42620 Science, Technology and Society

January 2026

Introduction to the SDG guideline

Phases 4 and 5

Michael Hauschild (Pernille Ohms)

Agenda

- Questions for phases 1 to 3?
- **Phase 4** – Assessment of the impacts of the effects on the SDGs
- **SDGUI** – phase 4
- **Phase 5** – Interpretation
- Group work

Example: Urban farming

“The city of Boston in the state Massachusetts has decided that they will stop importing tomatoes from Mexico by 2030 and instead they will start growing tomatoes to cover their own needs. To do this they will build heated greenhouses on the roofs of all existing buildings to be able to grow tomatoes during the entire year.”

Example: Urban farming

- What is the functional output?
- What is the baseline system?
- What is the new system?

Example: Urban farming

Functional output

700,000 people living in Boston by 2030
Assuming people eat 1 tomato per day
1 medium tomato weighs on average 123 gram

Annual supply of 31,000 tons tomatoes

Example: Urban farming

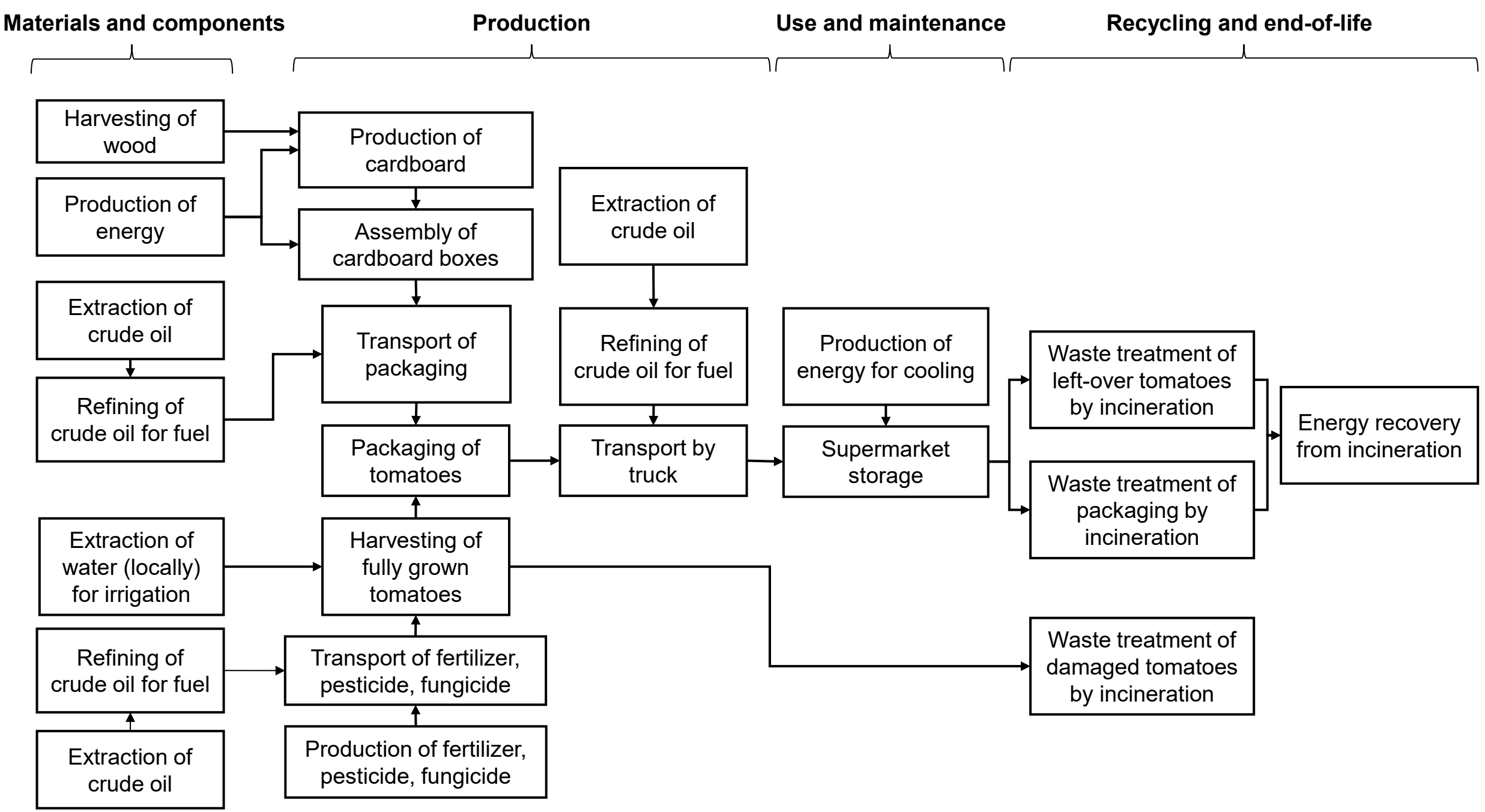
Baseline system

31,000 tons tomatoes grown in Mexico

- How are they grown in Mexico?

31,000 tons tomatoes transported from Mexico to Boston

- How are they transported?

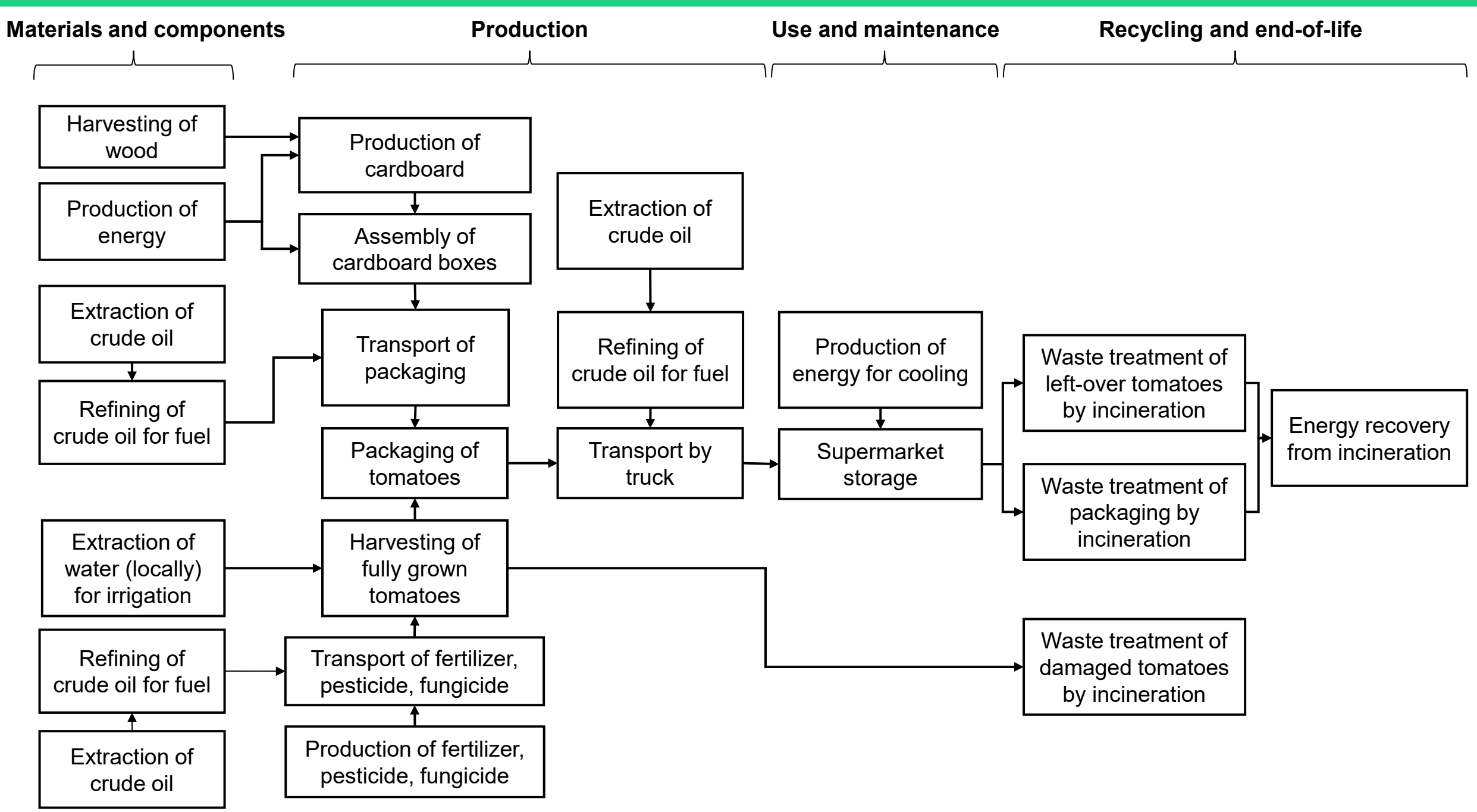

Materials and components
Production
Use and maintenance
Recycling and end-of-life
Harvesting of wood
Production of energy
Extraction of crude oil
Refining of crude oil for fuel
Extraction of water (locally) for irrigation
Refining of crude oil for fuel
Extraction of crude oil
Production of cardboard
Assembly of cardboard boxes
Transport of packaging
Packaging of tomatoes
Harvesting of fully grown tomatoes
Transport of fertilizer, pesticide, fungicide
Production of fertilizer, pesticide, fungicide
Extraction of crude oil
Refining of crude oil for fuel
Transport by truck
Production of energy for cooling
Supermarket storage
Waste treatment of left-over tomatoes by incineration
Waste treatment of packaging by incineration
Waste treatment of damaged tomatoes by incineration
Energy recovery from incineration

Example: Urban farming

New system

31,000 tons tomatoes grown in greenhouses on roofs in Boston
- What do we need to grow tomatoes on roofs in Boston?

31,000 tons tomatoes transported from roofs to supermarkets
- How are they transported?


Materials and components
Production
Use and maintenance
Recycling and end-of-life
Harvesting of wood
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Extraction of crude oil
Refining of crude oil for fuel
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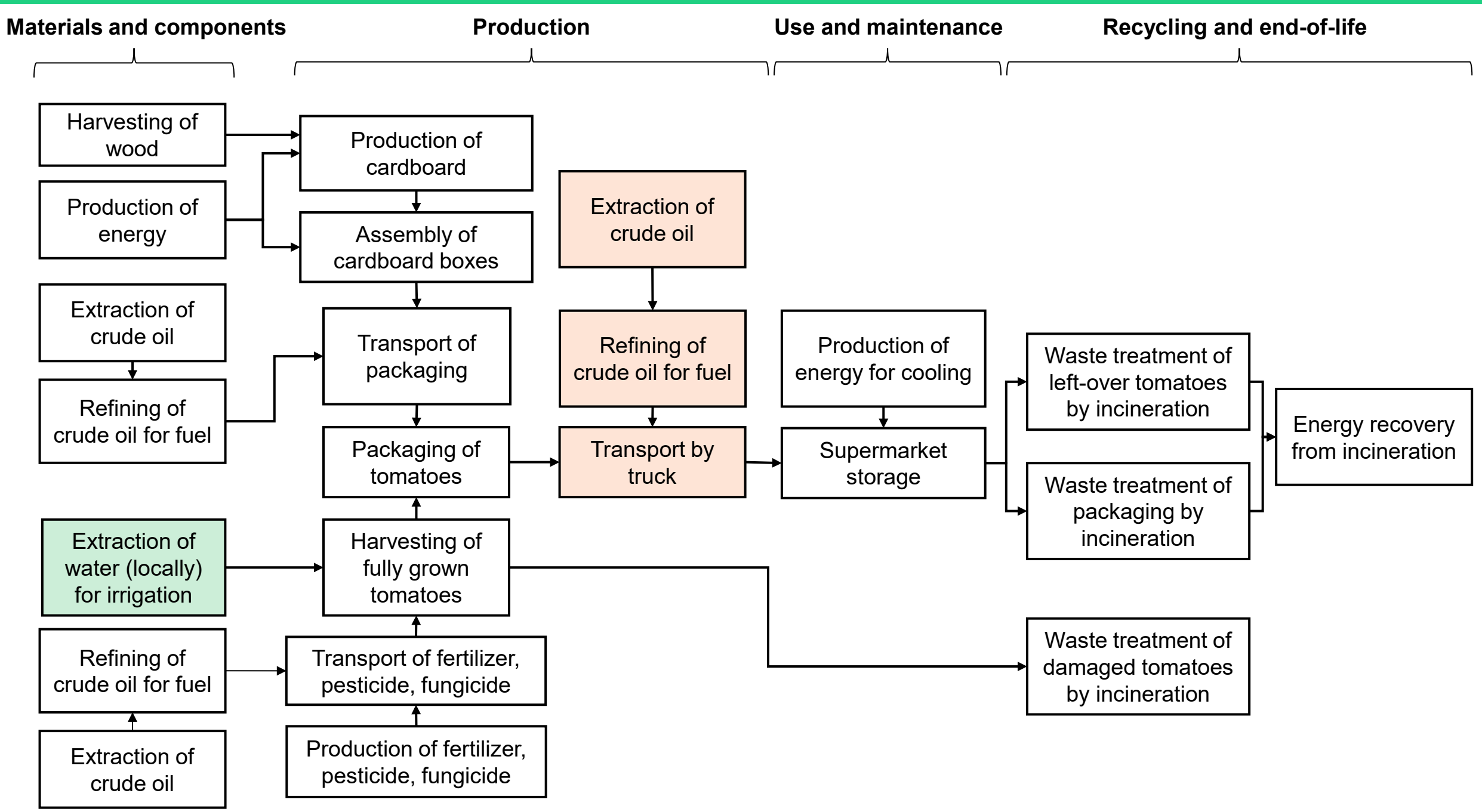
Energy recovery from incineration


Materials and components
Production
Use and maintenance
Recycling and end-of-life
Harvesting of wood
Production of energy
Extraction of crude oil
Refining of crude oil for fuel
Extraction of water (locally) for irrigation
Refining of crude oil for fuel
Extraction of crude oil
Production of cardboard
Assembly of cardboard boxes
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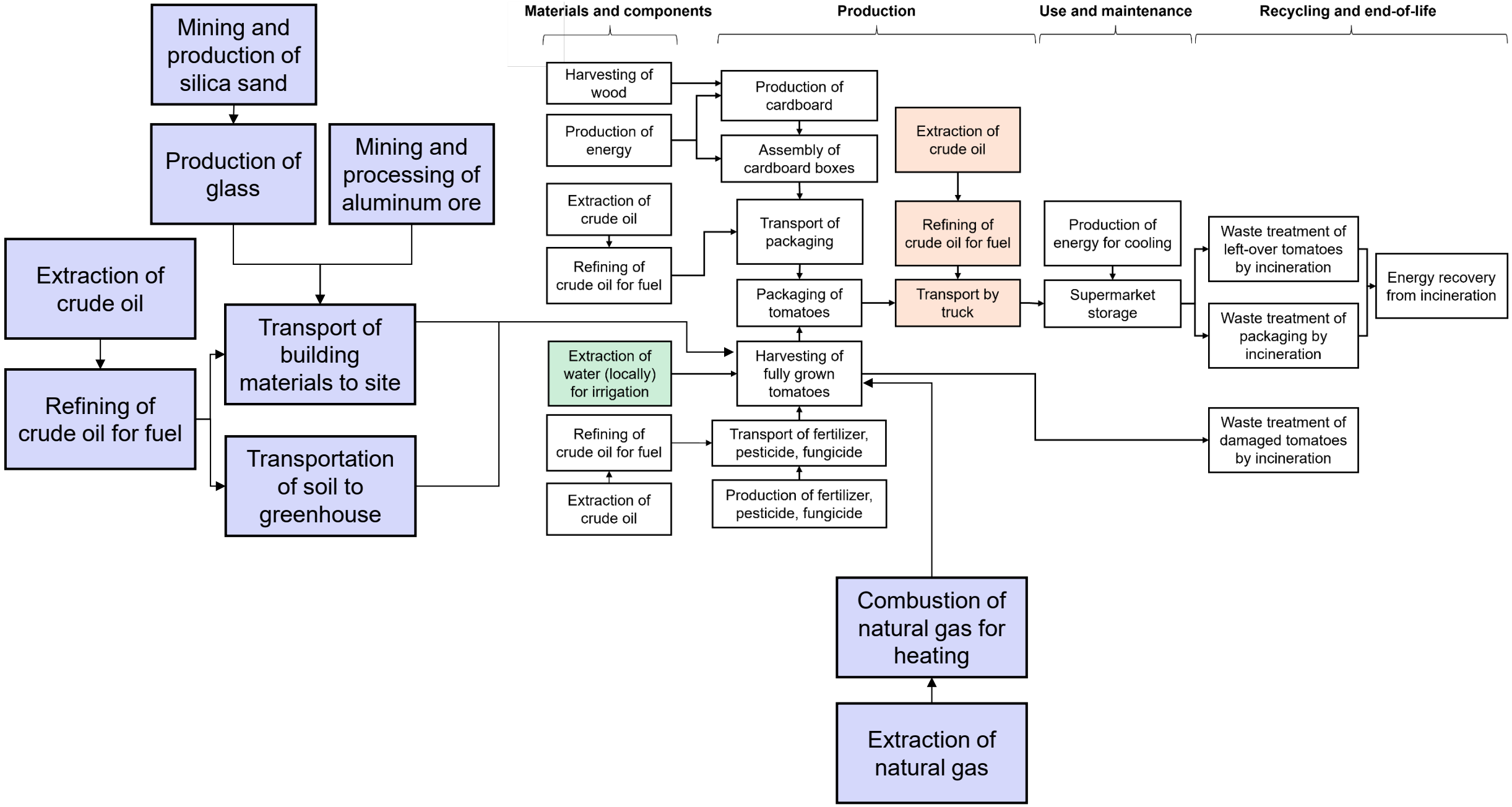
Packaging of tomatoes
Harvesting of fully grown tomatoes
Transport of fertilizer, pesticide, fungicide
Production of fertilizer, pesticide, fungicide
Extraction of crude oil
Refining of crude oil for fuel
Transport by truck
Production of energy for cooling
Supermarket storage
Waste treatment of left-over tomatoes by incineration
Waste treatment of packaging by incineration
Waste treatment of damaged tomatoes by incineration
Energy recovery from incineration


Materials and components
Production
Use and maintenance
Recycling and end-of-life
Mining and production of silica sand
Production of glass
Mining and processing of aluminum ore
Extraction of crude oil
Refining of crude oil for fuel
Transport of building materials to site
Transportation of soil to greenhouse
Harvesting of wood
Production of energy
Extraction of crude oil
Refining of crude oil for fuel
Production of cardboard
Assembly of cardboard boxes
Transport of packaging
Packaging of tomatoes
Extraction of water (locally) for irrigation
Refining of crude oil for fuel
Extraction of crude oil
Transport of fertilizer, pesticide, fungicide
Production of fertilizer, pesticide, fungicide
Harvesting of fully grown tomatoes
Extraction of crude oil
Refining of crude oil for fuel
Transport by truck
Production of energy for cooling
Supermarket storage
Waste treatment of left-over tomatoes by incineration
Waste treatment of packaging by incineration
Energy recovery from incineration
Waste treatment of damaged tomatoes by incineration
Combustion of natural gas for heating
Extraction of natural gas

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Testing the environmental performance of urban agriculture as a food supply in northern climates

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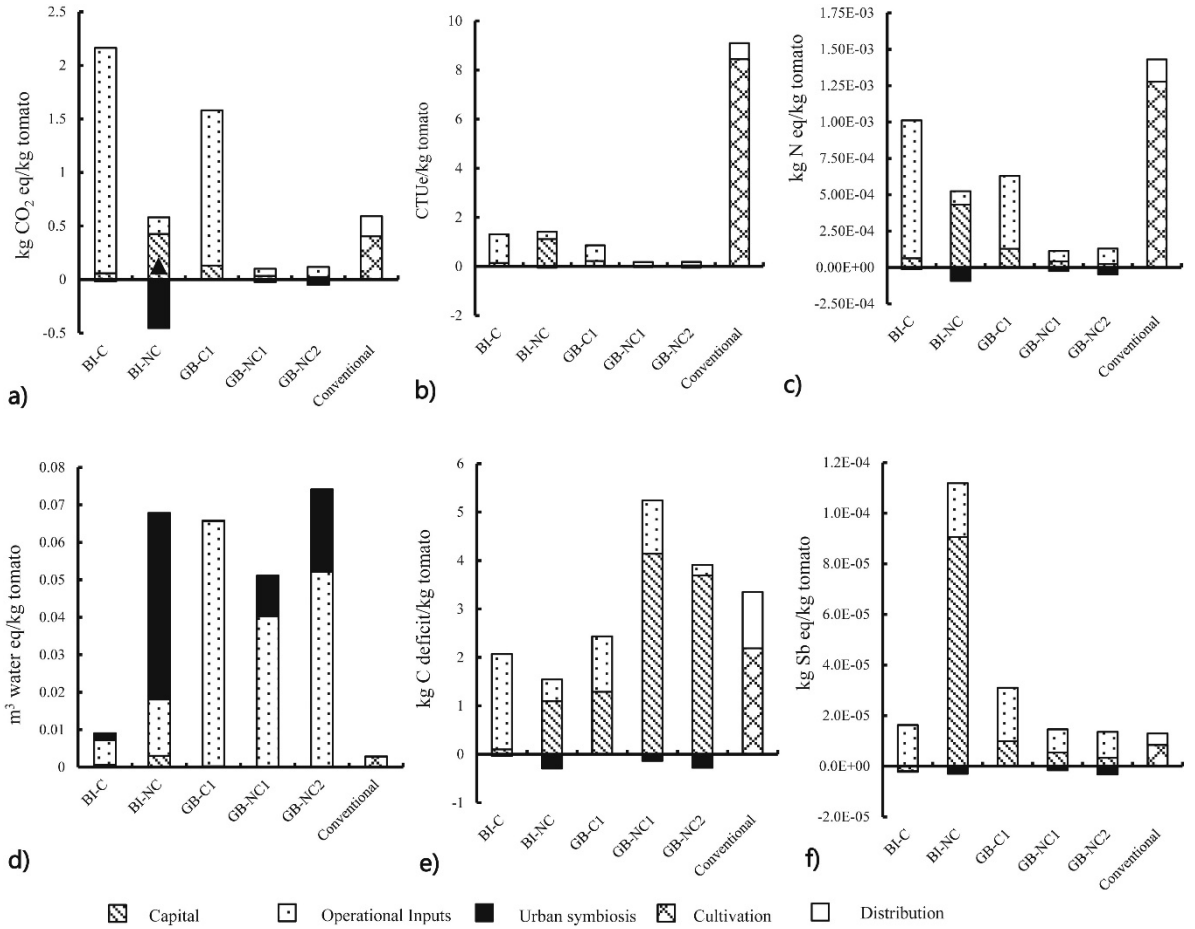
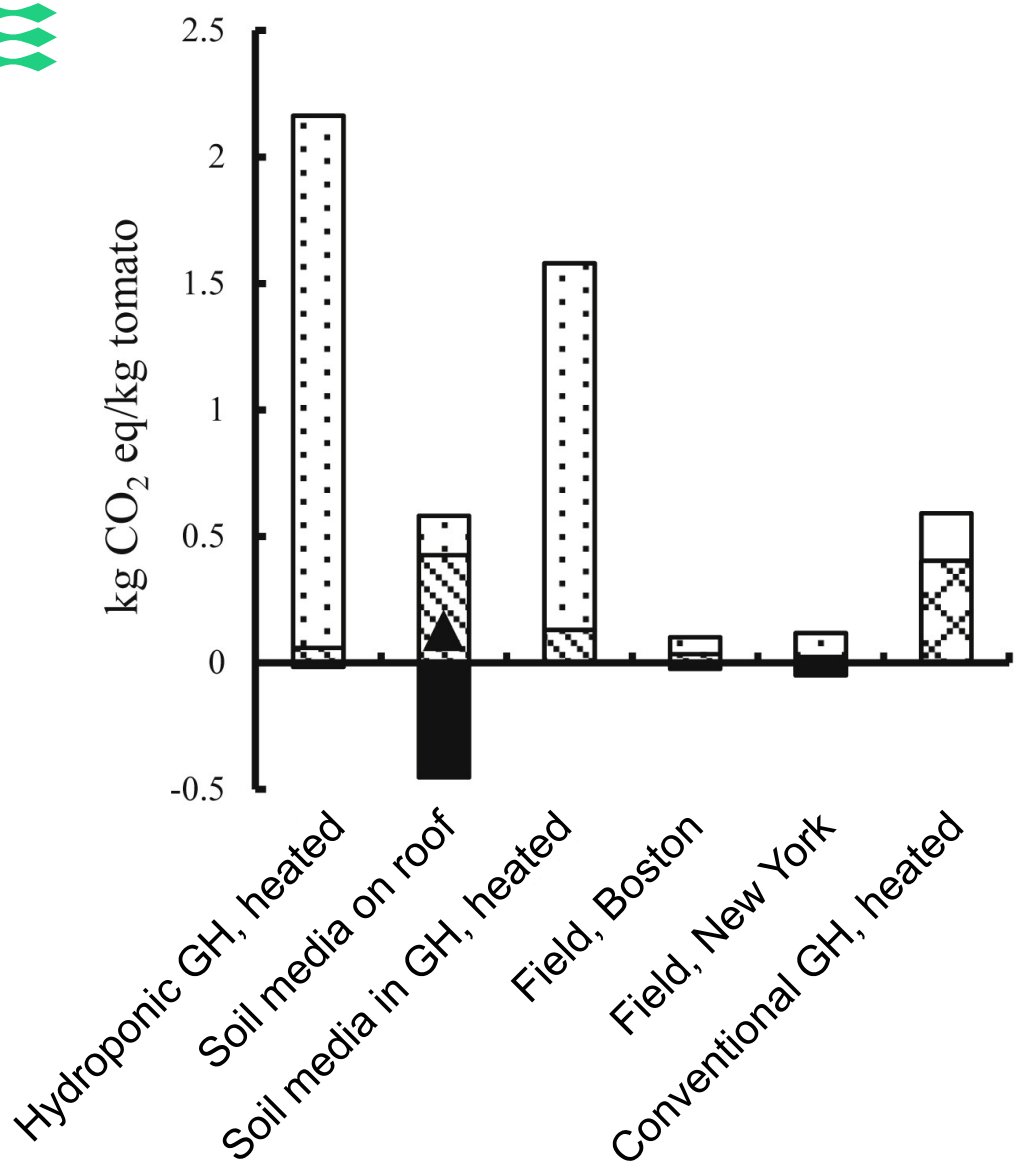
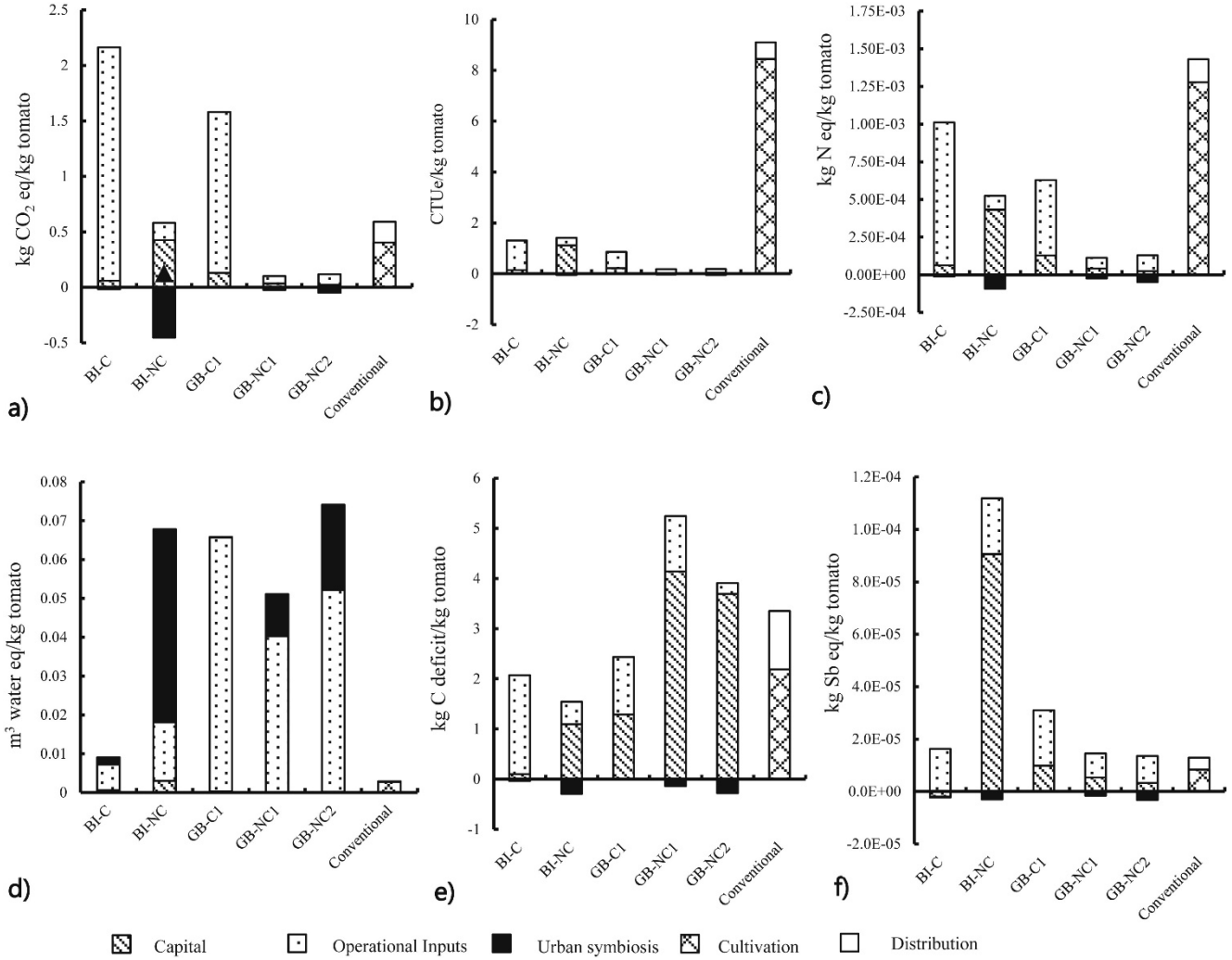
ABSTRACT

The past decade has seen a renaissance of urban agriculture in the world's wealthy, northern cities. The practice of producing food in and around cities is championed as a method to reduce environmental impacts of urban food demands (reducing distance from farm to fork – 'food miles') whilst conferring a number of ancillary benefits to host cities (runoff attenuation, urban heat island mitigation) and ex-urban environments (carbon sequestration). Previous environmental assessments have found urban agriculture to be more sustainable than conventional agriculture when performed in mild climates, though opposite findings emerge when external energy inputs are significant. In this study we perform an environmental life cycle assessment of six urban farms in Boston and New York City, US producing lettuce and tomatoes, with conventional counterparts across six impact categories. Performance of urban agriculture was system dependent and no farm provided superior performance to conventional for all indicators. High-yield, heated, greenhouse production of tomatoes has potentially higher environmental burdens than conventional methods in terms of climate change (267–369%) and non-renewable resource depletion (108–239%), driven primarily by external energy inputs. Heated lettuce production systems showed similar trends. Low-tech, empty-lot farming appears to hold some advantages in terms of climate change burdens and resource use, though water and land usage was found to be elevated relative to conventional lettuce and tomatoes. Open rooftop farming apparently provides benefits if high yield crops (e.g. tomatoes) are cultivated, otherwise significant capital inputs detrimentally affect environmental performance. In general, the benefits of reduced food miles may be overwhelmed by energy inputs and inefficient use of production inputs. A comparison of urban agriculture and solar panels showed that the latter would confer greater benefits to mitigate climate change per unit area. Thus, urban agriculture may not be the optimal application of space in northern cities to improve urban environmental performance.




kg CO_2 eq/kg tomato
2.5
2
1.5
1
0.5
0
-0.5
Hydroponic GH, heated
Soil media on roof
Soil media in GH, heated
Field, Boston
Field, New York
Conventional GH, heated


a)
kg CO_2 eq/kg tomato
b)
CTUe/kg tomato
c)
kg N eq/kg tomato
d)
m^3 water eq/kg tomato
e)
kg C deficit/kg tomato
f)
kg Sb eq/kg tomato
BI-C
BI-NC
GB-C1
GB-NC1
GB-NC2
Conventional
Capital
Operational Inputs
Urban symbiosis
Cultivation
Distribution

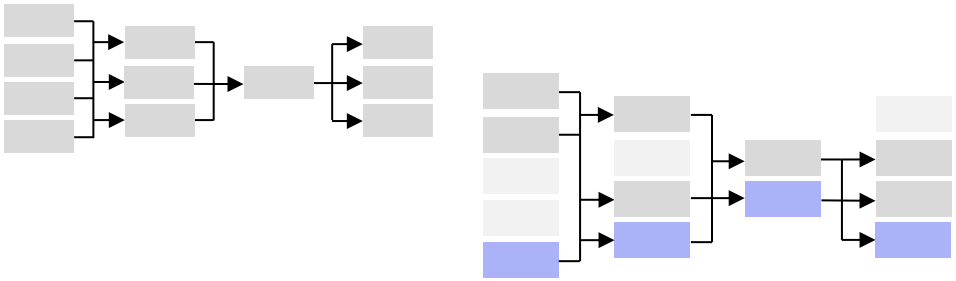
Questions for Phase 1 to 3 ?

1 Understanding and scoping the:

The BASELINE system

The NEW system

2 Process diagrams



3 Effects

Physical Effects Table

Raw materials	Production	Use	Recycling & End-of-Life
~~Effect~~ = Proces 1: Ingen ændring	~~Effect~~ = Proces 5: Ingen ændring	~~Effect~~ = Proces 8: Ingen ændring	Effect 10 − Process 9 fjernet
Effect 1 ↗ Process 2 øget	Effect 5 − Process 5 fjernet	Effect 8 + Process 14 tilføjet	~~Effect~~ = Proces 10: Ingen ændring
Effect 2 − Process 3 fjernet	Effect 6 ↘ Process 7 reduceret		~~Effect~~ = Proces 11: Ingen ændring
Effect 3 − Process 4 fjernet	Effect 7 + Process 13 tilføjet		Effect 11 + Process 15 tilføjet
Effect 4 + Process 12 tilføjet			

Non-Physical Effects Table

Raw materials	Production	Use	Recycling & End-of-Life
		Effect 9 + Ikke-fysisk effekt tilføjet	

How many effects?

1. Minimum the number of processes + non-physical

2. As many as needed but no more than necessary… (iteration!)

Remember: Split the work on processes and effects between you all in the group

Teaching goals

- Understand the importance of adopting a **life cycle / systems perspective** and considering a wide range of **impacts** within each of the three **sustainability dimensions** - environment, society and economy.
- Be able to **conduct a sustainability assessment** of the introduction of a **new technology** in relation to the UN sustainable development goals (**SDG**s).

Phase 4

1. Analyse the impacts from an effect on the SDGs
2. Identify **interlinkages** between the SDGs

Phase 5

1. Discuss the most important **sustainability aspects** of a technology change
2. Identify possible **hot spots** and present **suggestions** for improvements

Phase 4:
Assessment of the impacts of the effects on the SDGs

Two steps

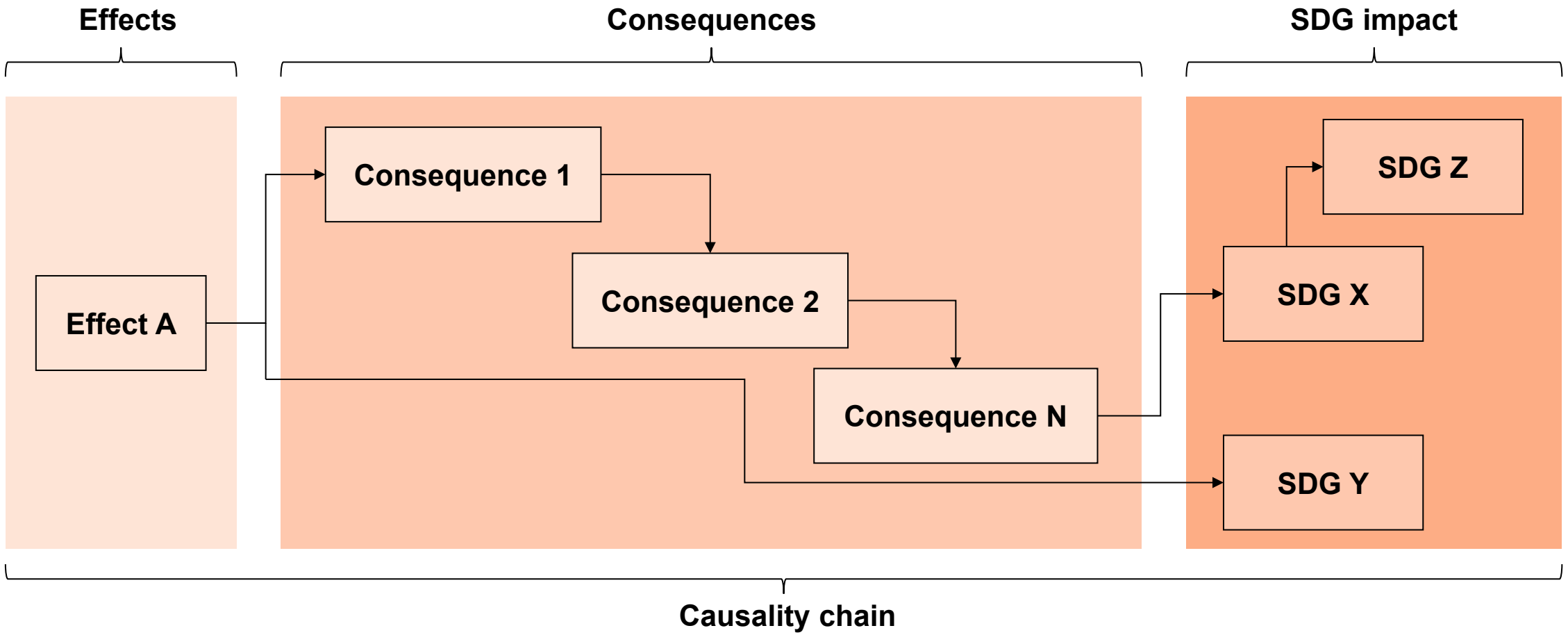
1

Link the effects to the SDGs

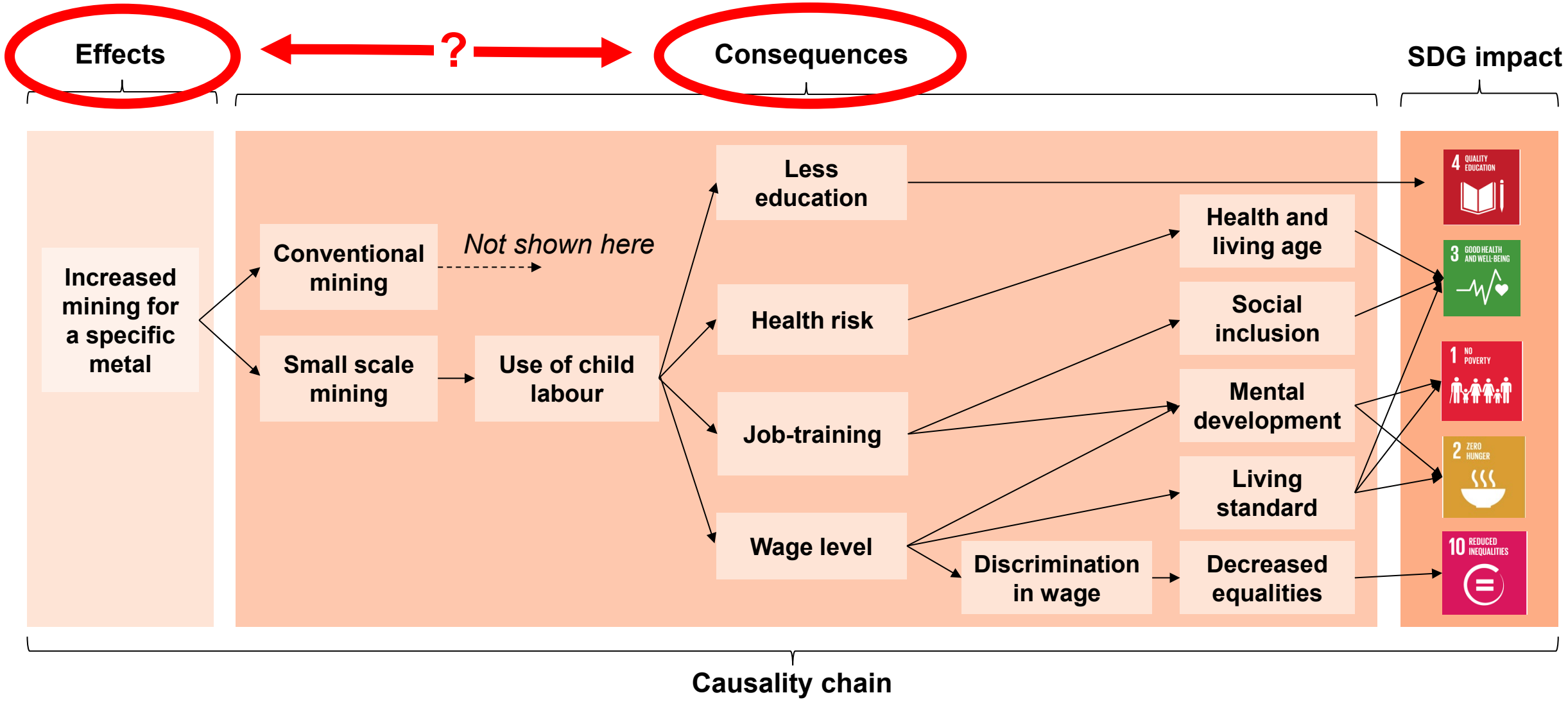
2

Semi-quantitative assessment of each consequence

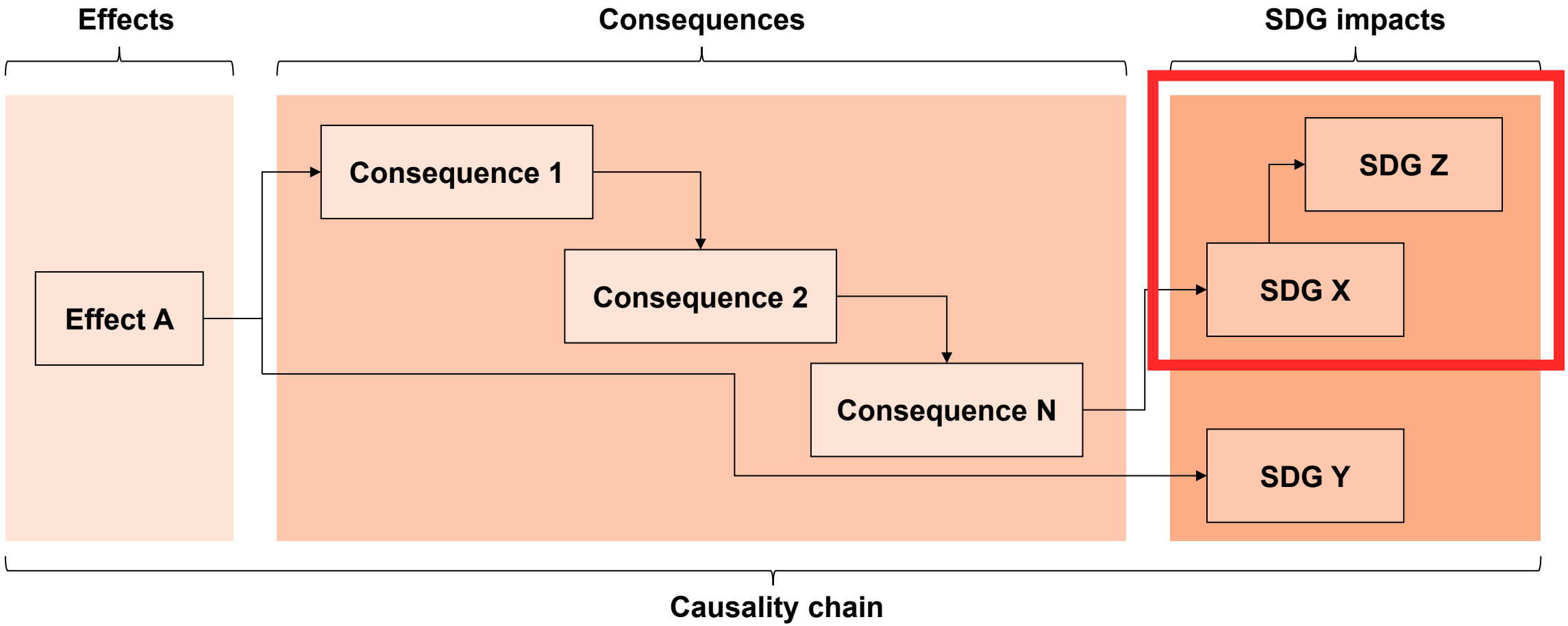
Step 1: Link the effects to the SDGs - directly or via consequences



Example: Causality chain for metal mining



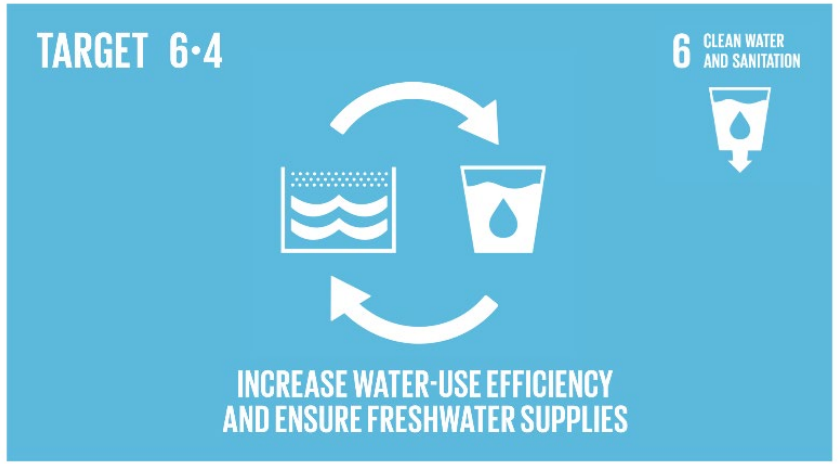
Step 1:
Identify interlinkages between the SDGs



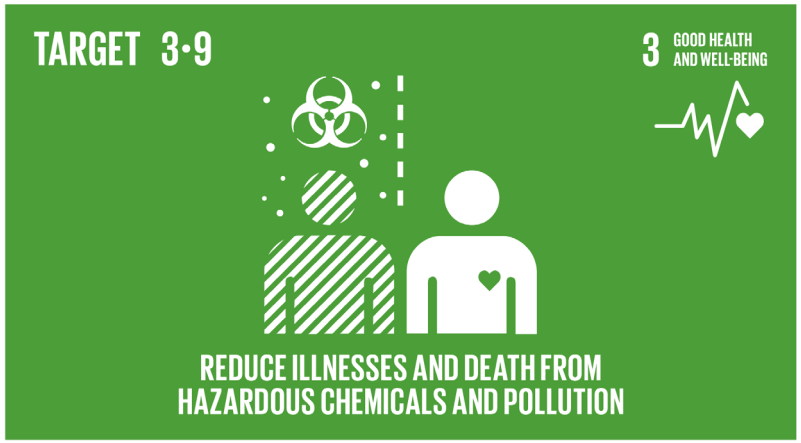
Protection of coastal ecosystems (14.2) and conservation (14.5)

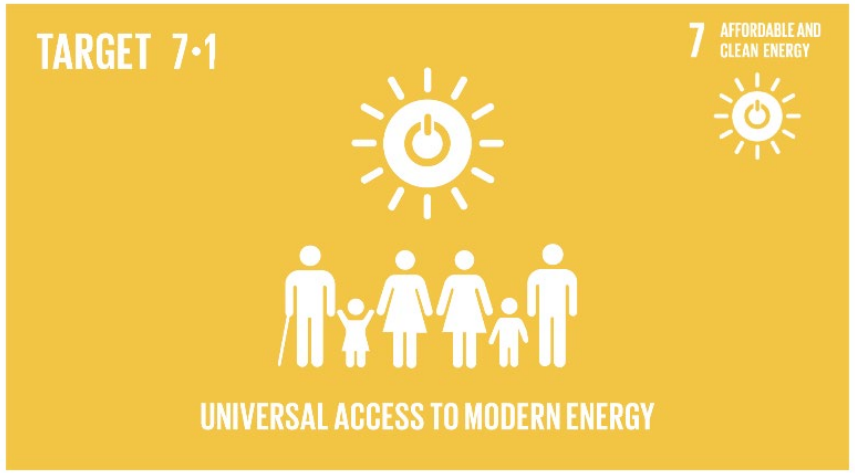
Double agricultural productivity and small farm income (2.3)

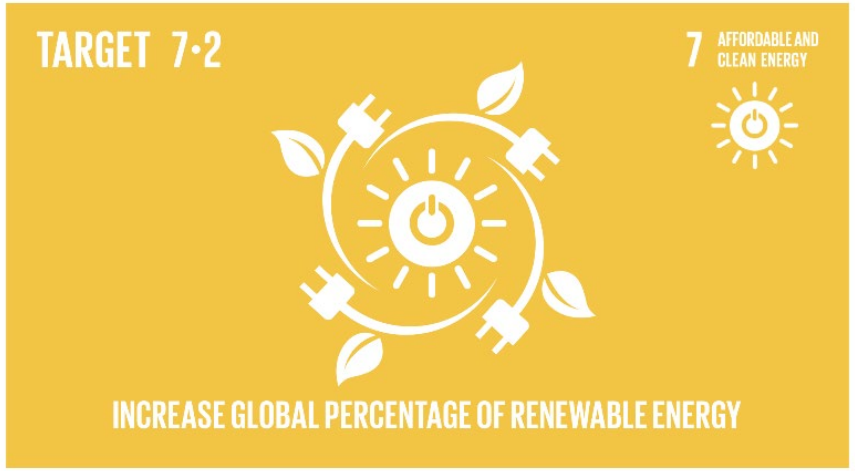
Access to food (2.1)



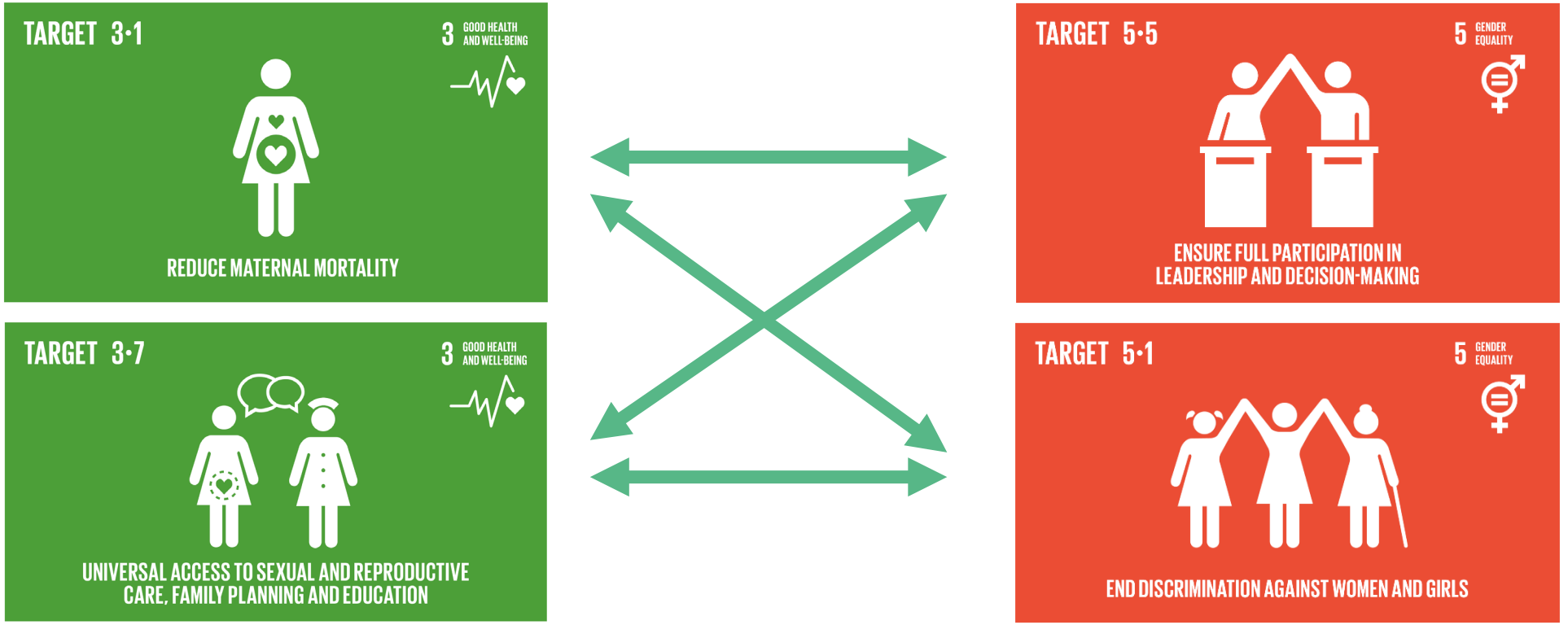
Reduce death and illness from chemicals and pollution (3.9)







Access to maternal health (3.1) and sexual and reproductive health care services (3.7)



Reduce deaths and injuries from road traffic accidents (3.6)

Exercise:
Link target 12.5 to other SDGs

10 minutes

Talk in groups of 2-4 about:

1. SDG targets, that impact target 12.5 positively/negatively and
2. Targets that target 12.5 impacts positively/negatively

Phase 4:
Assessment of the impacts of the effects on the SDGs

Two steps

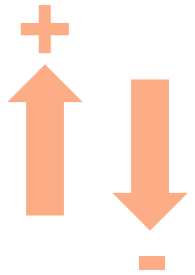
1

Link the effects
To the SDGs

2

Semi-quantitative assessment of each consequence

Step 2:
Semi-quantitative assessment – three criteria



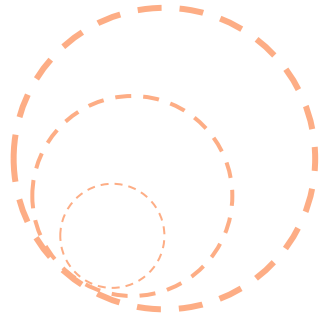
Pos/Neg

Is the impact positive og negative?

Likelihood

How likely is it that the impact will happen?

(if possible, based on objective data)



Size

What is the expected size of the impact?

(if possible, based on objective data)

Semi-quantitative assessment: Estimating the likelihood

	Description	Likelihood
Likely	**Fair ground** to believe that the SDG impact will happen.	> 67%
Possible	**Some possibility** to believe that the SDG impact will happen.	33-67%
Unlikely	**Little possibility** to believe that the SDG impact will happen. If the possibility cannot be estimated, use this category.	< 33%

Semi-quantitative assessment: Estimating the size

50-100%

The effect will have a **"major" impact** on the SDG

Example: More electrical cars in a renewable energy system → reduced emission of particles → large impact on SDG 3 (health) and SDG 11 (sustainable cities)

20-50%

The effect will have a **"moderate" impact** on the SDG

Example: New battery technology will impact SDG 8 (decent jobs) positively, but compared to the full job market of the local battery technology sector the contribution to SDG 8 may be limited.

5-20%

The effect will have a **"minor" impact** on the SDG

Example: Production of parts for electrical cars → More emissions of chemicals to the sea (SDG 14) → But little impact compared to other pollution sources

0-5%

The effect will have **"no or negligible" impact** on the SDG

Step 2:
Semi-quantitative assessment – scoring system

Size \ likelihood	**Likely**	**Possible**	**Unlikely**
Major	+++/---	++/--	+/-
Moderate	++/--	+/-	0
Minor	+/-	0	0
Negligible	0	0	0

One good advice on the impact assessment:

If you are convinced that the case is either very positive or very negative…

Try to argue for the opposite position!

Summing up: What do we expect from phase 4?

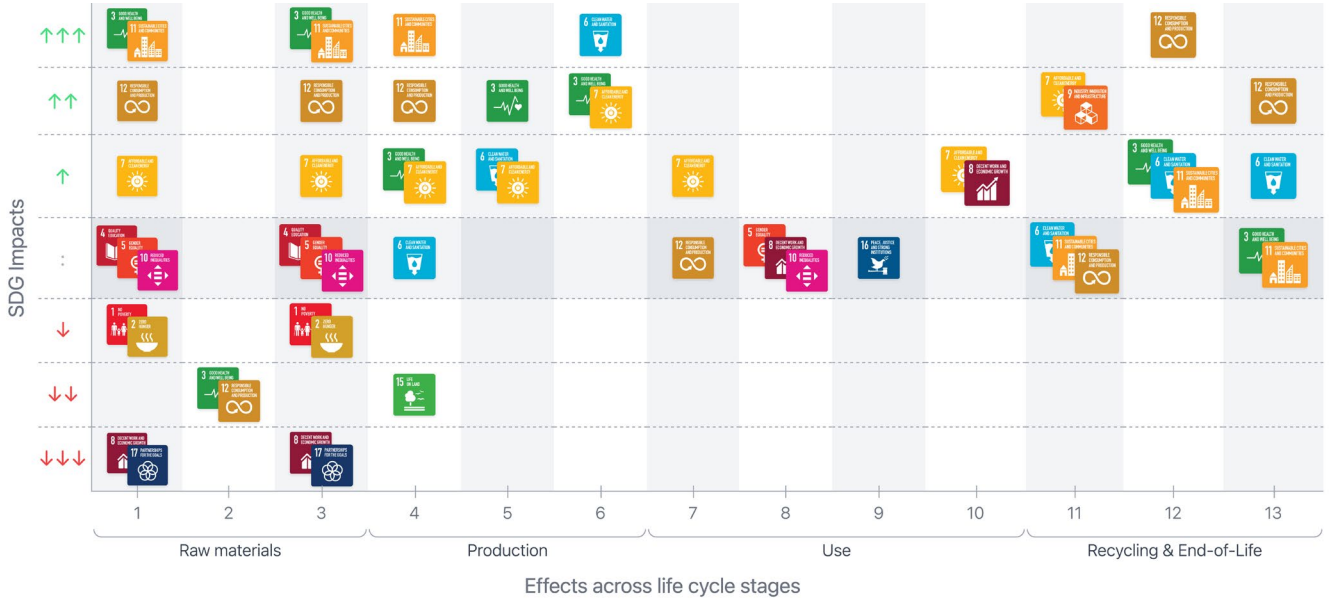
1. **SDG impacts with scoring (effect impacts)**

Pos/Neg

Likelihood

Size

2. **Visualisation of the results for the report**



Phase 5: Interpretation of your results and recommendations

- Which are the **most important** sustainability aspects?
- **Which SDGs** are impacted by the project? In **which life cycle stages** do they appear? **What causes them**?
- Which **interrelations** do you see **between the SDGs** and do you see consequences **between life cycle stages**?
- **Where** in the life cycle of the system, can you **introduce change** in order to reduce negative impacts or increase positive impacts?
- **Which specific changes** could that be?
- Which **short term** and which **long term recommendations** will you pass on to **which decision makers** around the case?

Demonstration of SDGUI, phase 4

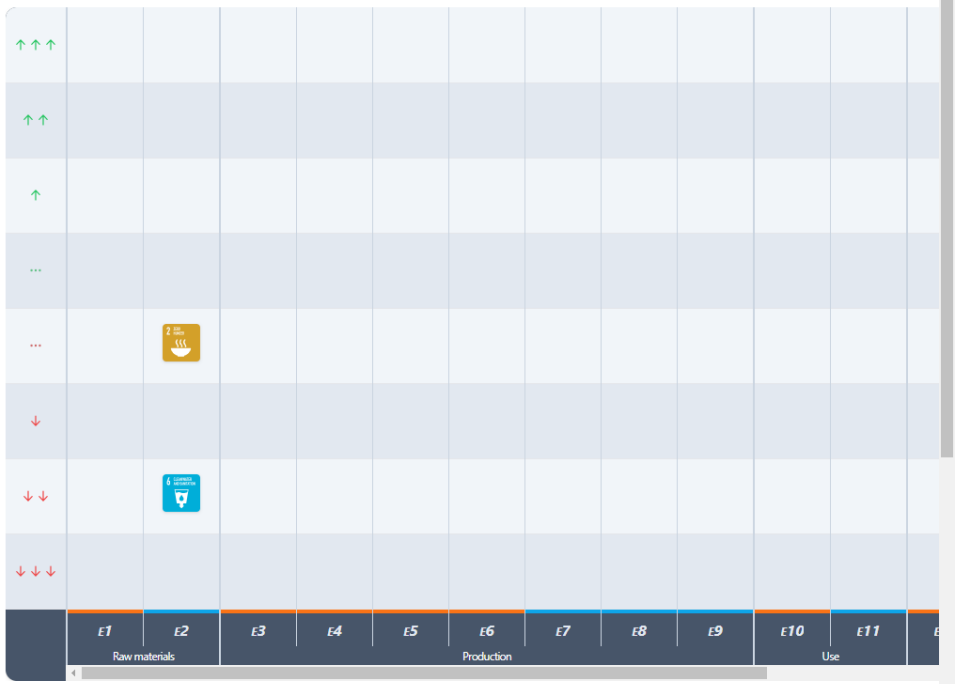
Phase 4

Evaluating the impacts of the application(s) on the SDGs

The effects identified in Phase 3 (Table 2.2) need to be linked to all the SDGs, which they can impact positively and/or negatively. Identifying and evaluating these links is the objective of Phase 4, which is divided into two steps and aims to:

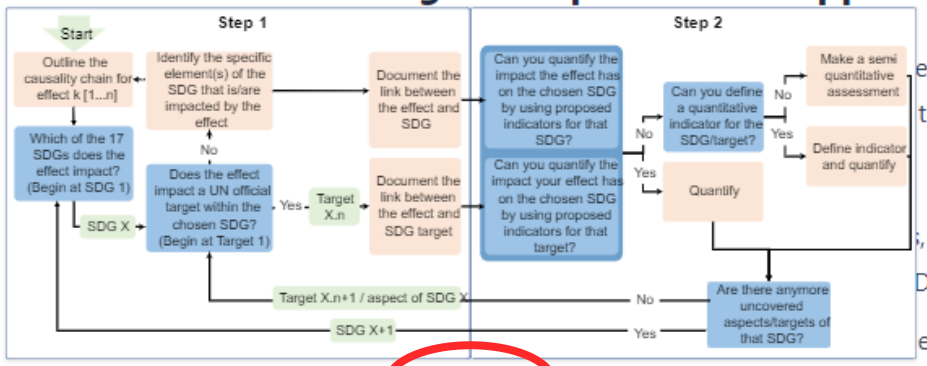
1. Identify the SDGs that may be impacted by the effects, by mapping out the chain of consequences linking effects to the goals of the UN SDG framework (Step 1, Phase 4)
2. Characterize in a semi-quantitative way the impact of each effect on the SDGs (Step 2, Phase 4) Figure 2.9 provides a decision tree, aimed at facilitating the conduct of Phase 4 when addressing each effect.

Deleted Impact



Phase 4

Evaluating the impacts of the application(s) on the SDGs



ed to all the SDGs, which they can

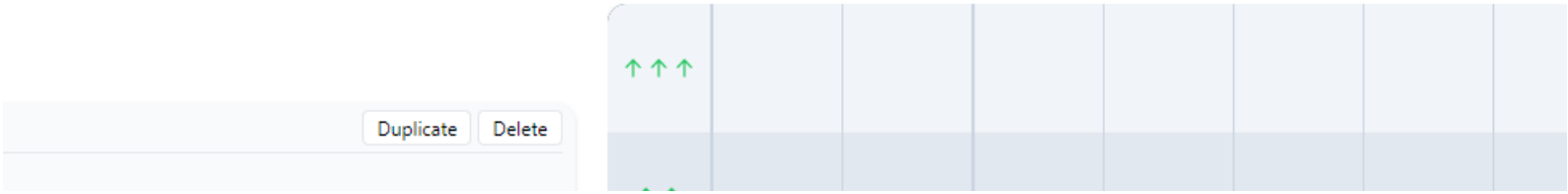
ting these links is the objective of

; by mapping out the chain of

DG framework (Step 1, Phase 4)

each effect on the SDGs (Step 2,

Phase 4). Figure 2.9 provides a decision tree, aimed at facilitating the conduct of Phase 4 when addressing each effect.



SDGUI | Introduction | Phase 3 | Phase 4

E2 + → →

Duplicate Delete

2.3

2 ZERO HUNGER

By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment

Justification for impact

↑ ↓

Growing cotton may put a pressure on prices on land for growing food for poor people

Likelihood

0% - 33%

Unlikely

Justification for likelihood

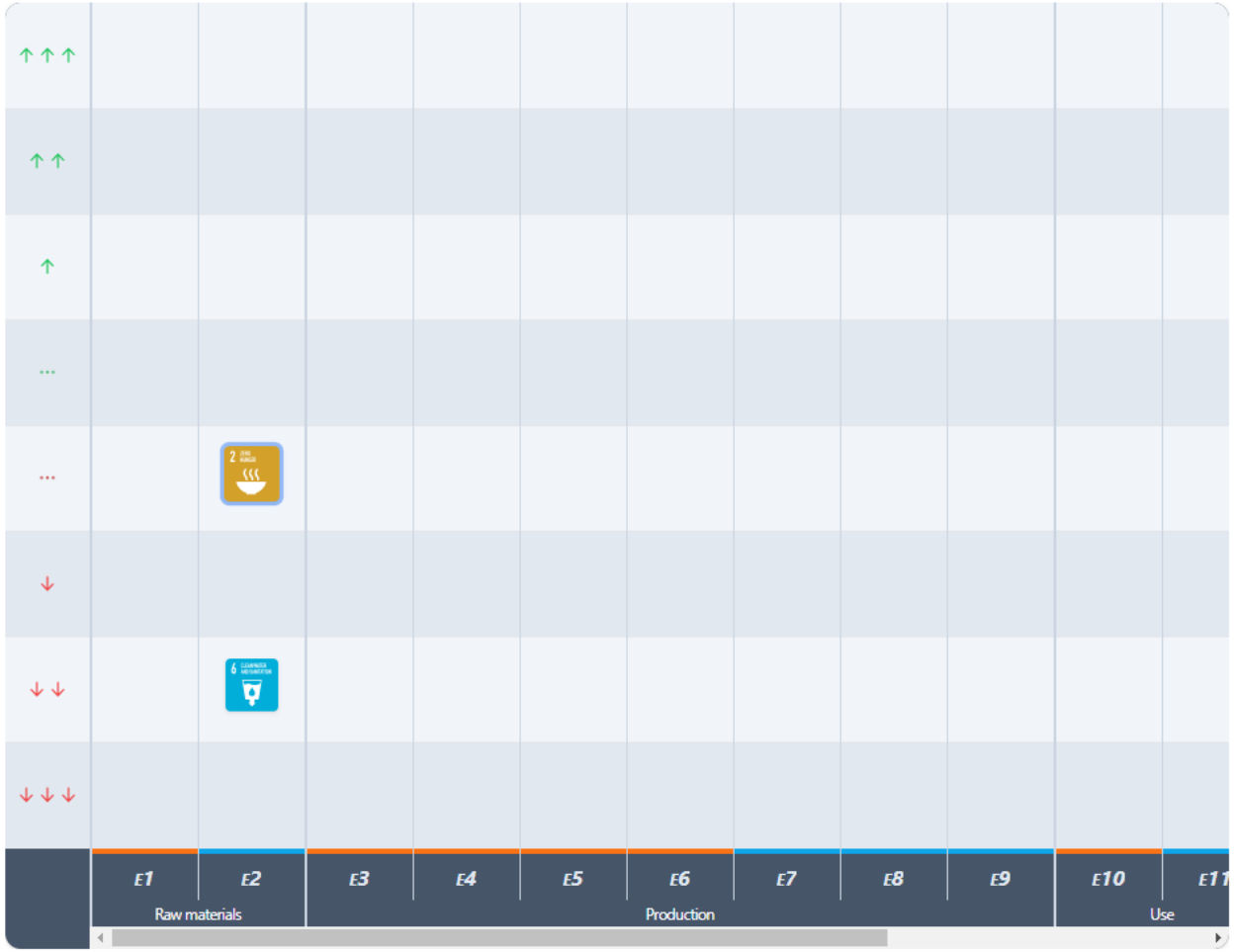
Cotton has been a well-established crop for many years, so few surprises on land prices.

Magnitude

Negligible

Justification for magnitude

See under likelihood.




SDGUI
Introduction
Phase 3
Phase 4
E2
6.2
By 2030, achieve access to adequate and equitable
all and end open defecation, paying special attent
and girls and those in vulnerable situations
Justification for impact
Cotton crops are very water-dema
Likelihood
Justification for likelihood
See under impact.
67% - 100%
Likely
Magnitude
Justification for magnitude
It's a well-known aspect of growing cotton.
Moderate
6 CLEAN WATER AND SANITATION
Ensure availability and sustainable management of water and sanitation for all
Goal 6 goes beyond drinking water, sanitation and hygiene to also address the quality and sustainability of water resources. Achieving this Goal, which is critical to the survival of people and the planet, means expanding international cooperation and garnering the support of local communities in improving water and sanitation management.
6.1
By 2030, achieve universal and equitable access to safe and affordable drinking water for all
6.2
By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
6.3
By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
Raw materials
Production
Use

SDGUI | Introduction | Phase 3 | Phase 4

E2 → → Drop here to add as consequence

Duplicate Delete

6.2

Drop to change the impacts SDG

By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

Justification for impact

Cotton crops are very water-demanding.

Likelihood

67% - 100%

Likely

Justification for likelihood

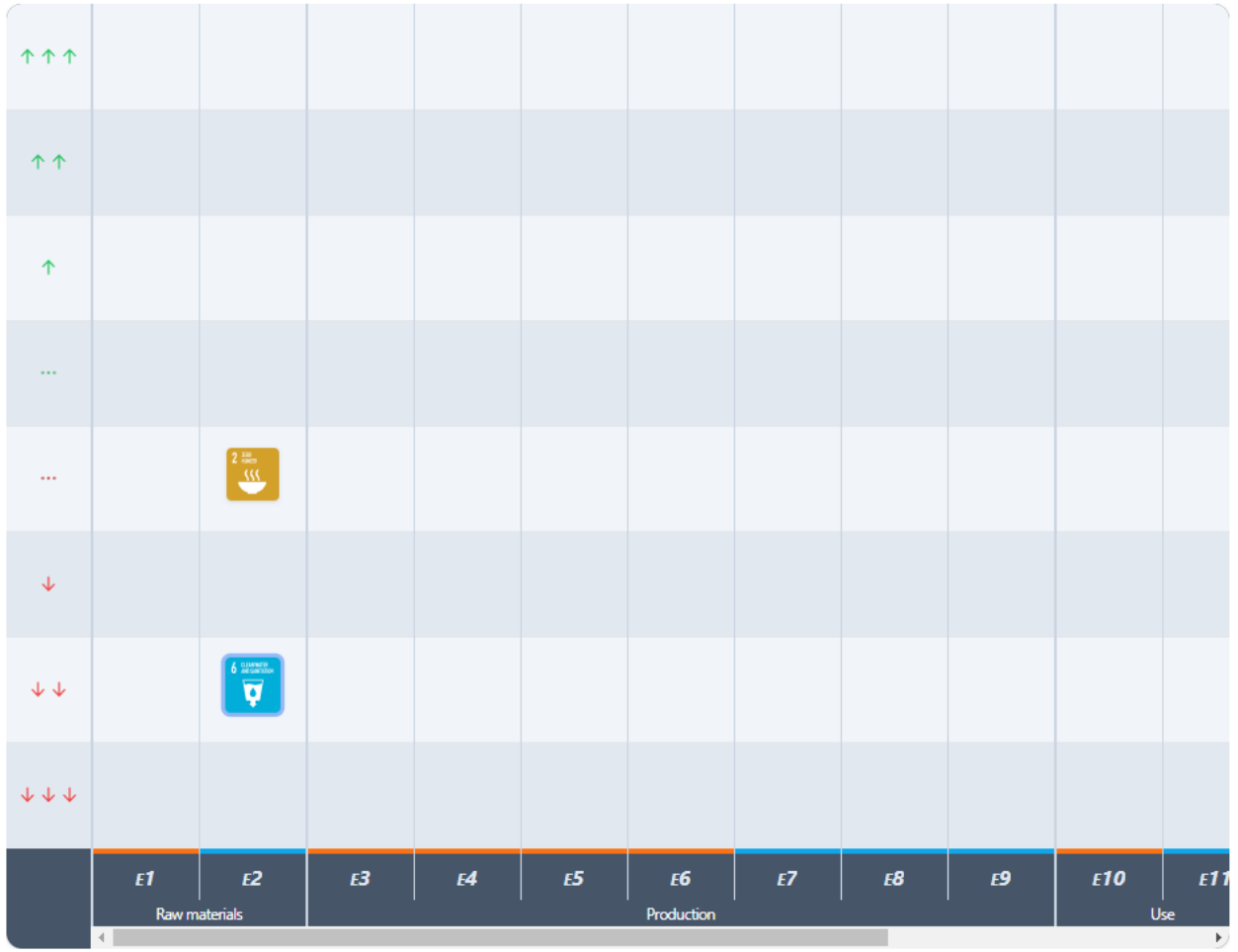
See under impact.

Magnitude

Moderate

Justification for magnitude

It's a well-known aspect of growing cotton.

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E1
E2
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E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
E14
Raw materials
Production