



Week 13 - revisions

CiRAIG



Outline



1. Course evaluation
2. Mindmap on Life cycle assessment
3. Quizz
4. Questions (project, exam..)



Critical readings

Team work (~5)

see file « Critical analysis of 3 case studies »
on Moodle

Critical readings : 1) waste treatment criticism

These [waste gasification] expensive new technologies solve the problem of waste management upstream and not at the source. "But they need fuel, and that fuel comes from the waste we want to reduce," said M. Ménard. What's more, gasification has not been proven on a large scale, he added. "It's not a proven process for household waste," he said. "In addition, gasification produces a synthetic gas that is not dangerous. **However, when burned to produce energy, it emits twice as many greenhouse gases as a coal-fired power plant producing the same amount of energy.**"



→ Discuss Karel Menard's assertion from a LCA perspective

Critical readings : 1) waste treatment criticism

These [waste gasification] expensive new technologies solve the problem of waste management upstream and not at the source. "But they need fuel, and that fuel comes from the waste we want to reduce," said M. Ménard. What's more, gasification has not been proven on a large scale, he added. "It's not a proven process for household waste," he said. "In addition, gasification produces a synthetic gas that is not dangerous. **However, when burned to produce energy, it emits twice as many greenhouse gases as a coal-fired power plant producing the same amount of energy.**"

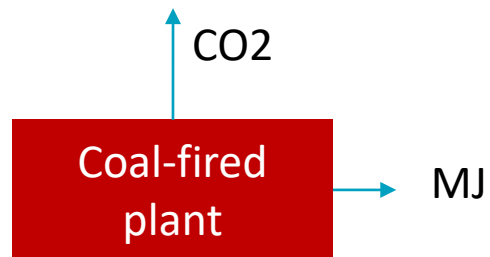
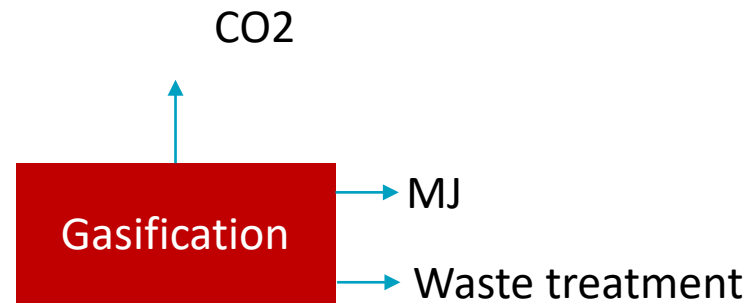
→ Discuss Karel Menard's assertion from a LCA perspective

Hints:

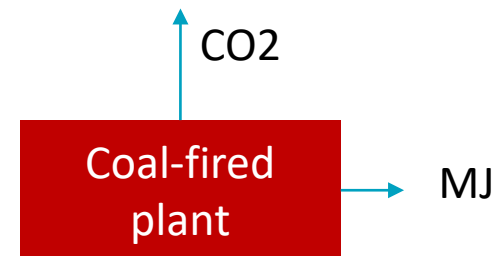
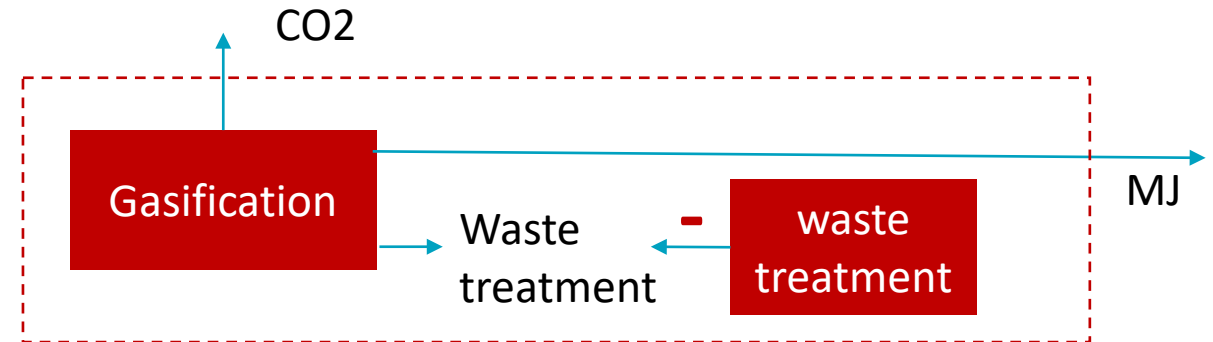
- Consider the function(s) of each system separately: "Gasification of organic waste" and "Thermal power plant".
- Help yourself by drawing the two product systems
- How to make them functionally comparable?

Critical readings : 1) waste treatment

Problem #1: Multifunctionality

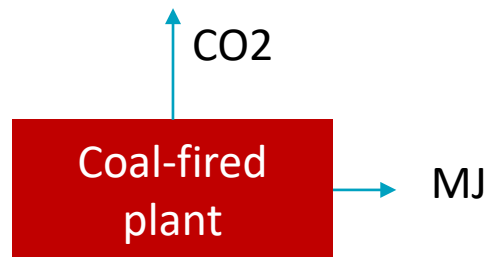
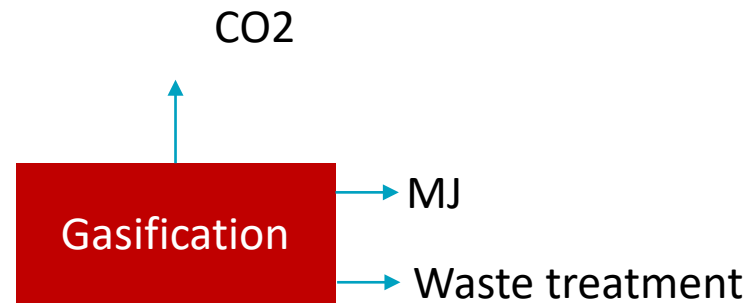


Correct problem setting:
two functional equivalent system

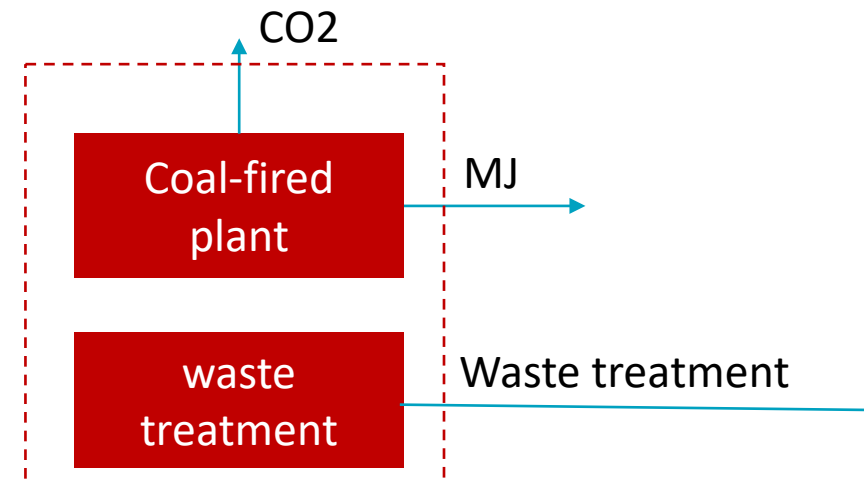
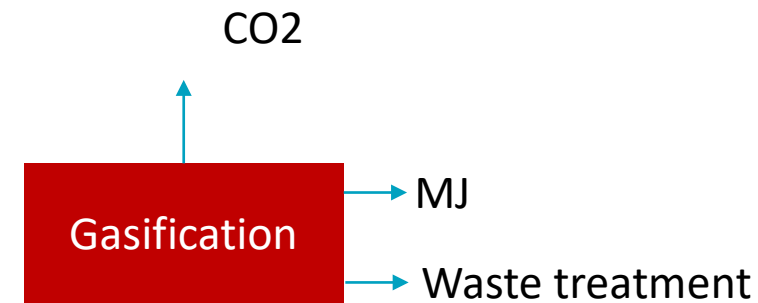


Critical readings : 1) waste treatment

Problem #1: Multifunctionality

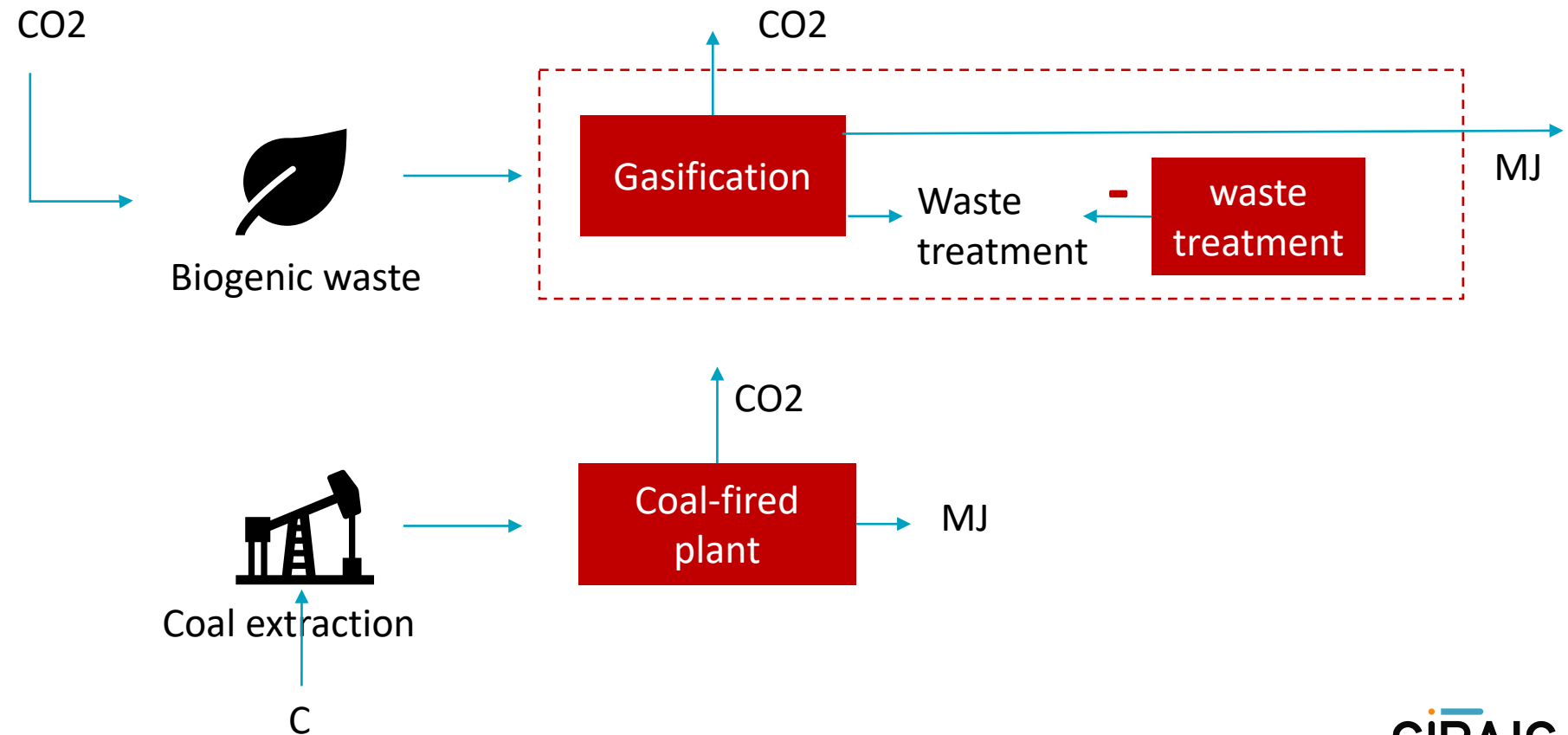


Correct problem setting:
two functional equivalent system



Critical readings : 1) waste treatment

Problem #2: fossil vs. biogenic carbon



Critical reading #2: CO₂ into clean fuel

In order to reduce greenhouse gases, the Centre de recherche industrielle du Québec (CRIQ) has created a system to convert carbon dioxide (CO₂) from the industrial sector into fuel. This involves diverting the CO₂ to ponds to feed the growth of microalgae, which will then be harvested and transformed into biofuel or methane, which will in turn feed the industry



→ Discuss this industrial proposition from a LCA perspective

Critical reading #2: CO2 into clean fuel

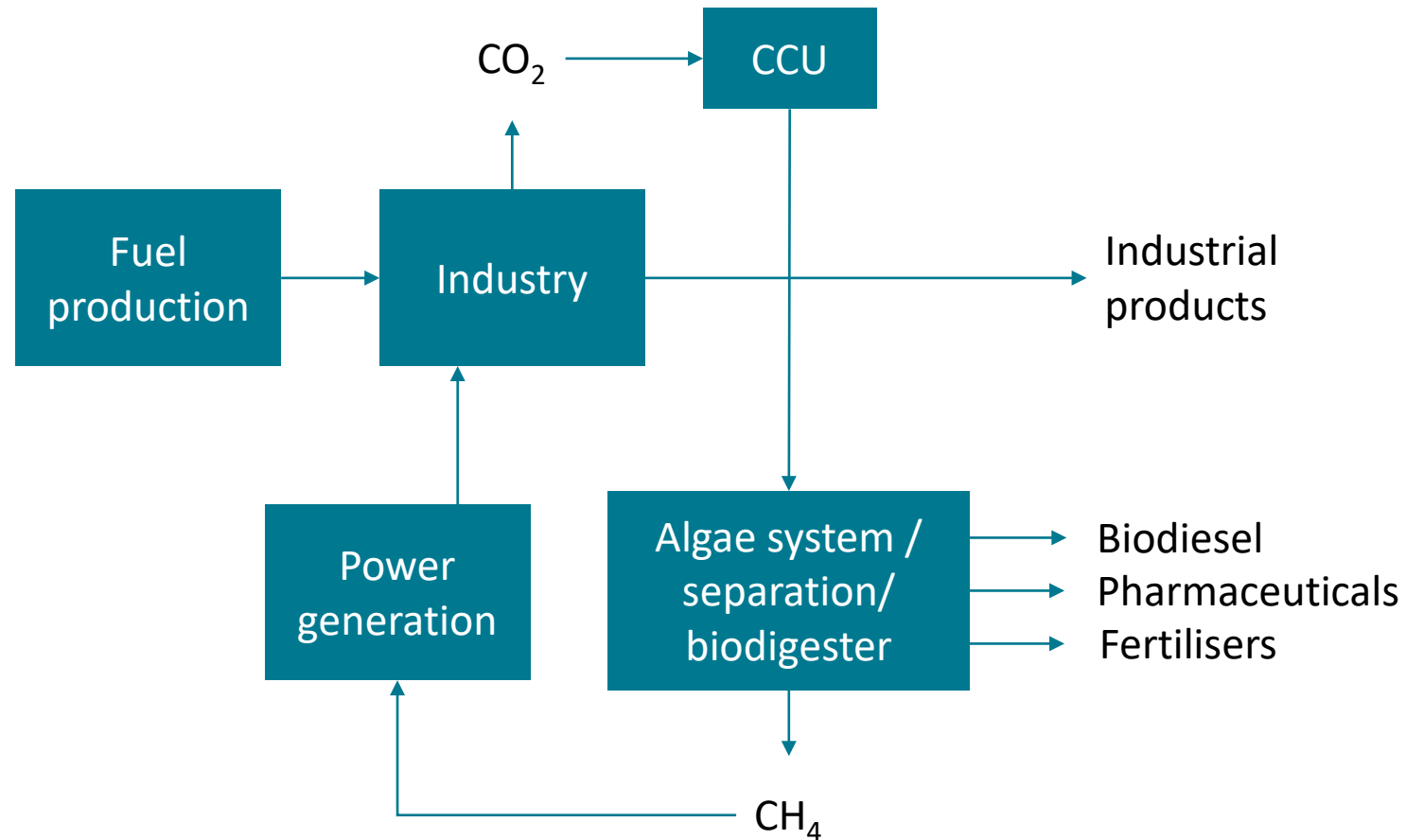
In order to reduce greenhouse gases, the Centre de recherche industrielle du Québec (CRIQ) has created a system to convert carbon dioxide (CO2) from the industrial sector into fuel. This involves diverting the CO2 to ponds to feed the growth of microalgae, which will then be harvested and transformed into biofuel or methane, which will in turn feed the industry

Hints:

- Represent the system, and show the different elementary and economic flows
- What issue do you identify in this product system?
- How can this issue be handled, and what are the consequences with it?

→ Discuss this industrial proposition from a LCA perspective

Critical reading #2: CO₂ into clean fuel



- 1) How would you solve the (multifunctional) problem by :
 - an economic allocation?
 - a system expansion?
- 2) What are the consequences on (fossil) fuel supply if electricity is produced on-site?

Critical reading #3: la désunion Européenne”

« And, to make matters worse, a proposal for a directive on the exploitation of shale gas [is proposed by Brussels], a greenhouse gas 25 times more powerful than CO₂ »

LA SUITE DU PAQUET ENERGIE CLIMAT

Objectif atteignable? Affirmatif. Selon une **étude publiée à l'automne dernier par l'Agence européenne de l'environnement (AEE)**, les pays membres de l'Union ont déjà réussi à abattre, collectivement, leurs émissions carbonées de 19% entre 1990 et 2012. Dans le même temps, le PIB européen a bondi de près de 50%.

Individuellement, ce n'est pas si simple. Une **seconde note de l'AEE** rappelle que l'Autriche, la Belgique, l'Espagne, la Finlande, l'Irlande et le Luxembourg n'ont, aujourd'hui, aucune chance d'atteindre leurs objectifs nationaux, notamment dans les secteurs de l'habitat et des transports.

OBJECTIF CARBONE

Que devrait proposer Bruxelles pour aller de l'avant? Comme en 2008, une série de mesures qui imposeront au Vieux monde de réduire de 35 à 40% ses émissions de gaz carbonique, entre 1990 et 2030. La similitude avec le PEC 2020 s'arrête là. A la différence du 3x20%, les pays membres n'auront plus aucun objectif contraignant en énergie «vertes». Le but désormais visé, dit-on dans les couloirs du Berlaymont, étant que 24 à 30% de l'énergie finale consommée, en 2030, soient d'origine renouvelable.

Bruxelles devrait aussi annoncer une nouvelle réforme du marché des quotas d'émissions de gaz à effet de serre (ETS), présenter une communication sur la compétitivité de l'industrie européenne. Et, comble du ridicule, une proposition de directive sur l'exploitation des gaz de schiste, un gaz à effet de serre 25 fois plus puissant que le CO₂.

→ Discuss the misinterpretation of a reporter who criticizes a draft shale gas development directive in relation to meeting GHG emission targets

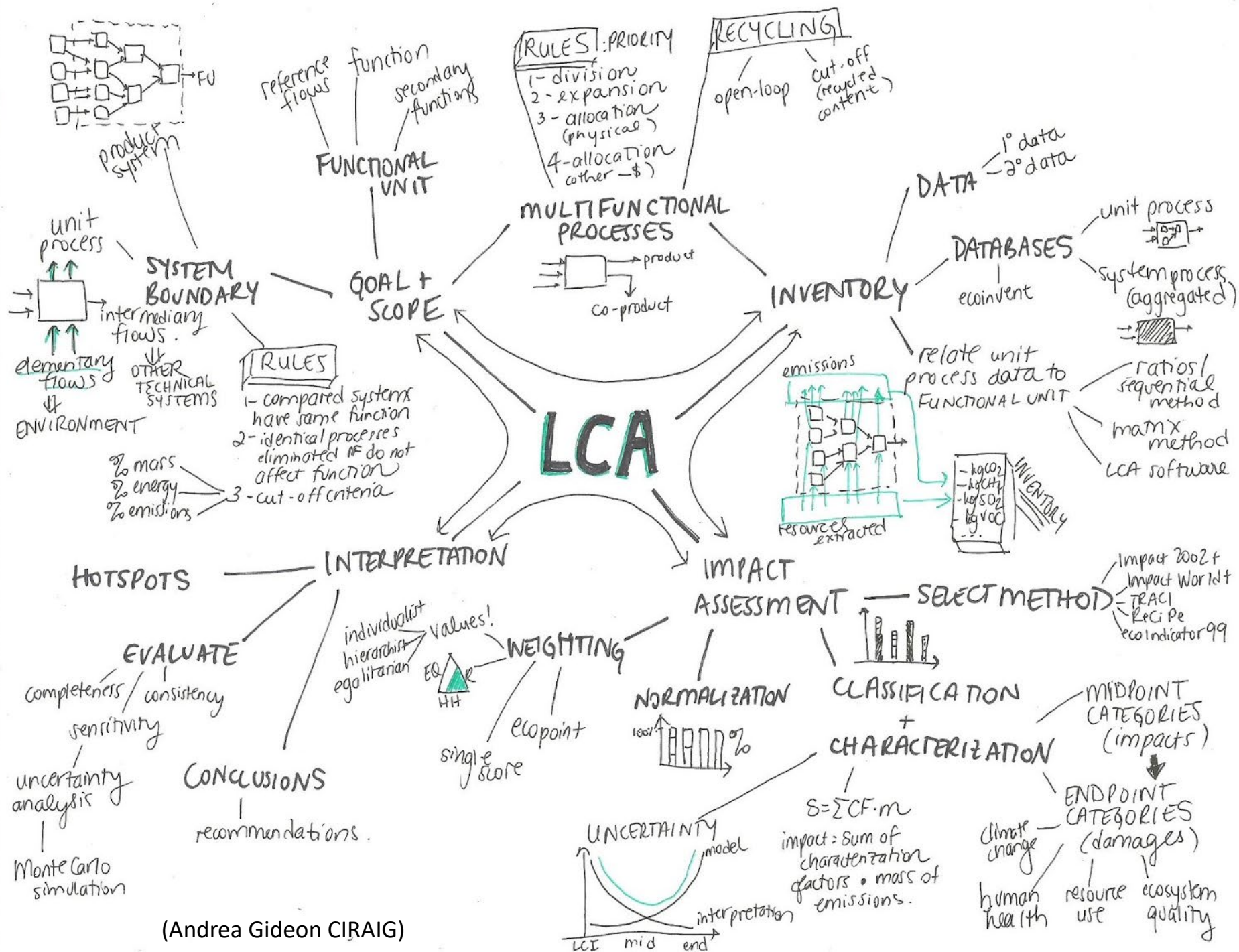
Critical reading #3: la désunion Européenne”

« And, to make matters worse, a proposal for a directive on the exploitation of shale gas [is proposed by Brussels], a greenhouse gas 25 times more powerful than CO₂ »

→ Shale gas: intermediate (or « economic ») flow
≠
elementary flow

→ Discuss the misinterpretation of a reporter who criticizes a draft shale gas development directive in relation to meeting GHG emission targets

Mindmap Life cycle assessment





QUIZZ

Quizz



Name the 4 terms in the following equation:

$$I=P*A*T$$

Which term does LCA aim to minimise?

Impact ; Population ; Affluence ; Technology



Which international standard governs LCA?

ISO 14044:2006



Name a strong assumption that is made regarding the geographical context of the LCI when applying a LCIA methodology such as ReCiPe, LIME or TRACI?

*All elementary flows are occurring in the geographical context of the LCIA method of reference:
(ReCiPe: EU, LIME: Japan, TRACI: US)
(IMPACT World+ has global coverage)*



What does a cradle-to-gate LCA study mean? Give an example.

From material extraction to company gate

Subsequent life cycle stages are excluded (e.g. use and/or EoL)

Example: LCA focusing on an industrial process



What is the main advantage of aggregating LCIA results into a single indicator?

What is the main disadvantage?

Advantage: Communication and simplification

Disadvantage: loss of information, overlook on tradeoffs, aggregation based on (subjective) value choices

What is the difference between problem-oriented impacts (midpoint) and damage-oriented impacts (endpoint) in terms of certainty and environmental relevance?

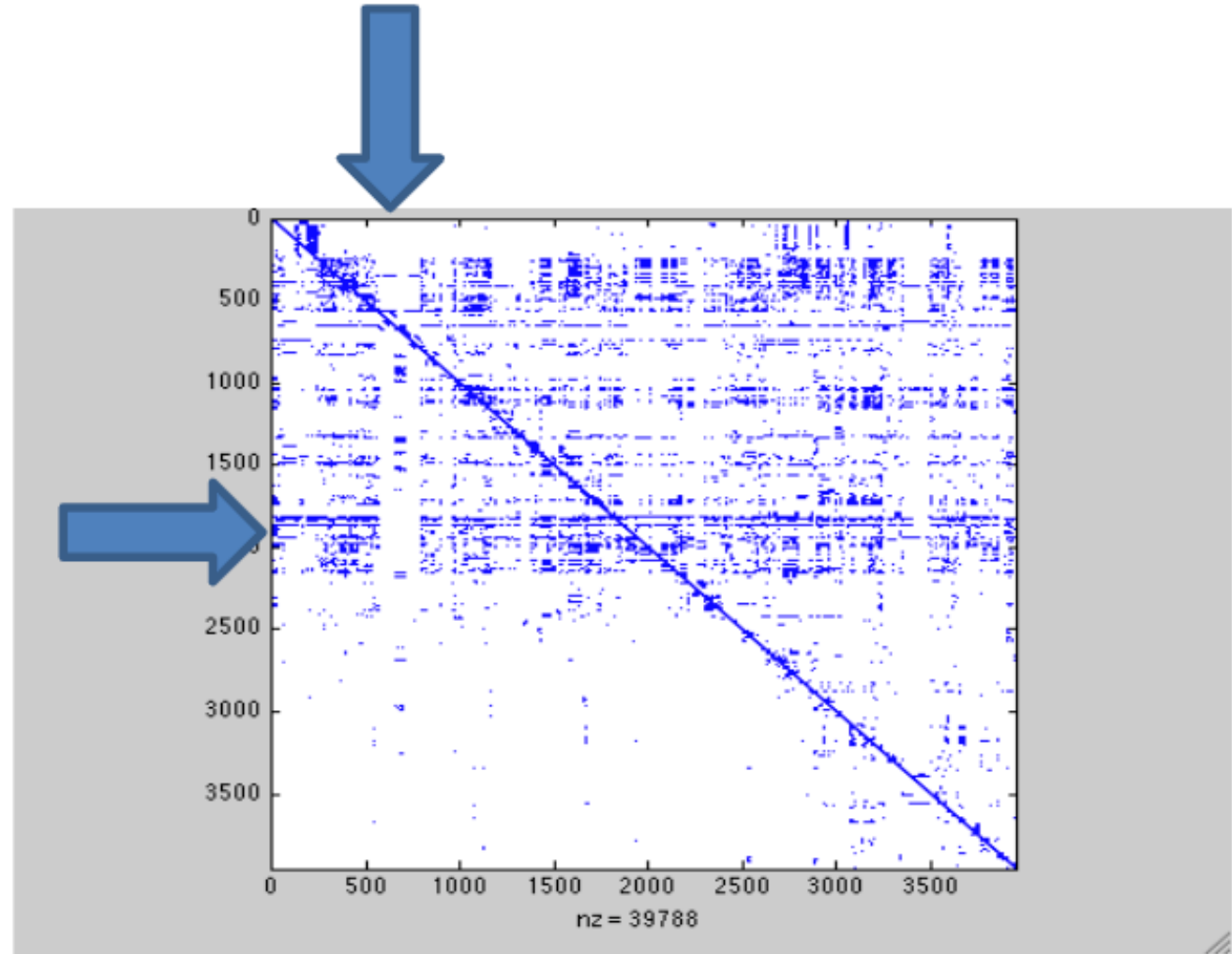
The two indicators are positioned at different level across the cause-effect chain

Midpoint : higher certainty of model / lower environmental relevance

Endpoint : lower certainty of model / higher environmental relevance

Quizz

- a. What is this matrix?
- b. Why is the identified row almost full?
- c. Why is the identified columns almost empty except the diagonal element?



a. Technological A / b. Electricity (in a lot of processes!) / c. Aggregated processes



Am I allowed to compare normalized scores from different damage categories without applying weighting factors?

No – a comparison between normalized scores ALWAYS implies weighting! Implicit weighting (1:1) if not specified differently



Rank the four approaches for dealing with multifunctional processes, according to ISO 14044:

System boundaries expansion

Allocation

Subdivision

Physical relationships between inputs and outputs

Subdivision/System expansion/Underlying physical relationship/Allocation



Provide an example of each of the following allocation approaches:

Subdivision

System boundaries expansion

Physical relationships between inputs and outputs

Allocation



What is the meaning of the following acronymes added to
ecoinvent process names

« RER » , « CH » , « GLO » and « ROW »

RER: Europe

CH: Switzerland

GLO: global

ROW: rest of the world



What does DALY means?

Disability-adjusted life years. Equivalent years of life lost in full health. DALYs for a disease or health condition are the sum of the years of life lost to due to premature mortality (YLLs) and the years lived with a disability (YLDs) due to prevalent cases of the disease or health condition in a population (WHO, nd.)

Quizz



The calculation of inventory using the matrix method is based on the following equation: $g=B(A-1)f$. Name the 4 terms in this equation and explain what they represent

g : vector of scaled elementary flows (i.e. life cycle inventory)

B : Matrix of elementary flows

A : Technological matrix

f : final demand flow (corresponding to the functional unit)

Quizz



Name one advantage and one disadvantage of modelling a product system using aggregated processes ("S" in ecoinvent).

- + Faster computation*
- Loss of information*



Explain the meaning of the following unit: tkm
Cite two distinct but equivalent cases for 10 tkm

*Unit of measure of freight transport: transport of one ton of goods
by a given transport mode over one kilometre
10 t transported over 1 km vs. 2 t transported over 5 km*



The LCIA phase provides the information to interpret the LCI results. Give an example where such an assessment would not be necessary to determine which of products A or B would be better for the environment.

If all the elementary flows of the LCI are systematically lower in A than B, or the contrary



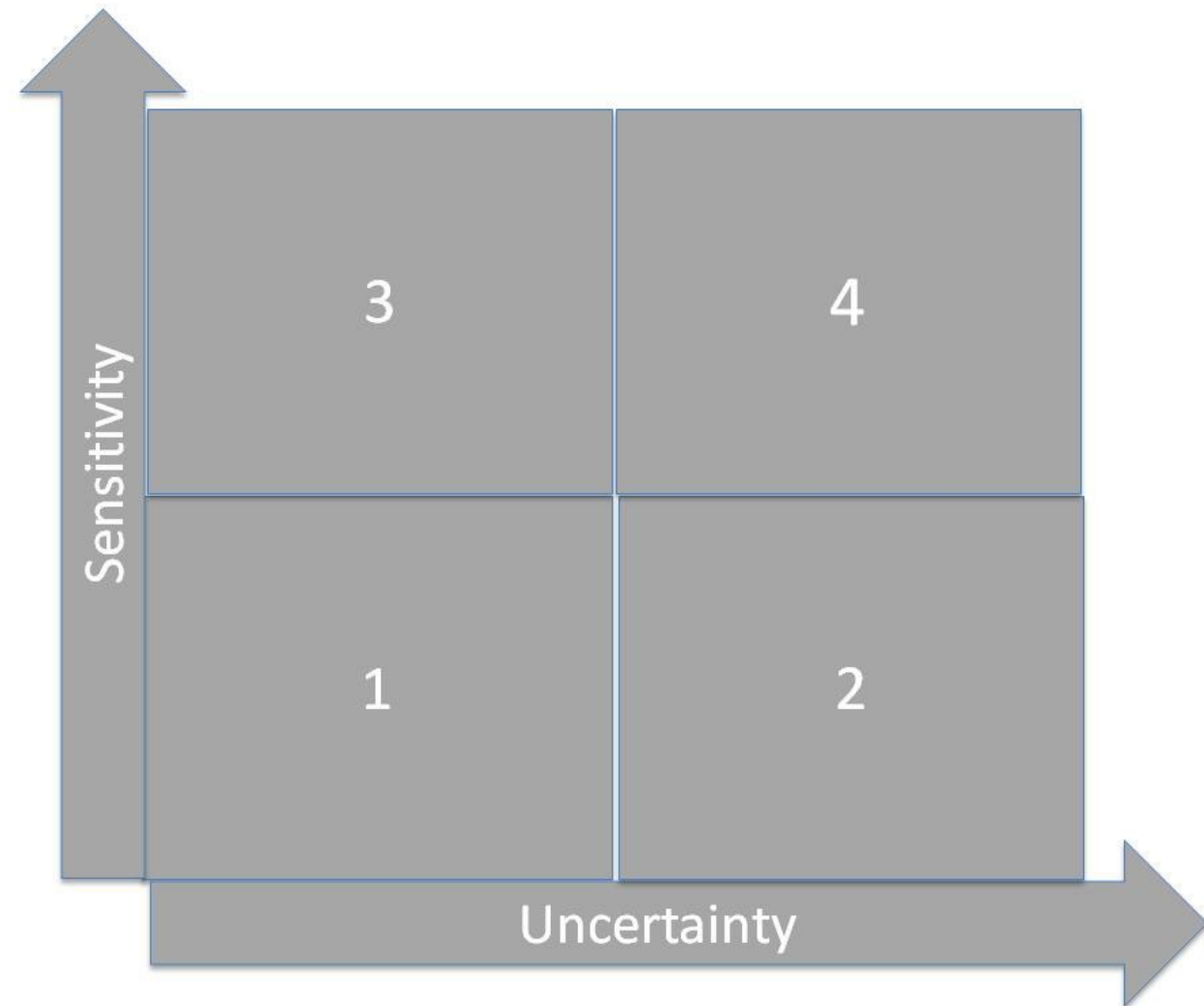
Why can't product systems containing multifunctional processes be solved by the matrix method before either allocating or expanding the system boundaries?

Because matrix A is not square (so it can't be inverted)

Quizz

Where should you focus your efforts to improve data quality?

4



Quizz



We've carried out an LCA study for you on the production of white sheets of paper. You are unhappy with the study because the functional unit is as follows: The production of 5 sheets of white paper. You would actually like to know the impact of producing 100 sheets of white paper. What should you do?

LCA is linear! Multiply the result per 20



What is the justification for excluding a life cycle stage or a unit process from the system boundaries of a product system?
(Provide two examples)

- 1. If it is the same in the two product system we're comparing and provide the same quantity of outgoing reference flow*
- 2. If it account for less than a cut-off criteria (e.g. 1 % of mass, energy, impact)*

QUESTIONS