aac0f23df557800 which is valid for 7 days only. The package includes:

- ecoinvent, cut-off, EN15804 system model datasets, as library projects (both unit and system)
- EN15804+A2 LCIA impact assessment & LCI indicators method, as one method that facilitates calculating the Environmental Footprint (EF)-based impact assessment and additional indicators in one go.
- an extensive user manual regarding installation and use

Signatures

- By signing, you confirm that you have fully read and attentively understood the instructions and materials for the group project.
- Please insert the names of your group members and the group administrative representative in the space provided in the Table below, as well as in the file name.
- Save the file as: MSE433_FirstName_LastName_Group##_2025; e.g., “MSE433_Claire_Peter_Group02_2025.”
- Ensure that your name matches your EPFL student profile. Deadline to upload your fully signed table (this slide) is by 12:00 PM on Monday 10th March 2025. Please fill in the names of all the group members so that you receive the grade for the work performed.

Name & Family name	EPFL sciper	Assign one person as the group representative and mark their name below.
1.		
2.		
3.		
4.		
5.		

Respect and agreement

- We encourage you to engage in individual research and writing as part of your group project. To ensure the best learning experience for you and your team members, please respect the following declaration:
- We take full responsibility for our work and will not allow or assist anyone in copying it with the intent of submitting it as their own. We affirm that this assignment is entirely our original work.
- Plagiarism, defined as using another person's work and claiming it as your own, is strictly prohibited under EPFL guidelines and societal norms. We recognize that copying someone else's case study assignment (or any part of it) is unacceptable. To ensure fairness and uphold academic integrity, your ongoing group project may be reviewed using plagiarism detection software. Any instances of plagiarism will be investigated and penalized according to departmental discretion under EPFL rules.
- You are expected to ensure equitable distribution of work among team members, both in quality and quantity. Maintain an open mind, respect others' opinions, and work collaboratively toward a data-driven consensus.
- Your submission should reflect academic or industry-standard professionalism, similar to a report or paper that you will present in the future to senior management. Be concise and direct.

Grading

The course grading is on 100 pts, based on 4 assessments:

1. debate (10 pts)
2. report* (50 pts)
3. presentation* (20 pts)
4. 1hr written exam (multiple choice questions, 20 pts)

(*) The presentation and report are graded using marking rubrics (see detailed guidelines on the course moodle page)

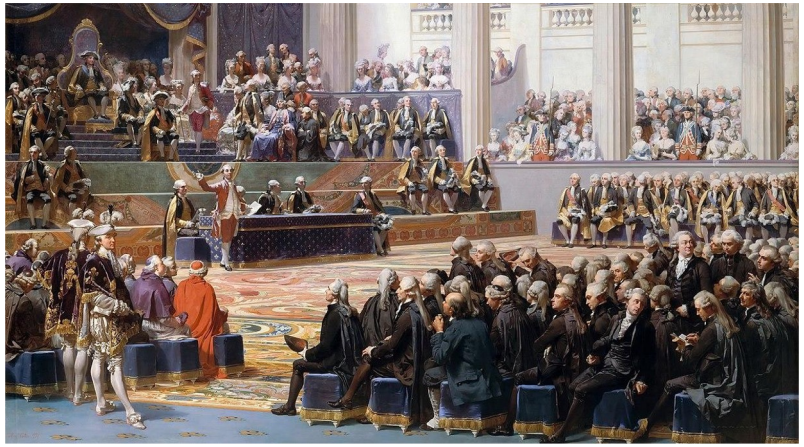
Debates

- 9 debate sessions on sustainability questions (the 1st debate will be a demonstration)
- Every student gives a short presentation during 1 of the debate sessions (10% of grade)
- The questions, dates of the debates and student names will be pre-assigned via moodle
- 45 minutes per debate, 1st half: student presentations
  - Introduction by the course lecturers (1 slide with order of talks)
  - Individual student presentations (pptx template available on moodle; pptx slides to be sent to lei.xu@epfl.ch the day before*)
  - e.g. 8 students per week, same question, 3 minutes
  - 1 TA runs presentations, one PC
- 2nd half: Circle with the student presenters + TAs
- YL & MDW give a short summary at the end

(*) with copy to yves.leterrier@epfl.ch, martyn.wakeman@epfl.ch, claire.paetsch@epfl.ch, jean-baptiste.desbrest@epfl.ch, brynja.bjarnadottir@epfl.ch

Debates

- Debates will be recorded by Zoom
- 10 pts total
  1. quality of presentation (4 pts)
  2. presentation dynamics (3 pts)
  3. quality / coherence of references (3 pts)
- YL & MDW grade



https://fr.wikipedia.org/wiki/États_généraux_(France)

Debate questions

#	Date	Week	Debate question
0	24th Feb	2	Debate 0 (YL and RQ, 20 min example, no students presenting) **Waste recycling logistics: should the polluter pay?**
1	3rd March	3	Debate 1 (YL, Brynja with OMNIS) **What are the stakeholder impacts of materials from the perspective of the global north & global south?**
2	17th March	5	Debate 2 (YL, JB) **What are the impacts of petrochemical extraction vs NetZero economies?**
3	24th March	6	Debate 3 (MDW, Brynja) **To what extent are bio-materials scalable with respect to planetary boundaries, water and land system change vs. agriculture & diet?**
4	31st March	7	Debate 4 (MDW, Lei) **What are the merits and limitations of industrial decarbonization vs carbon off-setting, CCUS, and carbon credits?**
5	14th April	9	Debate 5 (YL, JB) **How to reduce the scope 1,2,3 impacts of a car?**
6	28th April	10	Debate 6 (YL, Lei) **How can we reduce the impingement of materials on the novel entities planetary boundary and human health?**
7	5th May	11	Debate 7 (MDW, Claire) **Discuss the different socio-economic pathways, the NetZero transition, and the role of societal change**
8	12th May	12	Debate 8 (MDW, Claire with IMD) **How to quantify humanity's progression: discuss GDP as a measure of prosperity / economic growth?**

Respect recommendations in debates

- Ask open questions
- Reflective listening
- Not answering with “but, …”
- Aim to understand and open rather than close
- Watch your emotions and do not project these onto others
- Aim to understand where the other person is coming from
- Look for common ground
- Do not humiliate or shame another’s response
- Aim is to learn together
- Accept that there are different opinions about sustainability
- Remain data driven

Mid-term review

- April 7, 2025
- Not graded but very important!
- All group members must be present and all must present!
- Each group will present its progress with a short (5-6 slides) presentation, which must include:
  - Objective of the project
  - Role of individual group members
  - Definition of circular product
  - Circular business model canvas
  - Material Circularity Indicator (MCI) calculation
  - Initial Life Cycle Assessment and life cycle costing calculations
  - Future work plan

Group project report

- The project report should be concise and scientifically sound!
- A good report should be easy and interesting to read.
- Aim to write your report as a publication: imaging you are preparing a journal paper manuscript for the journal “Nature Sustainability” Nature Sustainability
- 10 pages excluding: references and annexes

Group project report

Required ANNEXES

- Circular business model canvas
- Supply chain systems map template
- Stakeholders table
- SMART initiatives table

Group project report

The report is graded over 6 categories (50 pts total) using a marking rubric (information in the following):

- Q1. Define circular product (5 pts)
- Q2. Best carbon footprint materials (5 pts)
- Q3. Circular supply chain (5 pts)
- Q4. Impact assessment (20 pts)
- Q5. Cost model of product (5 pts)
- Q6. Initiatives (10 pts)

Marking rubric and grading

- The marking rubric aids transparency and also provides suggestions as how to approach the various topics and maximize your grade!
- 6 rubrics = 6 categories as listed in previous slide
- The grade is the same for all students in the group.

Marking rubric – Q1: Define circular product

- **Define circular product (5 pts)**
  - Value proposition versus incumbent,
  - Circular business model canvas
  - CAD model of design to give the BOM and mass, extra 2 pts
  - FEA model showing the design and materials meet the main load case(s), extra 2 pts

1	i) define your product and its value proposition and ii) choose a company making this product and explain your choice. Describe the industrial sector, list main companies / competitors.	(1 pt.)
2	Compare and contrast current sustainability / decarbonization strategies of sector.	(1 pt.)
3	Propose a competitive product enabled by an emerging material/technology/supply chain offering a circular and lower impact approach	(1 pt.)
4	For your competitive product, present a simple design to give the bill of materials (BOM), masses, manufacturing processes [this will be used throughout the case study] (extra 2 pts. for optional CAD model, extra 2pts. for FEA model)	(1 pt.)
5	Complete the circular business model canvas	(1 pt.)

Marking rubric – Q1: Define circular product

Question	Satisfactory	Excellent	Exemplary
1)	Good description of product, VP, supply chain, and competitors (0.6pts)	Clear and nuanced product, VP, supply chain, and competitor description with referenced sources (0.8pts)	Company specific product VP and supply chain described versus competitors with referenced sources and flow diagrams (1pts)
2)	Sustainability and decarbonization strategies of sector summarized. (0.6pts)	Sustainability and decarbonization strategies of sector summarized in table. (0.8pts)	Sustainability and decarbonization strategies of sector summarized in comparative ranking chart. (1pts)
3)	Competitive product proposed with well-argued multi-perspective justification of value proposition or advantages. (0.6pts)	Competitive product proposed with well-argued technical, environmental, societal justification of value proposition or advantages. (0.8pts)	Competitive product proposed with exemplary technical, environmental, societal justification of value proposition or advantages and impacts. (1pts)
4)	Good product proposal with design, high level BOM, masses and manufacturing processes. (0.6pts)	Excellent product proposal with design, BOM for key materials, CAD model (+2pts) masses and manufacturing processes, diagrams. (0.8pts)	New and innovative solution/design, detailed BOM, CAD model (+2pts) masses and manufacturing processes, diagrams, FEA model showing mass to meet main load case(s) (+2pts). (1pts)
5)	Circular business model canvas fully complete with logical descriptions. (0.6pts)	Circular business model canvas fully complete with logical and referenced descriptions. (0.8pts)	Circular business model canvas fully complete with logical, nuanced, and referenced descriptions. (1pts)
General	Limited quantitative referenced data (5 refs) OR only a clear response. (0.6pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning, AND An excellent response, (0.8pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning, AND Tables / charts included, AND Excellent writing and grammar with an exceptionally clear and structured response. (1pts)
Points	3	4 (+2pts)	5 (+2pts) (+2pts)

THE CIRCULAR DESIGN GUIDE

WORKSHEET

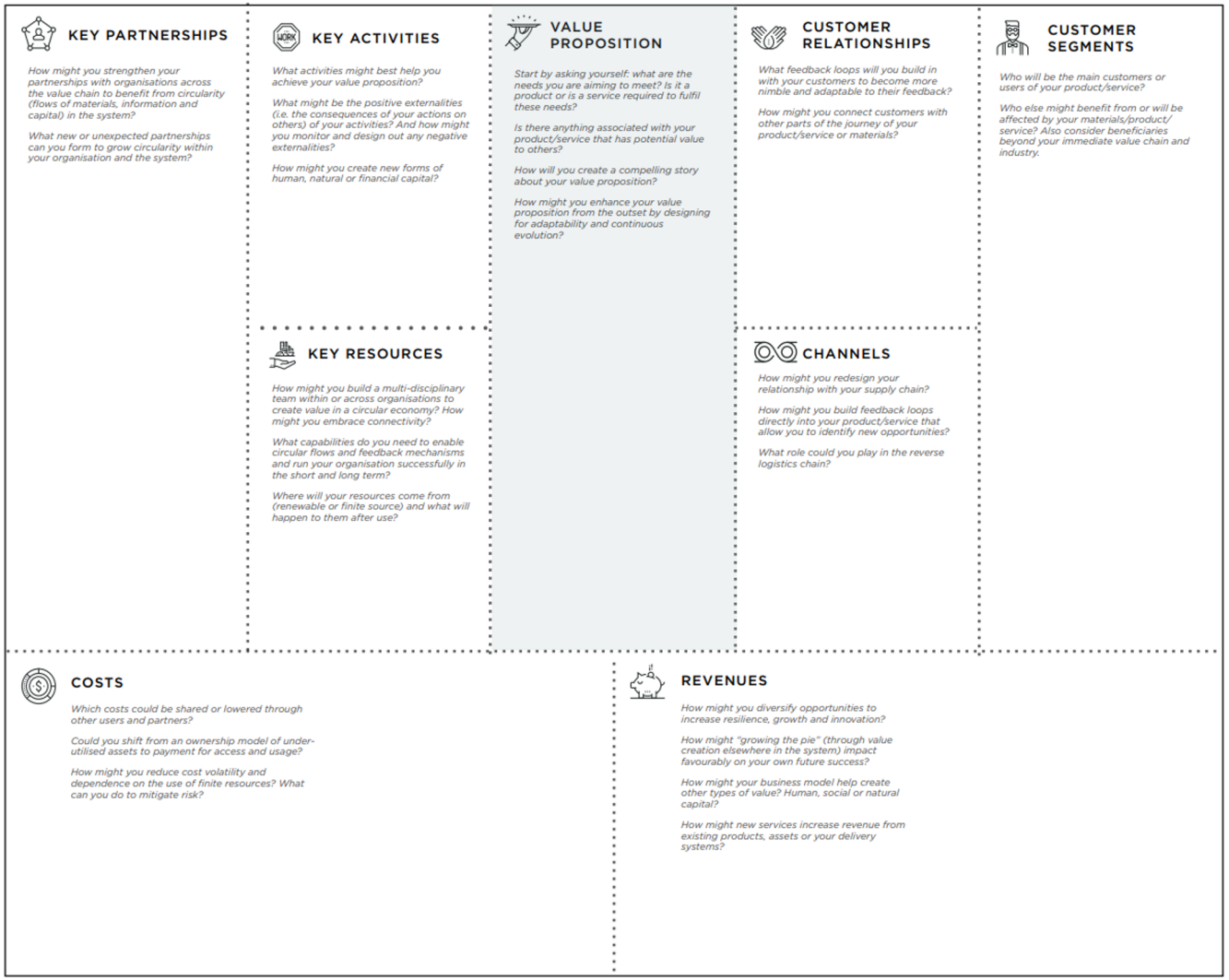
Business Model Canvas

A3 or bigger

The business model canvas has been developed by Osterwalder & Pigneur (strategyzer.com). You might have filled one of these in before - here we have added some prompts and questions that you might find helpful in the context of the circular economy.

If you need more space, create your own canvas using post-its.

Given in report Annex



IDEO

ELLEN MACARTHUR FOUNDATION

Circular design guide - Business Model Canvas | Shared by Digital (thirdlight.com)

Marking rubric – Q2: Best carbon footprint materials

- **Best carbon footprint materials (5 pts)**
  - Materials selection
  - Design for circularity

No.	Question	Points
1	List the materials used in the product and describe their upstream scope 3 impacts	(1 pt.)
2	Propose best carbon footprint materials for the product (scope 3 upstream)	(2 pts.)
3	Examine the EU end-of-life and waste legislation and give two routes to meet circularity and recycling targets at end-of-life with re-use of recovered materials (scope 3 downstream)	(2 pts.)

Marking rubric – Q2: Best carbon footprint materials

Question	Satisfactory	Excellent	Exemplary
1)	Materials well described with good description of scope 3 impacts (0.45pts)	Clear and nuanced description of materials and their upstream scope 3 impacts with referenced sources (0.6pts)	Company specific materials description with referenced sources and flow diagrams with scope 3 impacts attributed to supply chain including raw materials extraction (0.8pts)
2)	Lower carbon footprint materials proposed with well-argued and multi-perspective discussion of advantages and issues (0.9pts)	Lower carbon footprint materials proposed with well-argued technical, environmental, societal perspectives of advantages and 2 specific issues (1.3pts)	Lower carbon footprint materials proposed with quantified technical, environmental, societal perspectives of advantages and 3 quantified issues (1.6pts)
3)	Good description of EL treatment, two CE scenarios and transition well described (0.9pts)	Excellent description of EL treatment, clear and nuanced description of two CE scenarios and transition with associated challenges (1.3pts)	Excellent description of EL treatment, quantified descriptions of two CE scenarios, legislation, and transition with associated challenges (1.6pts)
General	Limited quantitative referenced data (5 refs), OR A clear response, (0.75pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning, AND An excellent response (0.8pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning, AND Tables / charts included, AND Excellent writing and grammar with an exceptionally clear and structured response (1pts)
Points	3	4	5

Marking rubric – Q3: Circular supply chain

- **Circular supply chain (5 pts)**
  - Manufacturing route including supply chain,
  - Supply chain systems map template, MFA, circularity metrics

No.	Question	Points
1	Detail your products manufacturing route and circular supply chain	(1 pt.)
2	Draw a supply chain systems map	(2 pts.)
3	Model the materials flow (MFA) and model the degree of circularity of the incumbent versus your proposed solution	(2 pts.)

Circular design space instructions

Draw two supply chain maps of:

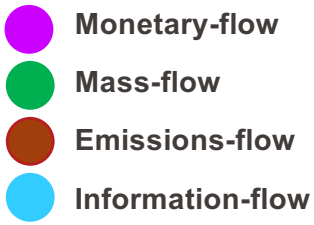
1)Linear incumbent supply chain

2)Their proposed circular alternative

- First draw boxes of the main supply chain steps (companies involved)
- Then connect these blocks with 4 sets of lines using the color code in the file.
- Use thicker lines where the flows are stronger using experience and what data you can find.

- **Monetary flow**
  - Payment for virgin products, payments for waste products, payments for recycled products, payments for leased services, payments for waste disposal
  - income from selling products, income from selling waste bi-products to a different company, income from supply a service, income from royalties/licensing etc
  - investments in: own facilities (primary), own facilities (re-furbish, repair, remanufacture etc), in a supply chain partner (JDA) / shared assets, in wider stakeholders
- **Mass flows**
  - Virgin products
  - Post-industrial waste, End of life waste
  - Re-use of recovered products: re-furbish, repair, remanufacture
  - Use of recycled materials to replace virgin feedstock
  - Use of lower embodied energy virgin feedstock to replace primary (petrochemical) feedstock
  - Lease of materials / ownership & take back
- **Emissions flows**
  - Examine scope 1, 2, 3 (upstream and downstream of where your 'start-up' is in the supply chain
  - As a first pass examine CO2e
  - As a second pass, emissions examined through broader lens: climate change (CO2e), freshwater impact, Chemical and plastic pollution reduction, Forest and seabed impacts, biodiversity impacts, suit pollution impacts)
  - Look at where in the supply chain the emissions occur
- **Information flow**
  - How can information flow be enhanced?
  - Sharing of LCA data
  - Blockchain/other
  - Enhance recycling stream purity
- **Mappings**
  - Where are you circular (7 principles)
  - Examine which SDGs you address
    - Direct (scope 1 & 2, scope 3 upstream and scope 3 downstream at end of life)
    - Indirect (scope 3 downstream in the use / consumption phase)
  - Which impacts do you reduce? What are your SMART (quantified) initiatives?

Draw product and supply chain flows: higher thickness is higher intensity



EPFL

Which SDGs do you target?

(1) scope 1&2, 3 upstream & downstream (EL)

(2) use/consumption)

SDG	(1)	(2)
1 No Poverty		
2 Zero Hunger		
3 Good heath		
4 Education		
5 Gender		
6 Clean water		
7 Clean energy		
8 Decent work		
9 Innovation / industry		
10 Reduced inequalities		
11 Cities and communities		
12 Consumption / production		
13 Climate		
14 Life below water		
15 Life on Land		
16 Peace & justice		
17 Partnerships for goals		

MSE-433

Which impacts do you reduce? (quantify)

	Climate change	Freshwater loss	Chemical & plastic pollution	Forest & seabed loss	Biodiversity loss	Suit nutrient pollution
Scope 1 direct						
Scope 2 indirect						
Scope 3 upstream						
Scope 3 downstream						

Your design space

What are your SMART quantified initiatives?

Specific	Measurable	Attainable	Relevant	Time-oriented	Slow	Close	Narrow	Regenerate

Examine

- Business
- Supply chain
- Production
- Materials

Where are you circular?

7 principles	
1 Longevity	
2 Reuse (refurbish / repair/ remanufacture)	
3 Resource-efficient manufacturing	
4 Recycling / design for disassembly	
5 Collaboration in value chain	
6 Local sourcing & production	
7 Business model innovation	

Draw product and supply chain flows: higher thickness is higher intensity

- Monetary-flow
- Mass-flow
- Emissions-flow
- Information-flow

Circularity metrics

- Please use the Material Circularity Indicator to assess the degree of circularity (use the excel thinkstep tool available on moodle)
  a. Linear incumbent
  b. Your proposed circular solution

Marking rubric - Q3: Circular supply chain

Question	Satisfactory	Excellent	Exemplary
1)	Products manufacturing route and circular supply chain well described with references (0.45pts)	Products manufacturing route described in a flow chart and circular supply chain described including geo-locations of each step and references (0.6pts)	Products manufacturing route described in a detailed flow chart (machine and cell level) and circular supply chain described including geo-locations of each step and transportation and references (0.8pts)
2)	Supply chain systems map lacks detail (lacking 1 or more of: Monetary, mass, emissions, information) (0.9pts)	Detailed supply chain systems including: monetary, mass, emissions, information flows (1.3pts)	Detailed supply chain systems including accurate and referenced thicknesses of relative flows: monetary, mass, emissions, information flows (1.6pts)
3)	Adequate materials flow (MFA) model made for top 3 product constituents and the degree of circularity of the incumbent versus your proposed solution well modeled used a tool (0.9pts)	Detailed materials flow (MFA) model made for top 5 product constituents including circularity in the mass flow and the degree of circularity of the incumbent versus your proposed solution well modeled used a tool (1.3pts)	Customized materials flow (MFA) model made for all product constituents including circularity in the mass flow and the degree of circularity of the incumbent versus your proposed solution well modeled used a tool (1.6pts)
General	Limited quantitative referenced data (5 refs), OR A clear response, (0.75pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning, AND An excellent response (0.8pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning, AND Tables / charts included, AND Excellent writing and grammar with an exceptionally clear and structured response (1pts)
Points	3	4	5

Marking rubric – Q4: Impact assessment

- **Impact assessment (20 pts)**
  - State main environmental and societal burdens of the product and how their approach mitigates these
  - SimaPro / Ecoinvent LCA of product, sensitivity study expected (2pts extra)
  - Split into scope 1,2,3 upstream and 3 downstream categories

No.	Question	Points
1	State main environmental, societal, and human health burdens of the product and how your approach mitigates these	(5 pt.)
2	Perform an LCA of your lower impact product versus the linear incumbent, including a sensitivity study, using SimaPro and Ecoinvent	(10 pts.)
3	Split the CO2e impacts into scope 1, 2, 3 (upstream and down-stream) categories. Map LCA impacts to planetary boundaries (PBs) and to the SDGs focused on society and human health.	(5 pts.)

Marking rubric - Q4: Impact assessment

Question	Satisfactory	Excellent	Exemplary
1)	State three main environmental, societal, and human health burdens of the product (9x burdens) and how your approach mitigates these, well referenced (2.25pts)	State three main environmental, societal, and human health burdens of the product (9x burdens) and how your approach mitigates these versus time and level of market adoption, well referenced (3pts)	Nuanced argument of the three main environmental, societal, and human health burdens of the product (9x burdens) and how your approach mitigates these versus time and level of market adoption, well referenced, with barriers to adoption of your approach (3.5pts)
2)	Product carbon footprint LCA made of linear incumbent and a convincing lower impact alternative (4.5pts)	Recipe 2016 method LCA made of linear incumbent and lower impact alternative with attention to detail with clear interpretation (6pts)	Exemplary LCA made of linear incumbent and circular alternative with attention to detail, including a sensitivity analysis (extra 2 pts) on important factors or unclear data, with clear interpretation (7pts) + (2pts)
3)	Good and accurate segmentation of CO2e scope 1, 2, 3 for linear versus lower impact solution; LCA impacts mapped to PBs and SDGs focused on society and human health (2.25pts)	Excellent presentation of CO2e segmented by scope 1, 2, 3 for linear versus lower impact solution; LCA impacts mapped to PBs in figure and SDGs focused on society and human health in figure / table (3pts)	Exemplary presentation of CO2e segmented by scope 1, 2, 3 for linear versus circular solution; quantified LCA impacts mapped to PBs in figure and SDGs focused on society and human health in figure / table. (3.5pts)
General	Limited quantitative referenced data (5 refs), OR A clear response (3pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning AND An excellent response (4pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning AND Tables / charts included, AND Excellent writing and grammar with an exceptionally clear and structured response (6pts)
Points	12	16	20 (+2)

Marking rubric – Q5: Cost model

- **Cost model of product (5 pts)**
  - Manufacturing and reuse and CAPEX including downstream

No.	Question	Points
1	From your bill of materials and manufacturing process flow diagrams already given, make an estimate of the part cost as a function of manufacturing volume: a) start-up, b) medium volume production, c) full-scale production	(3 pt.)
2	Detail the CAPEX needed for a), b), c)	(1pts.)
3	Detail how you would invest in your supply chain and with wider stakeholders towards becoming a NetPositive company	(1pts.)

Marking rubric – Q5: Cost model

Question	Satisfactory	Excellent	Exemplary
1)	Satisfactory cost model made from your bill of materials and manufacturing process flow diagrams already given, to give an estimate of the part cost as a function of manufacturing volume: a) start-up, b) medium volume production, c) full-scale production (1.2pts)	Excellent cost model made from your bill of materials and manufacturing process flow diagrams already given, to give an estimate of the part cost as a function of manufacturing volume: a) start-up, b) medium volume production, c) full-scale production; including sensitivity study (1.6pts)	Exemplary cost model to give an estimate of the part cost as a function of manufacturing volume: a) start-up, b) medium volume production, c) full-scale production; including sensitivity study; consideration of gross margin; including cost of carbon; with excellent input data (references /interviews) (2pts)
2)	CAPEX detailed by cell for cases a), b), c) versus time in the plant (0.45pts)	Excellent description of CAPEX detailed by cell for cases a), b), c) versus time in the plant (0.6pts)	Exemplary description of CAPEX detailed by cell for cases a), b), c) versus time in the plant (0.75pts); NPV/SROI calculation (+2pts)
3)	Description of how you would invest (details of what, when, and how much in monetary terms) in 2 specific stakeholders in your supply chain towards becoming a NetPositive company (0.45pts)	Description of how you would invest (details of what, when, and how much in monetary terms) in 2 specific stakeholders in your supply chain towards becoming a NetPositive company; linked into cost model (0.6pts)	Exemplary description of how you would invest (details of what, when, and how much in monetary terms) in 3 specific stakeholders in your supply chain towards becoming a NetPositive company; linked into cost model and SROI calculation (0.75pts)
General	Limited quantitative referenced data (5 refs), OR A clear response, (0.9pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning, AND An excellent response (1.2pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning, AND Tables / charts included, AND Excellent writing and grammar with an exceptionally clear and structured response (1.5pts)
Points	3	4	5 (+2pts)

Marking rubric – Q6: SMART sustainability initiatives and stakeholder engagement plan

- **Initiatives (10 pts)**
  - Give SMART sustainability initiatives quantified by the studies and stakeholder engagement plan

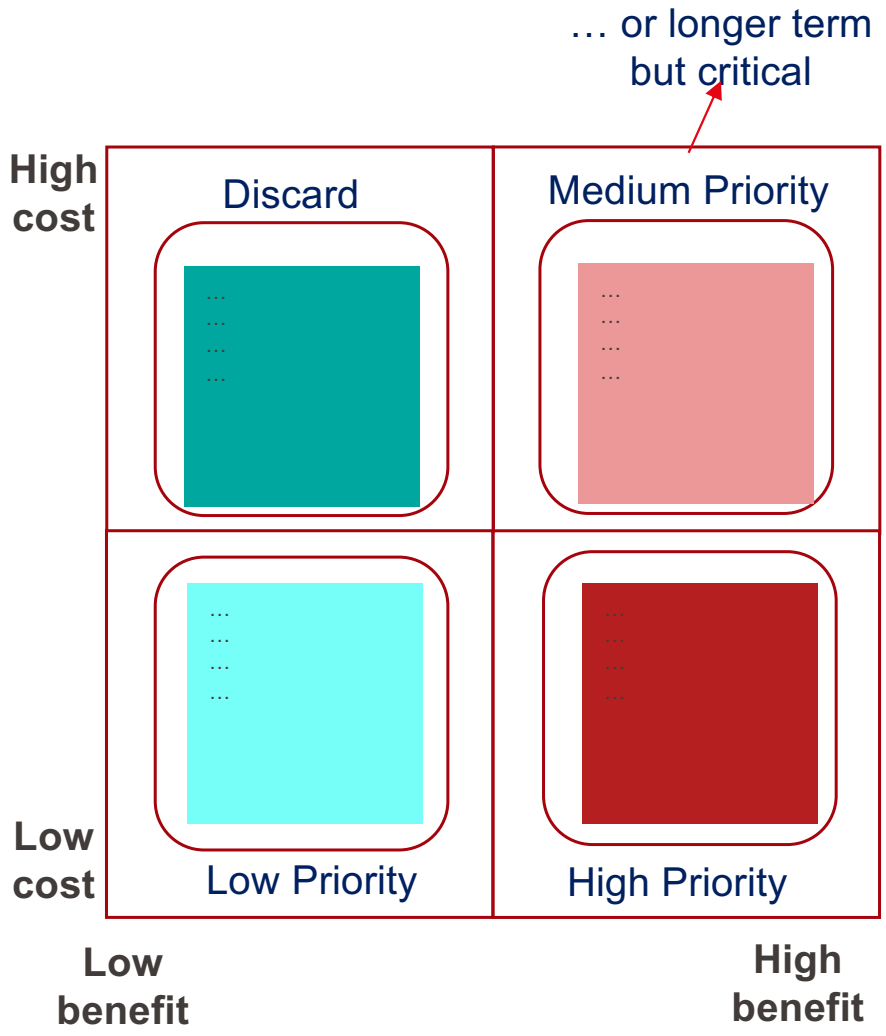
	Question	Points
1	Give a minimum of three SMART sustainability initiatives for the product /company towards becoming NetPositive Complete the equivalent of templates 1, 2.	3
2	State and justify your three most prominent change management challenges or barriers and for each example, discuss how will you overcome these three barriers? Complete template 3 Who are the key stakeholders to engage? Identify three to five key people in business / influential institutions / government / NGOs and complete equivalent of templates 3, 4.	3
4	Give quantified absolute targets and recommendations versus time: 2030, 2040, 2050 and make a roadmap (compare this to other companies NetZero strategies in the same product space).	4

An absolute target is a specific number (e.g., 2000m^2 of PV installed by 2026 in Szeged, Hungary assembly plant) whereas a relative target is a percentage change (e.g., 30% of power generated from PV in 2030)

Sustainability initiatives template 1

- Brain storming of initiatives
  - Material focused
  - Product focused
  - Operations focused
  - Supply chain
  - Industry wide

- Develop strategic mix of
  - Short
    (fast to implement, low cost/high benefit)
  - Medium
    (transition to the future)
  - Longer term
    (high risk, high benefit, maybe high cost)



Simple SMART initiative template 2

Detail your top (minimum three) initiatives and detail how you will make them SMART (quantified absolute and accountable targets). What is the expected impact?

SMART objectives	1.	2.	3.
Specific			
Measurable			
Achievable			
Relevant			
Time-oriented			
Expected IMPACT			

Simple SMART initiative template 3

Detail for each initiative the next steps, challenges, resources needed, key dates,

Initiative	Next steps	Change management barriers	Change management challenges	Resource needs	Key dates

Stakeholder engagement template: template 4

- Who are the stakeholders in a wider sense across the supply chain?
- Detail 3 to 5 members within your personal and professional network, in the company you are studying or in related influential institutions (e.g. business associations, government organisations, non-profit organisations, NGOs, academia).
- Identify those that can assist you in influencing sustainability-related change within your targeted product and company.
- For these targeted people, how would you propose to contact them and interact with them? What could the win-win be and any barriers or opportunities that might be important (relational or other)

Stakeholder (Person/LinkedIn)	Organization	Job Title	Influence	How to contact	How to interact	Win-win, next steps	(Relational) barriers/opportunities

Marking rubric - Q6: SMART sustainability initiatives

Question	Satisfactory	Excellent	Exemplary
1)	3 SMART initiatives given in absolute terms for the product /company towards becoming NetPositive Completed templates 1, 2. (1.2pts)	2 SMART initiatives, for each of short, medium, long term (6 total) given in absolute terms for the product /company towards becoming NetPositive. Completed templates 1, 2. (1.6pts)	3 SMART initiatives, for each of short, medium, long term (9 total) given in absolute terms for the product /company towards becoming NetPositive. Completed templates 1, 2 with nuanced details. (2pts)
2)	3 change management challenges or barriers given with discussion of how you will overcome these barriers. Template 3 complete. 3 generic (not name specific) stakeholders identified and templates 3, 4 complete. (1.2pts)	3 change management challenges or barriers given with discussion of how you will overcome these barriers. Template 3 complete. 3 name specific stakeholders identified including one NGO and templates 3, 4 complete. (1.6pts)	4 change management challenges or barriers given with discussion of how you will overcome these barriers. Template 3 complete. 4 name specific stakeholders identified including one NGO and one community group and templates 3, 4 complete. (2pts)
3)	Sustainability strategy defined - absolute targets and recommendations given versus time: 2030, 2050 and roadmap made. (1.8pts)	Sustainability strategy defined - quantified absolute targets and recommendations given versus time: 2030, 2040, 2050 and roadmap made. (2.4pts)	Sustainability strategy defined - quantified absolute targets and recommendations given versus time: 2030, 2040, 2050 and roadmap made (compare this to 3 other companies NetZero strategies in the same product space). (3pts)
General	Limited quantitative referenced data (5 refs) OR only a clear response. (1.8pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning, AND An excellent response, (2.4pts)	Quantitative referenced data (>10 refs), AND Showing a high level of systemic reasoning, AND Tables / charts included, AND Excellent writing and grammar with an exceptionally clear and structured response. (3pts)
Points	6	8	10

Leterrier / Wakeman

Tips to prepare a good report

The report should contain the following sections, LIMITED to 10 pages:

- **Heading** on first page, with title of the project, authors' names and affiliation (section), and course information.
- **Abstract** (one paragraph < 200 words) clearly presenting the objective of the case study, challenges and approach, key results and a short conclusion.
- **Introduction** (~1 page) including brief background information on the problem with key references, main challenges, objective of your work, hypotheses to be tested, significance of your work, and the structure of the report.
- **State of the Art** (~2 pages) where you describe what is known in the field (compilation of at least three technical papers), and what is relevant to your case study. All figures and tables must be cited in the text, and properly referenced.
- **Case study results and discussion** (~6 pages) structured according to the 6 categories (Q1. Define circular product, Q2. Best carbon footprint materials, Q3. Circular supply chain, Q4. Impact assessment, Q5. Cost model of product, Q6. Initiatives.) and where you develop your idea, with clear and explicit hypotheses, detailed analyses, calculations and results. This is where you critically analyze and interpret your results in light of the state of the art, in particular the technical papers from that section. The accuracy and reproducibility of your results should be addressed. You should add sensitivity analyses, where you check the influence of one parameter on the final results. You can also include a section on how the results could be further improved. Illustrations e.g. graphs, pictures or tables should be used and systematically referenced in the supporting text. Figures without written description are useless. To avoid extreme final file size, make sure to paste as jpg or pdf your xls graphs, sketches, etc.
- **Conclusions** (~0.5 page). This is a summary of the work, stating what was learnt, implemented and how this work could be expanded and/or applied to a specific context.

NOT counted in the 10-page limit:

- **Authors' contributions**, a paragraph where you indicate the contribution of each author of the report. You should also specify that 'All authors reviewed and approved the final written document.'
- **Acknowledgements**, a paragraph where you acknowledge persons and institutions which you have contacted or visited, have provided data, etc.
- **References**, with one section for published peer-reviewed data, and one section for non-peer reviewed data such as company reports, magazines data and misc. internet data with access date (see following slide).
- **Appendix**, where you can include relevant technical information, details on calculations, etc.

Referencing

- You are encouraged to reference papers, patents, company reports, press-releases, and other sources to justify your arguments and enhance your assignments.
- This includes figures, drawings, and tables. Please use the APA referencing format/style in your document (See References (apa.org)).
- Please ensure you have reviewed EPFL guidelines on citation and copyright (see Citation and copyright – Library - EPFL).
- Cite all external sources – be it websites, videos, or other content.
- You are strongly encouraged through the marking rubric to perform further research and to use references to substantiate your answers and arguments and to be creative.

Group project presentations

- 20 pts total
- May 19, 2025
- 10 minutes presentation, 5 minutes questions
- Everyone from each group must present
- Graded over same 6 categories as in report, see next slide
- Aim for 10 content slides (plus outline & cover) in landscape format
- Have some spare slides in annex to answer questions
- Large fonts especially on charts (are they visible at the back of the room?)

Group project presentations

- Graded over 6 categories (20 pts total)
  - **Define product (2 pts)**
    - Value proposition versus incumbent, new design
    - Circular business model canvas
  - **Best carbon footprint materials (2 pts)**
    - Materials selection
    - Design for circularity
  - **Circular supply chain (2 pts)**
    - Manufacturing route including supply chain,
    - Supply chain systems map template, MFA, circularity metrices
  - **Impact assessment (6 pts)**
    - State main environmental and societal burdens of the product and how their approach mitigates these
    - SimaPro LCA of product
    - Split into scope 1,2,3 upstream and 3 downstream categories
  - **Cost model of product (2 pts)**
    - Manufacturing and reuse and CAPEX including downstream
  - **Initiatives (6 pts)**
    - Give SMART sustainability initiatives quantified by the studies and stakeholder engagement plan

Best group projects prizes

3 best projects selected on 19th May

1st Prize:	Bag + 75 CHF EPFL shop (La Boutique) per student
2nd Prize:	50 CHF EPFL shop (La Boutique) per student
3rd Prize:	25 CHF EPFL shop (La Boutique) per student

Final written exam

- Total 20 pts
- May 26, 2025
- Open book exam
- 30 multiple choice questions in 60 minutes

Use of AI

- You are encouraged to utilize AI tools to aid the research of your assignment, however we consider that you will learn more restricting this to data searches.
- If used, document them and include your prompts in your report as an annex. There is no page limit for prompts.
- Where AI assistance is utilized, and also for references in general, you need to own the results and it is strongly recommended to check the sources and to rewrite this in your own words.
- It is your sole responsibility to fact-check and ensure the accuracy of your work.

Summary

The course grading is on 100 pts, based on 4 assessments:

1. debate (10 pts)
2. report* (50 pts)
3. presentation* (20 pts)
4. 1hr written exam (multiple choice questions, 20 pts)

(*) The presentation and report are graded using marking rubrics (see detailed guidelines on the course moodle page)