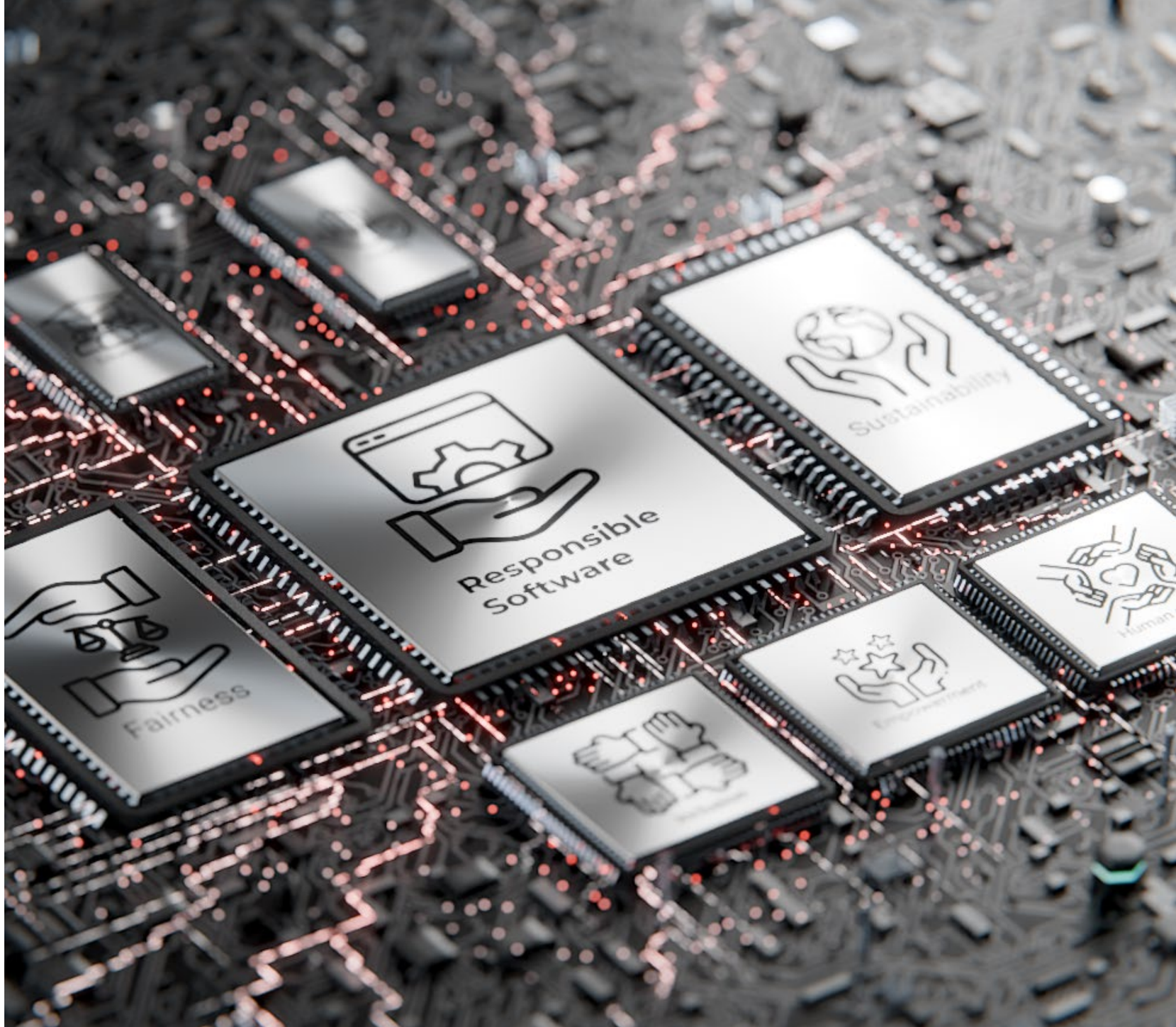
Sustainability 1 Review & Case studies
10 nov.

Cécile Hardebolle

Responsible Software



Agenda for today

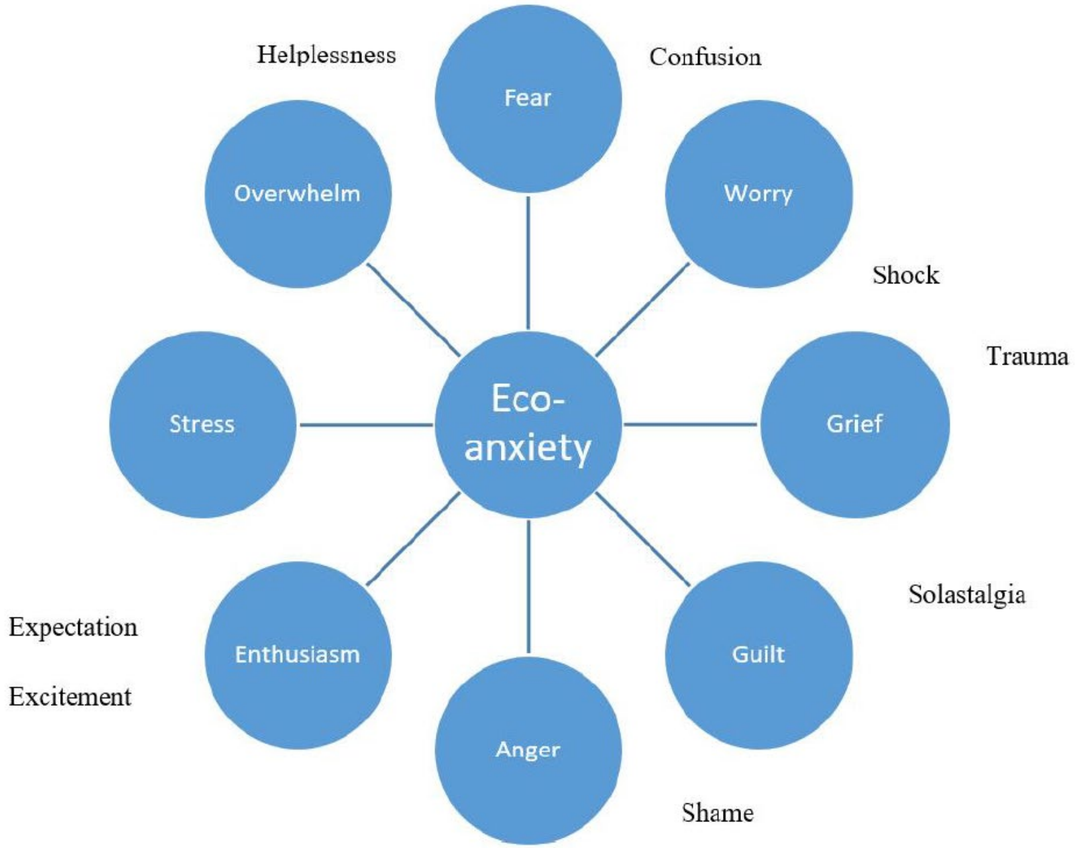
1. Interactive review questions on Sustainability 1

2. Case studies:
   a) Decision matrix
   b) Stakeholder analysis
   c) Edge cases

Review questions Sustainability 1

Emotional response to sustainability topics

I am very conscious that topics related to sustainability can generate **strong emotional responses** with a very broad range of emotions, often grouped under the term “eco-anxiety”



Pihkala, P. (2020). Eco-Anxiety and Environmental Education. Sustainability, 12(23), Article 23. https://doi.org/10.3390/su122310149

Emotional response to sustainability topics

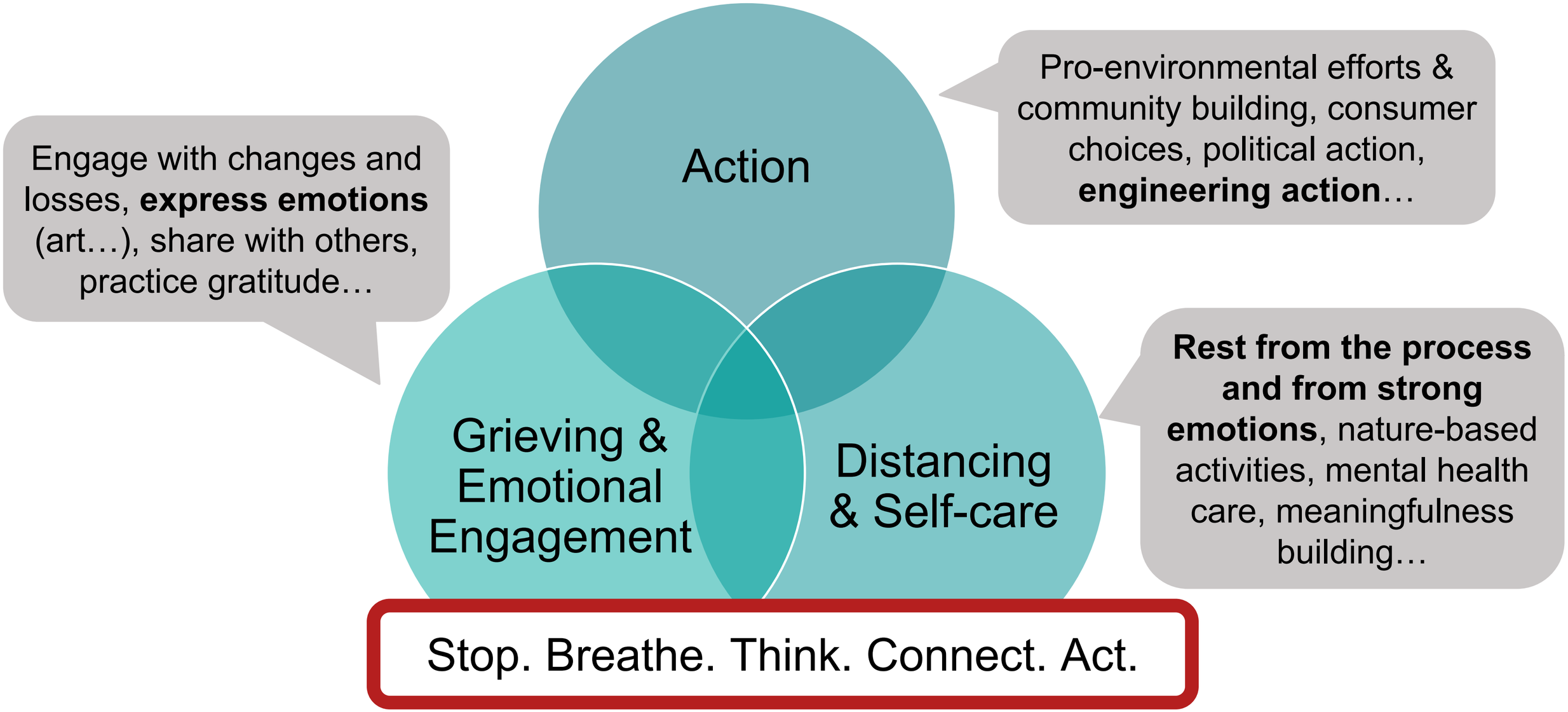
I am very conscious that topics related to sustainability can generate **strong emotional responses** with a very broad range of emotions, often grouped under the term “eco-anxiety”

- “Climate anxiety – like climate depression or climate rage – isn’t a pathology. **It’s a reasonable and healthy response to an existential threat**” (Ro, 2019)

- Emotions “have a **vastly important role in resisting injustice and providing energy to act**” (Pihkala, 2020)

Coping and changing: 3 dimensions

(Pihkala, 2022; Ro, 2019)



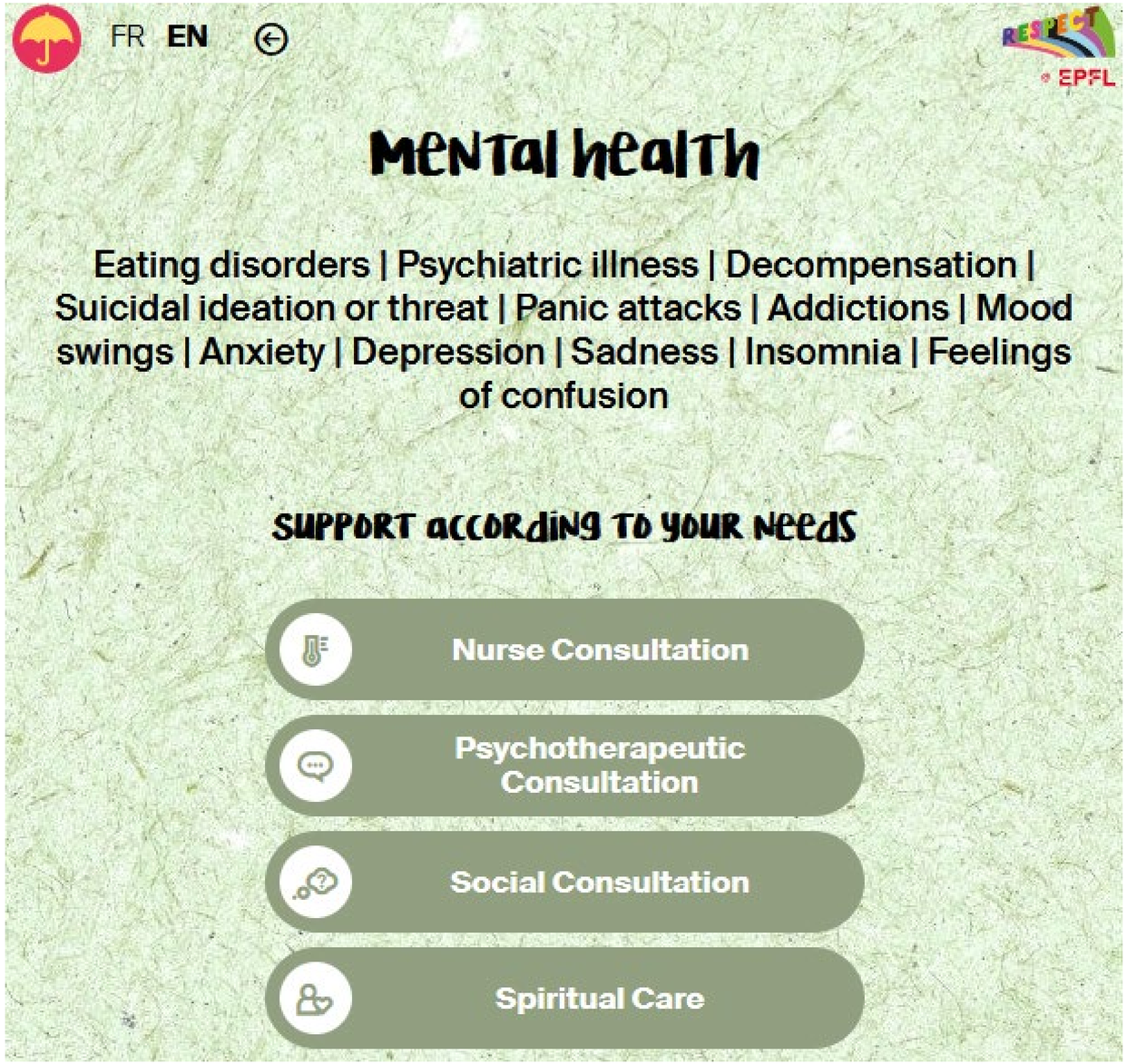
Coping and changing: 3 dimensions

In this course, the goal is to **empower you as software engineers** by developing your knowledge and skills for:

- **Identifying** the environmental impacts from software
- Determining **ways to reduce** these impacts

👉 **Giving you the means to act**

Seeking help



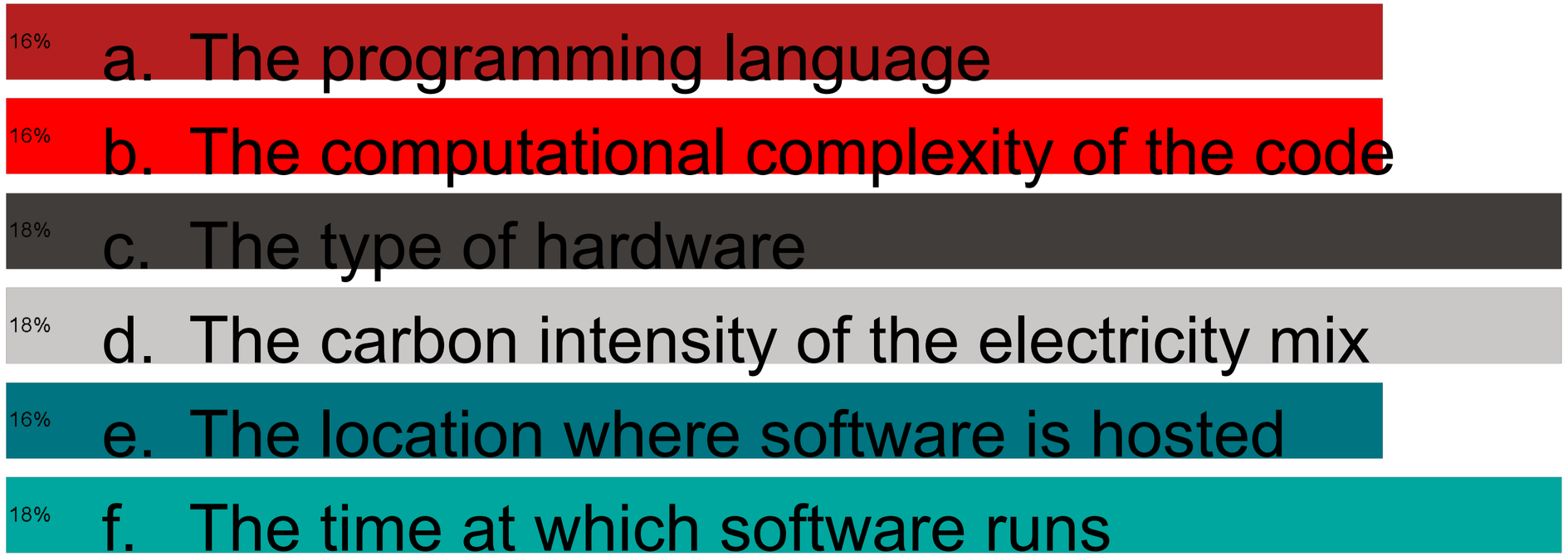
https://trust-point.epfl.ch

Carbon footprint factors

URL: ttpoll.eu
Session ID: cs290

What are (some of) the factors in the carbon footprint of software? (select all that apply)

All of these!



CO_2 equivalent

URL: ttpoll.eu
Session ID: cs290

An electricity production facility reports the following emissions per kWh produced:

- 250 g of carbon dioxide (CO2)
- 8 g of fossil methane (CH4)

What are the carbon emissions of the facility in g CO_2 eq / kWh (considering the GWP-100)?

Fossil methane has a GWP-100 = 30
=> 250 + (8 x 30) = 490

❌ 4% a. 240 g / kWh

❌ 12% b. 258 g / kWh

✅ 65% c. 490 g / kWh

❌ 12% d. 656 g / kWh

❌ 8% e. 906 g / kWh

Power Usage Effectiveness

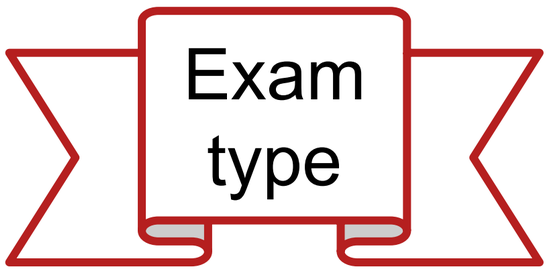
URL: ttpoll.eu
Session ID: cs290

The GreenDC datacenter consumes an average of 1 MW.
This means annually a total of 8 760 MWh of electricity.
50% of this electricity is used to power the IT equipment.
What is the PUE of GreenDC?

- ✗ 22% a. 0.5
- ✗ 0% b. 1
- ✗ 11% c. 1.5
- ✓ 67% d. 2

PUE = total electricity / electricity used by IT
PUE is always >= 1

Here: PUE = 8760 / (8760 * 0,5) = 2



Scopes in the GHG protocol

URL: ttpoll.eu
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For a software development company, the **electricity consumed** by software during the **development phase** falls into:

❌ 27% a. Scope 1 (direct)

✅ 40% b. Scope 2 (indirect, energy)

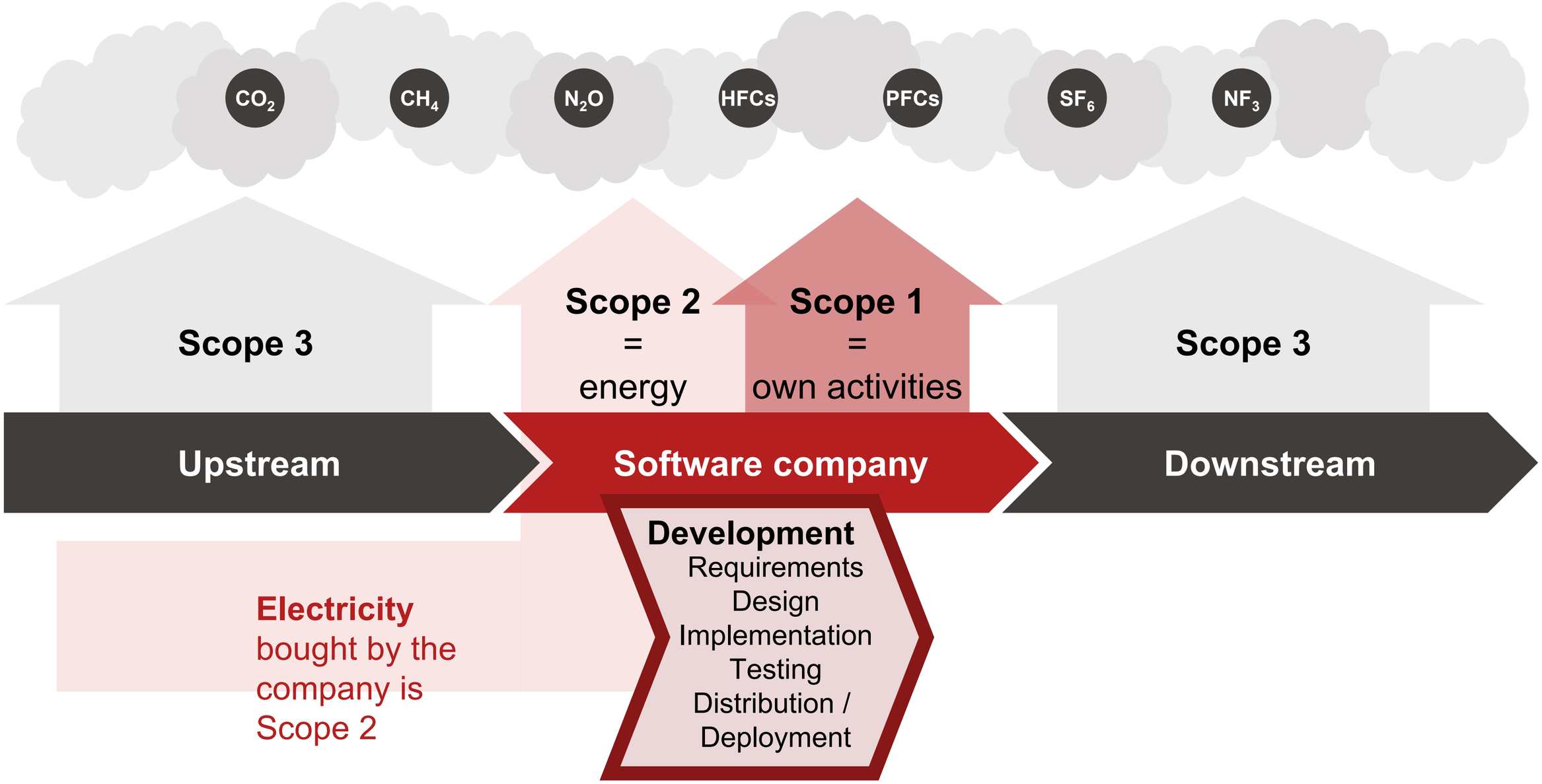
(✅) 13% c. Scope 3 (indirect, value chain)

(✅) 20% d. It depends

- It cannot be Scope 1 unless the software dev company produces its own electricity on site (very rare)
- If the development is done on machines hosted by the development company, the electricity used during development is bought by the company to an Electricity Provider => Scope 2
- If the development is done on a cloud platform hosted by another company, the electricity used during development is bought by a Cloud Provider, in which case it is considered coming from the value chain => Scope 3

Carbon accounting: GHG Protocol

https://ghgprotocol.org/



Case studies

Where to find the cases?

1. Go to **courseware**
2. Find **the case studies** for today: **Sustainability 1**
3. Download:
   - The **instruction sheet**
   - 1 cheatsheet: Decision Matrix

+ From previous chapters, you will need:

- Stakeholder analysis (0 - Introduction)
- Edge cases (2 - Safety 2)

Decision matrix

Instructions

Task = help a professor select a classroom polling system

Work in teams of 2-3:
Read the information provided:

- Scenario
- Summaries of the terms & conditions + privacy policies
  for 3 systems: Mentimeter, Kahoot! 360 and SpeakUp

1. Determine at least **5 criteria** to evaluate the different systems
   + Assign a weight to each criterion by **distributing 10 points**
2. Attribute a **score from 1 to 3** for each system on each criterion
   and compute the **total score** of each system to identify the finalist

Criteria for the decision

Which **criteria** did you identify?

👉 1 post / criterion

- Briefly **describe** the criterion
- Indicate the **weight** you assigned to it

Post your ideas:
https://speakup.epfl.ch
Room key: **81088**

Instructions

Task = help a professor select a classroom polling system

Difficulty = missing information that do not allow to evaluate all solutions on all criteria

Work in teams of 2-3:

Read the information provided:

- Scenario
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Which voting system?

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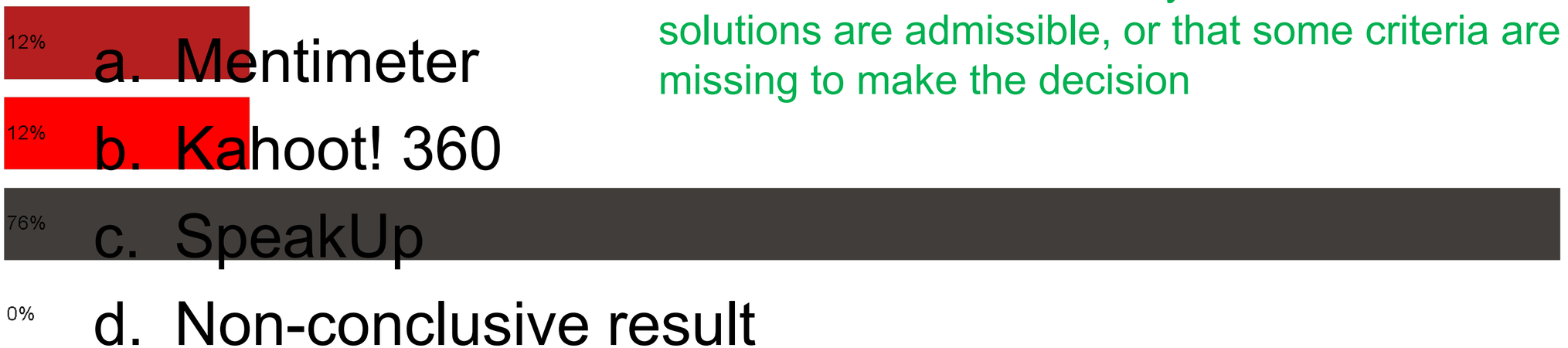
According to your matrix, which voting system should the professor use?

- Different criteria & weights lead to different decisions
- Non conclusive result: it may mean that several solutions are admissible, or that some criteria are missing to make the decision



Overall debriefing of the strategy

- It is important to carefully **think about your criteria** and their respective importance / weights
  - The criteria reflect the grounds on which you make the decision
  - ⚠️ The criteria should be all framed with the same valence
    i.e., they should either be all positive or all negative
  - In the context of a team, attributing weights to criteria can be done with “multivoting”

- The matrix can help **communicate the result of the decision** for a more transparent process

Stakeholder analysis
(review from Intro)

Instructions

a. Identify at least **8 stakeholders** and describe how they are affected by the project - at least 3 who are negatively affected

b. For each stakeholder, identify if they should be considered **direct** or **indirect** stakeholders and why

c. Describe how a **rebound effect** can occur in the case

Stakeholders

Which **stakeholders** did you identify?

👉 1 post / stakeholder

- Briefly **describe** the stakeholder
- Briefly indicate if they are **positively/negatively** affected by the project and how

Post your ideas:
https://speakup.epfl.ch
Room key: **45205**

Direct stakeholders

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Which of the following stakeholders can be considered **direct** stakeholders in the case:

27% a. Internal IT employees working on IT infrastructure
19% b. Corporate clients using the center to provide applications
8% c. Users of applications hosted by the center
24% d. Companies providing energy to the center
11% e. Local population in the area of the center
11% f. Local ecosystems in the area of the center

Direct

Direct or indirect

Indirect

The line between direct and indirect is very fine/blurred, sometimes it is hard to tell -> **argument** is important

Rebound effect

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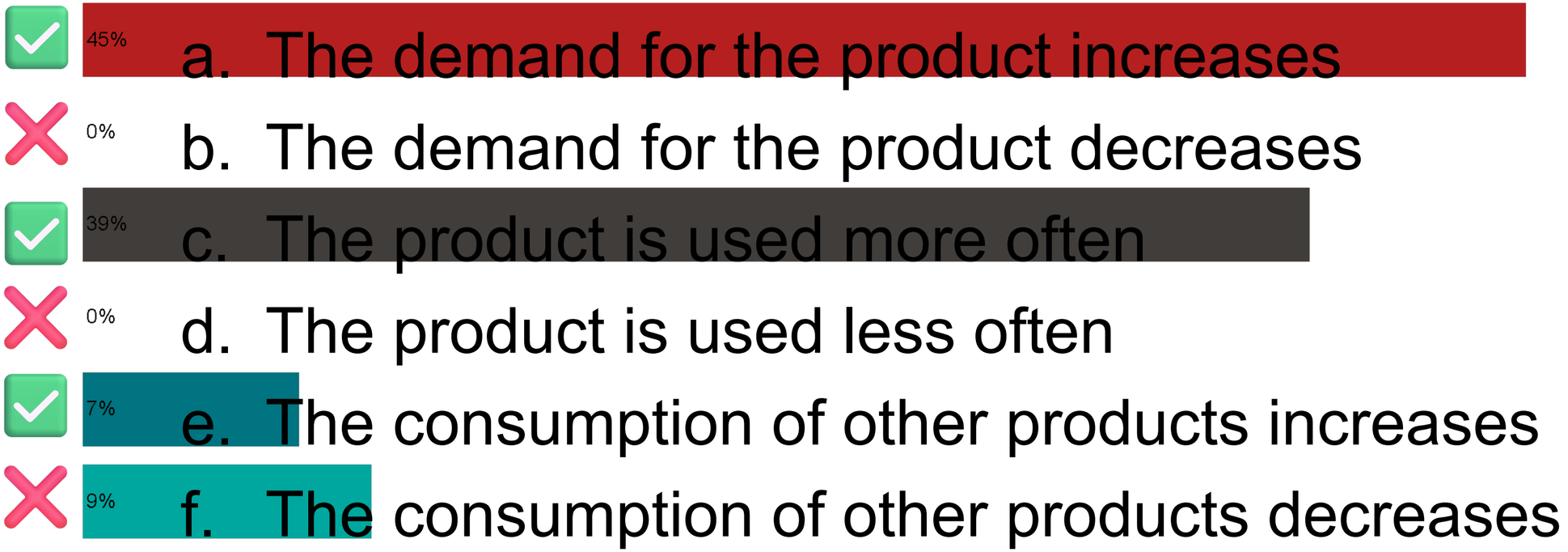
The rebound effect is when **higher energy efficiency** in a product (i.e. lower energy consumption from use) leads to an **increase of total energy consumption** because:
(select all that apply)



Edge cases
(review from Safety 2)

Instructions

- Read the scenario
- Apply the edge case analysis to anticipate challenges **with a sustainability focus** across the 3 categories:
  - Global reach
  - Mass adoption
  - Longevity

Edge cases

Which **edge cases** did you identify?

👉 1 post / edge case

- Name the **category**: mass adoption / global reach / longevity
- Briefly **describe** the identified consequence

Post your ideas:
https://speakup.epfl.ch
Room key: **28007**

Mitigation options

Choose 1 edge case:
How could you mitigate the consequences by making changes in the design of the app?

Do the same with all edge cases!

What’s next?

We start Sustainability 2!

Tomorrow, Tuesday 11: notebook on the **embodied emissions** of **hardware equipment**

By Monday 17:

- Watch **videos 6.1 to 6.4** + do the **quizzes**
- Finish the notebook
  (and any other leftover from previous weeks)

On Monday 17:

- Interactive questions on the theory
- Work on the **case studies together in class**

References

- Ro, C. (2019, October). The harm from worrying about climate change. https://www.bbc.com/future/article/20191010-how-to-beat-anxiety-about-climate-change-and-eco-awareness
- Pihkala, P. (2020). Eco-Anxiety and Environmental Education. Sustainability, 12(23), Article 23. https://doi.org/10.3390/su122310149
- Pihkala, P. (2022). The Process of Eco-Anxiety and Ecological Grief: A Narrative Review and a New Proposal. Sustainability, 14(24), Article 24. https://doi.org/10.3390/su142416628