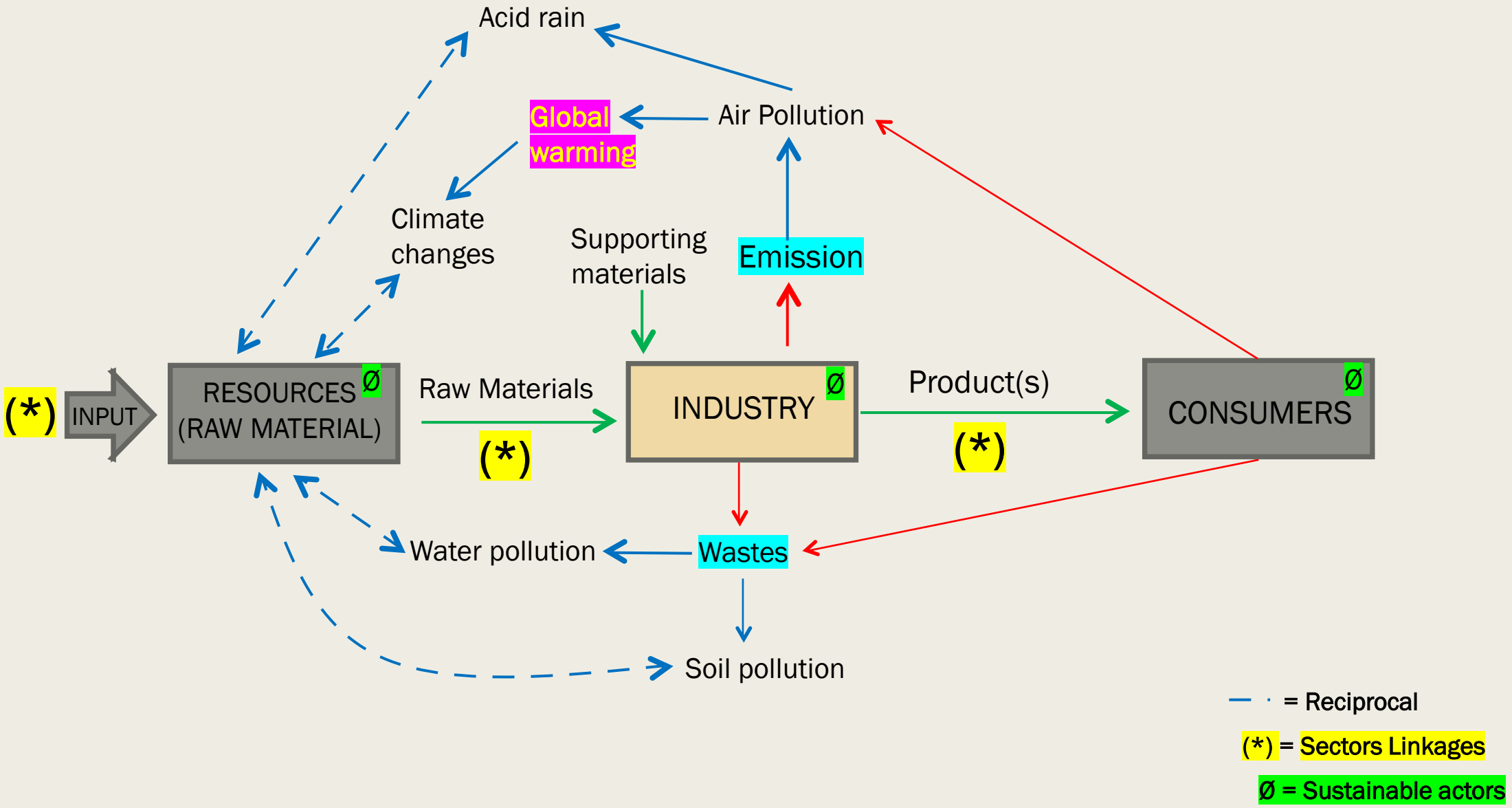
PEMBANGUNAN INDUSTRI BERKELANJUTAN

TAJUDDIN BANTACUT
P2SDM LPPM IPB University

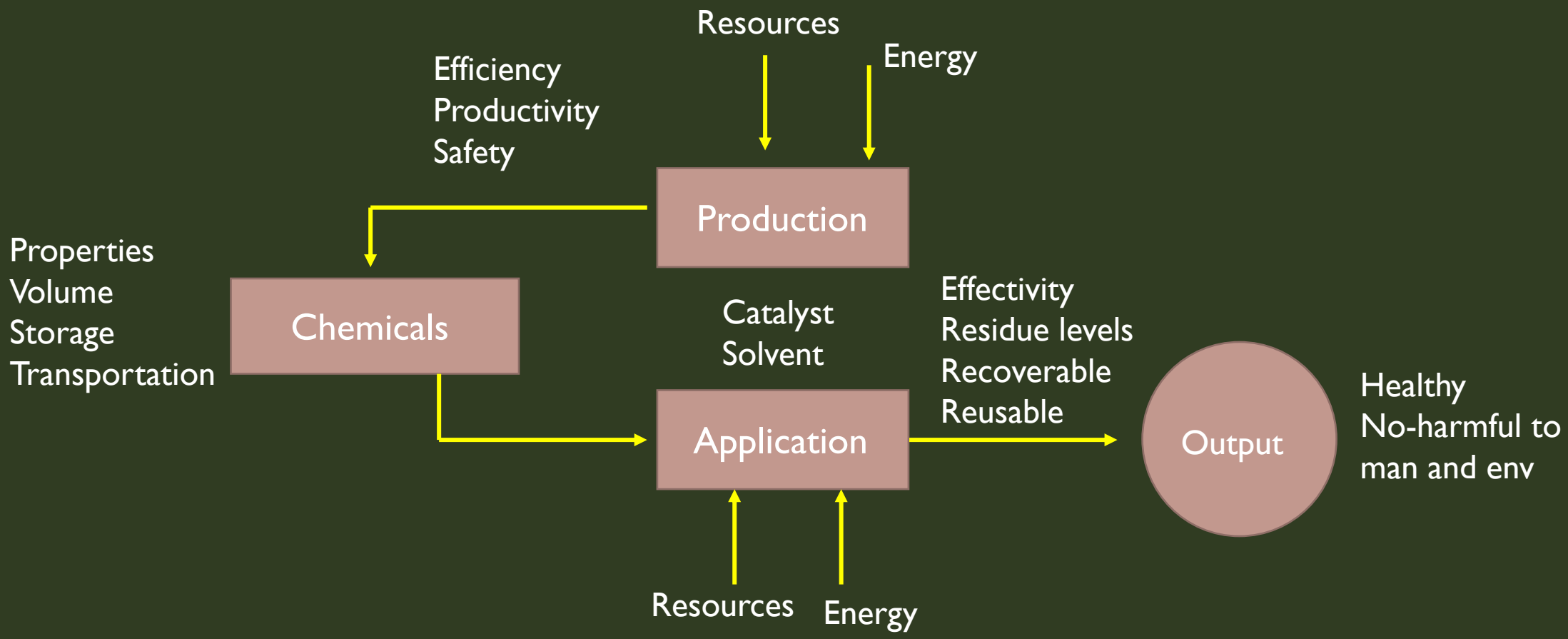
Webinar:
Peranan Dunia Industri dalam Perubahan Iklim Global
Program Studi Teknik Industri – Universitas Medan Area
29 Oktober 2021

Perspektif

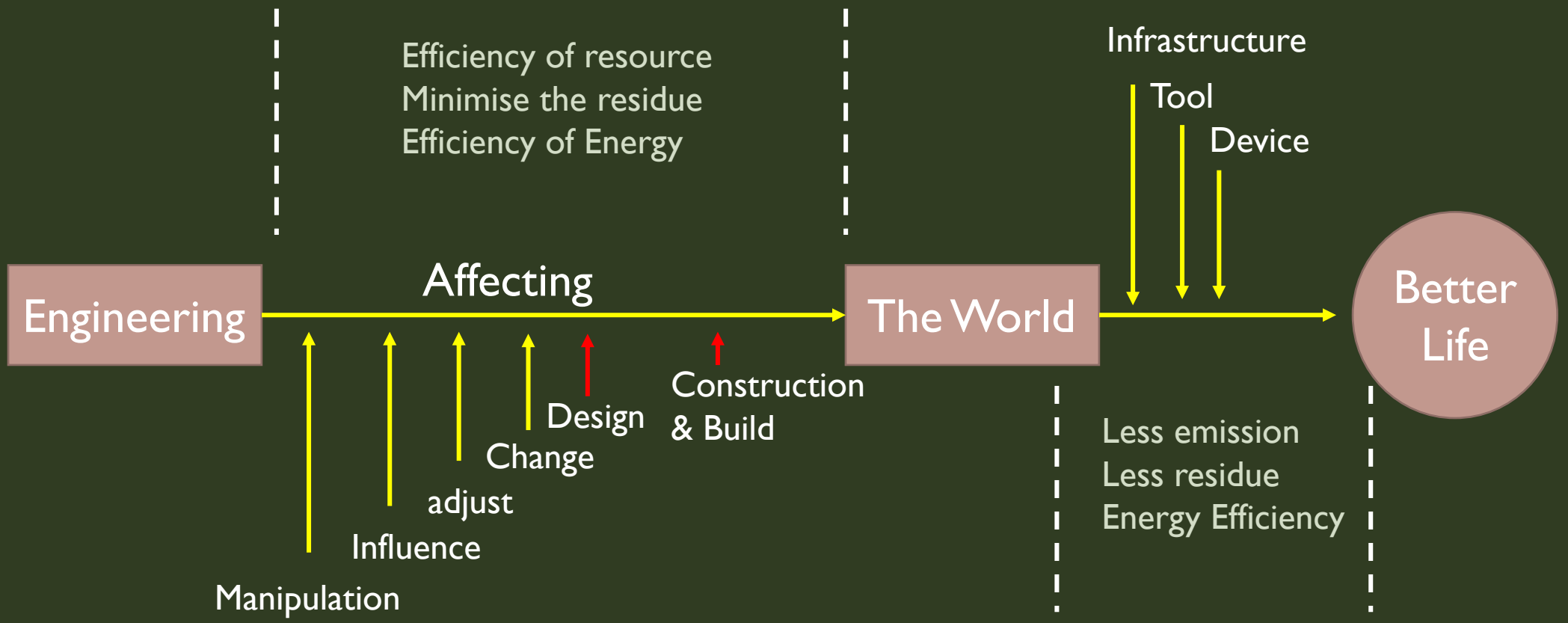
The Perspective



The Perspective: Chemistry

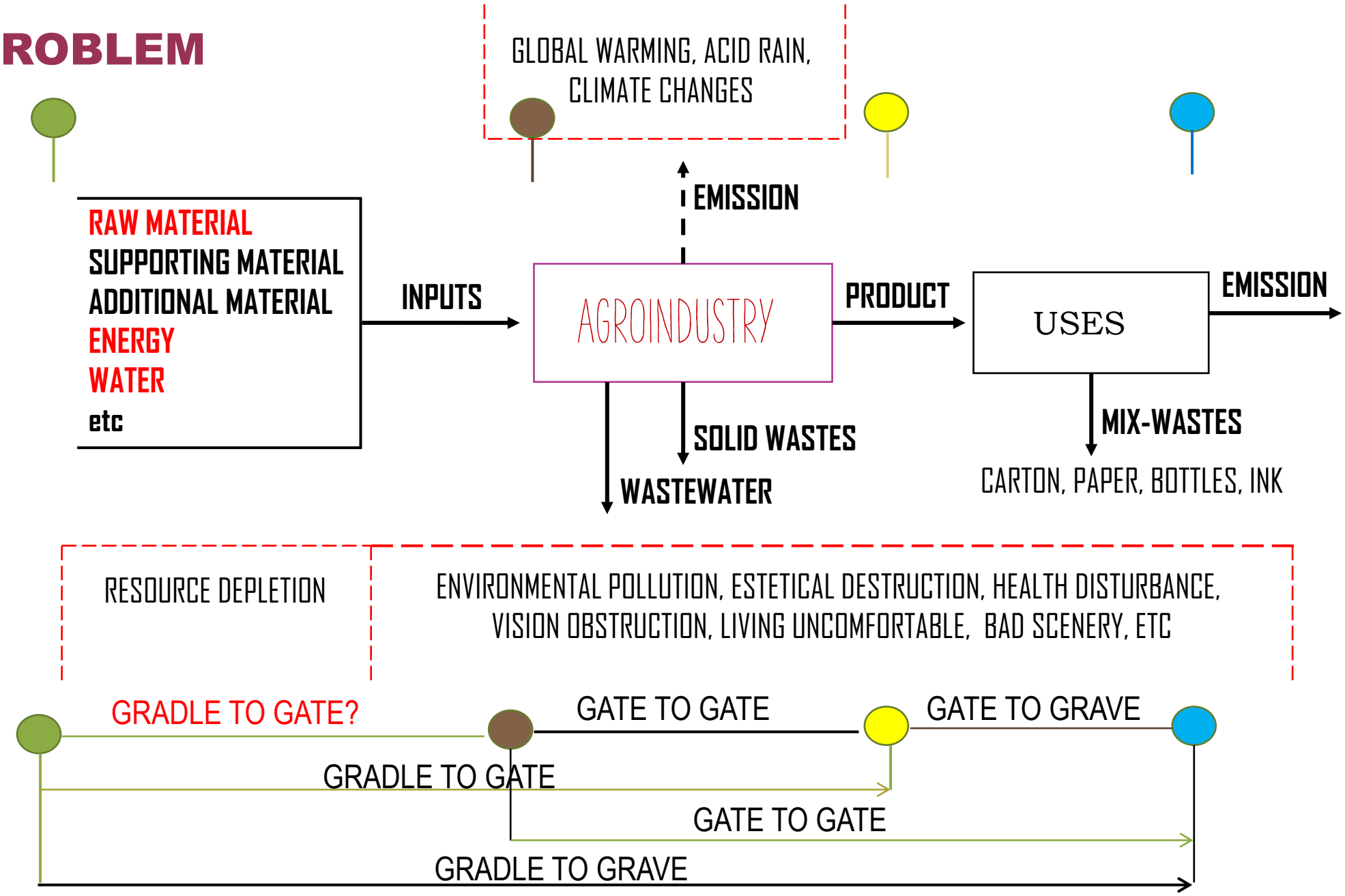


The Perspective: Engineering

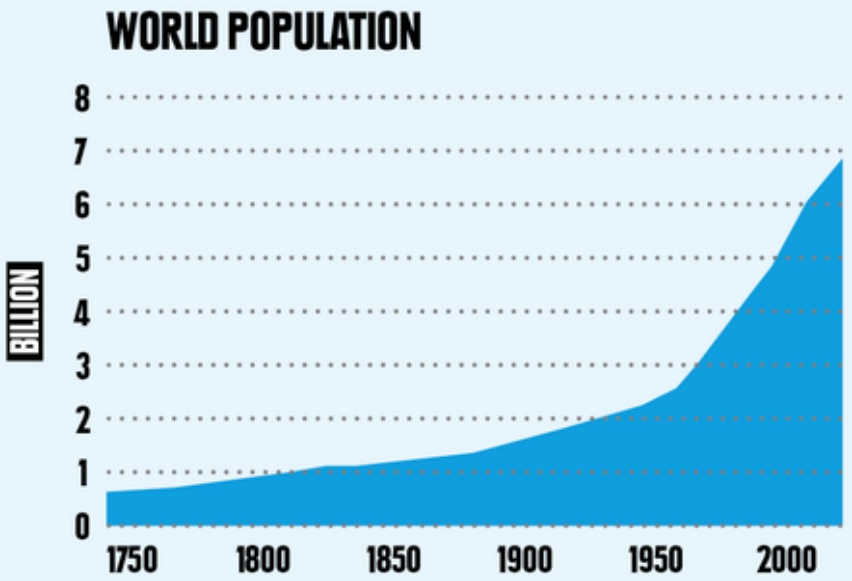


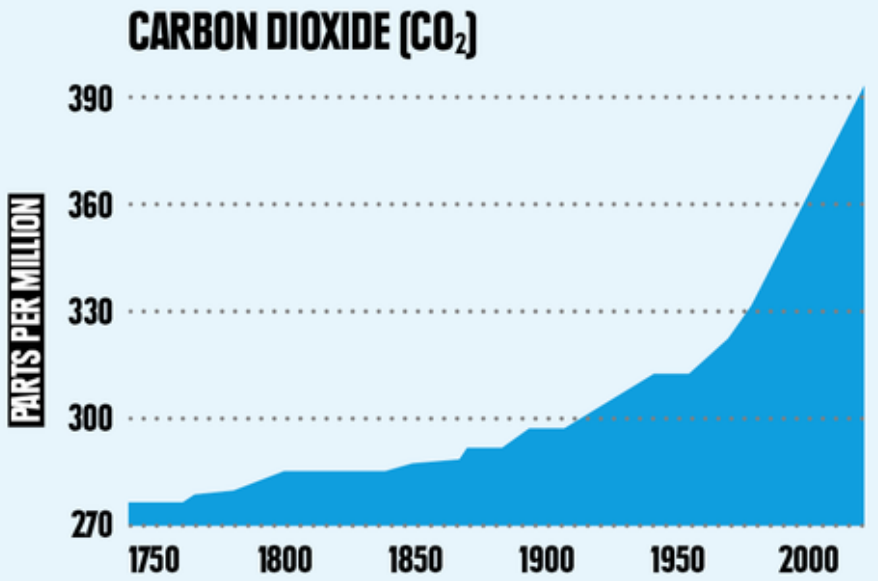
Masalah

THE PROBLEM

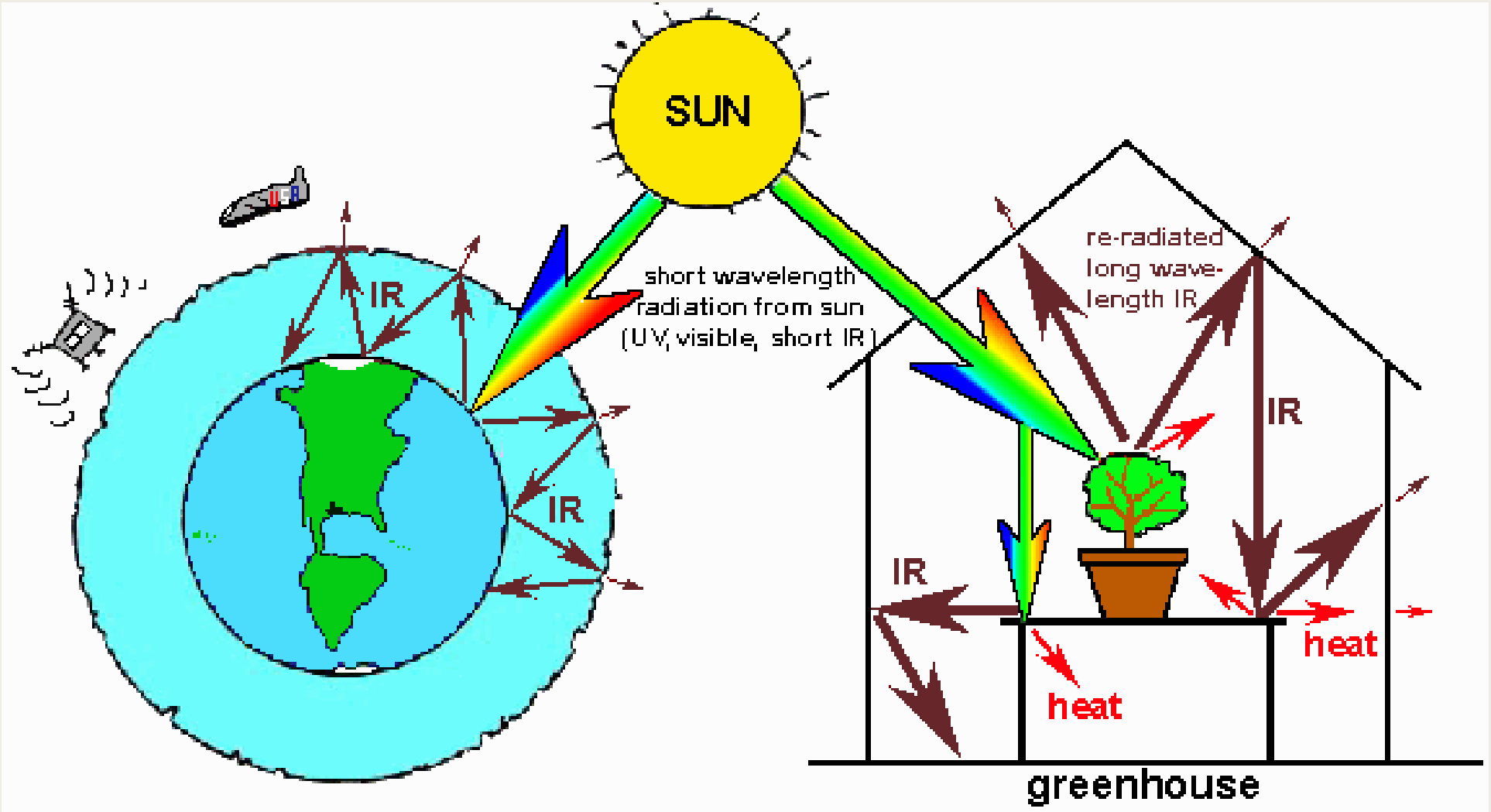

GLOBAL WARMING, ACID RAIN,
CLIMATE CHANGES
EMISSION
RAW MATERIAL
SUPPORTING MATERIAL
ADDITIONAL MATERIAL
ENERGY
WATER
etc
INPUTS
AGROINDUSTRY
PRODUCT
USES
EMISSION
SOLID WASTES
WASTEWATER
MIX-WASTES
CARTON, PAPER, BOTTLES, INK
RESOURCE DEPLETION
ENVIRONMENTAL POLLUTION, ESTETICAL DESTRUCTION, HEALTH DISTURBANCE,
VISION OBSTRUCTION, LIVING UNCOMFORTABLE, BAD SCENERY, ETC
GRADLE TO GATE?
GATE TO GATE
GATE TO GRAVE
GRADLE TO GATE
GATE TO GATE
GRADLE TO GRAVE

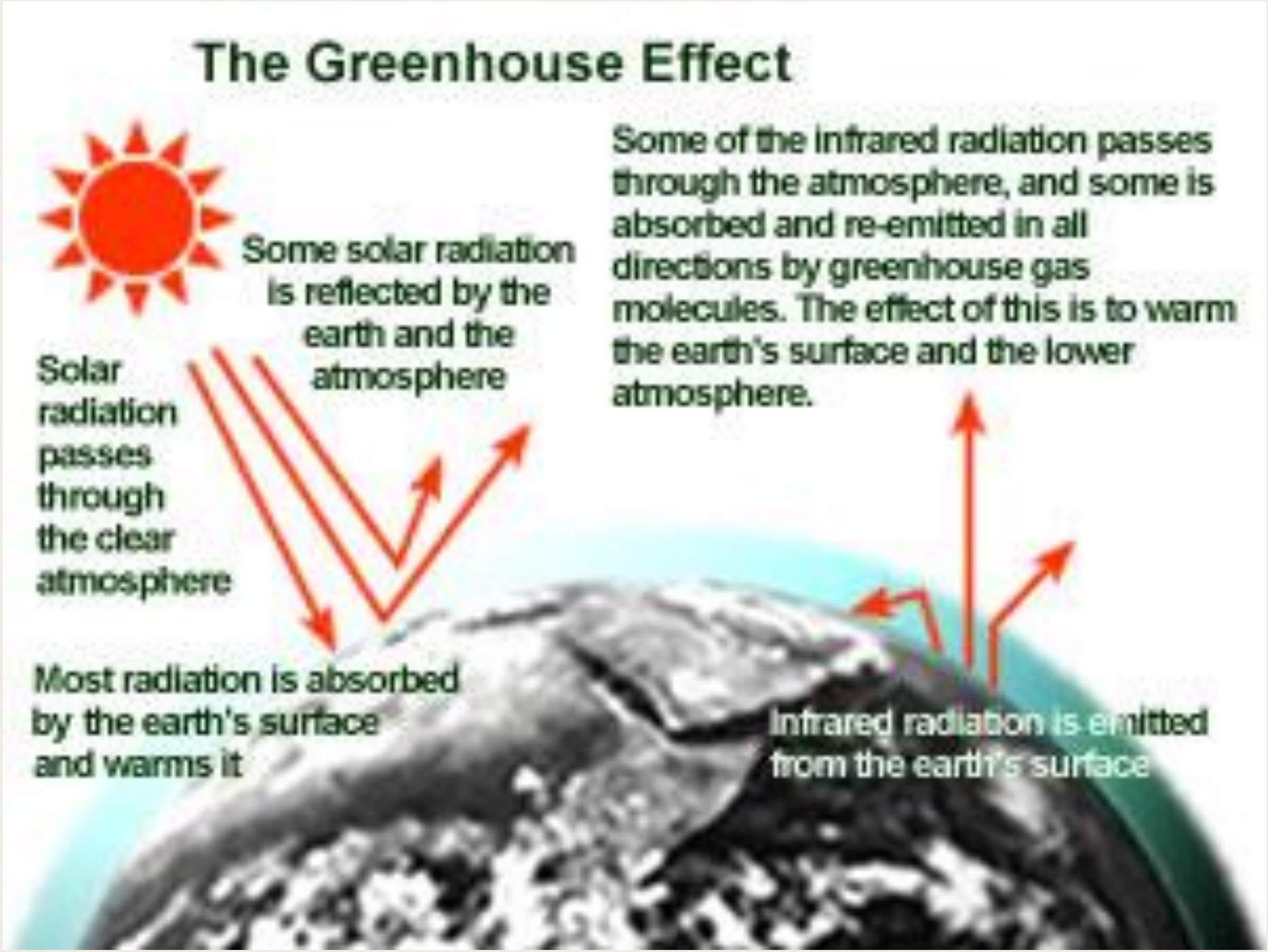
POPULATION AND CO_2 EMISSIONS, 1750-2015





Source: United Nations, 2017


SUN
short wavelength
radiation from sun
(UV, visible, short IR)
IR
IR
re-radiated
long wave-
length IR
IR
IR
heat
heat
greenhouse


The Greenhouse Effect
Some solar radiation is reflected by the earth and the atmosphere
Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the earth's surface and the lower atmosphere.
Solar radiation passes through the clear atmosphere
Most radiation is absorbed by the earth's surface and warms it
Infrared radiation is emitted from the earth's surface

Global mean temperatures are rising faster with time

Warmest 12 years:
1998,2005,2003,2002,2004,2006,
2001,1997,1995,1999,1990,2000

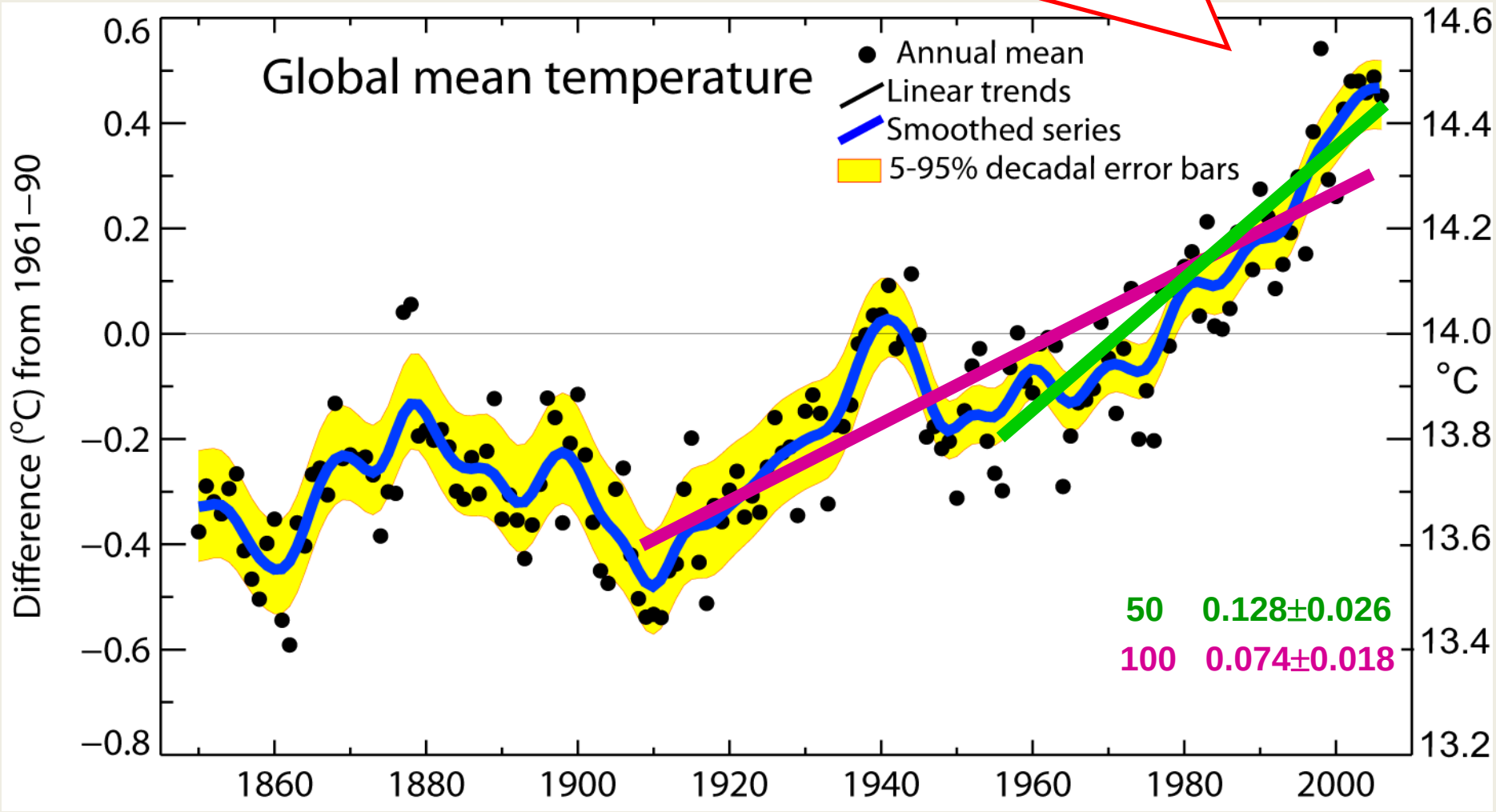
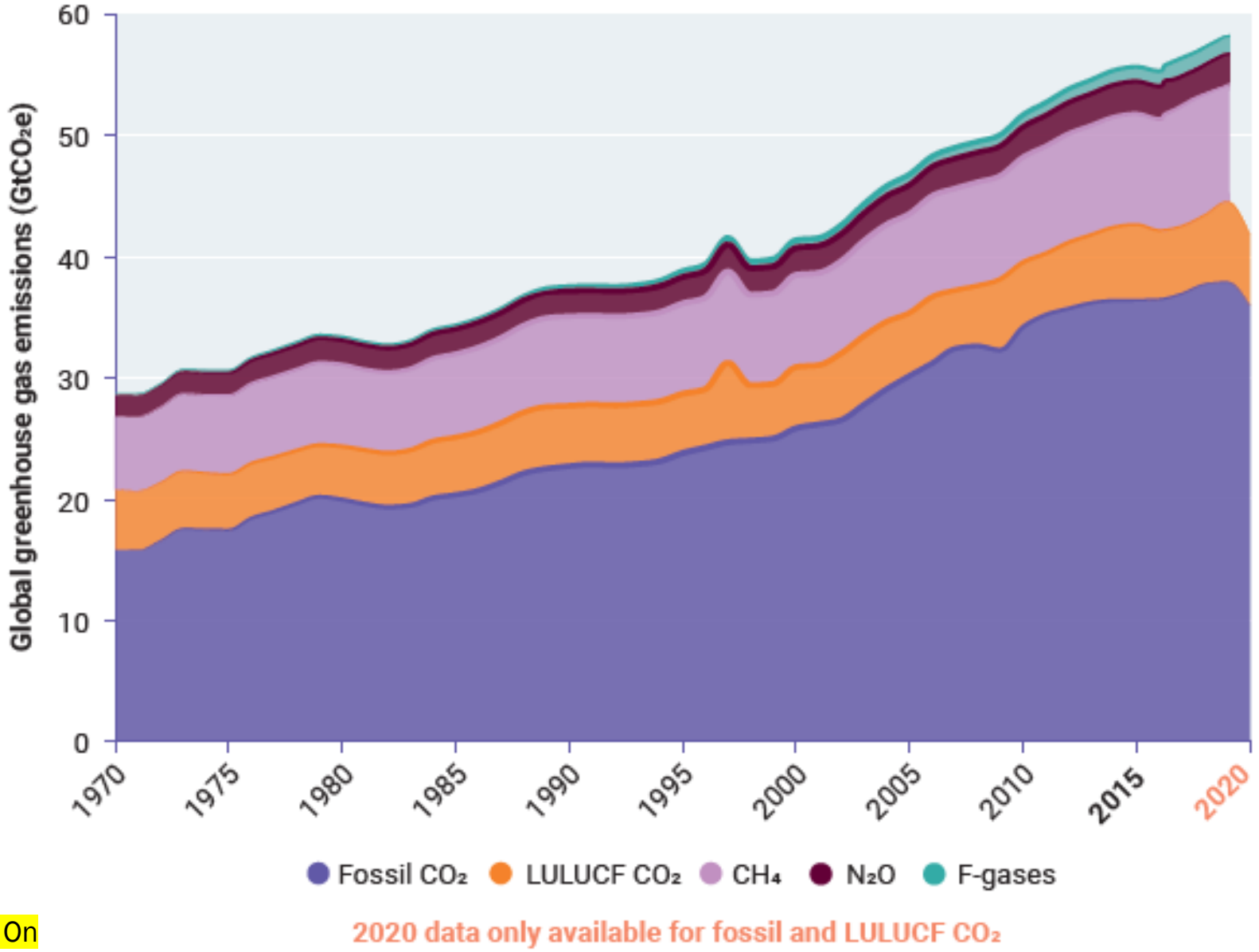


Figure ES.1. Global greenhouse gas emissions from all sources, 1970–2020

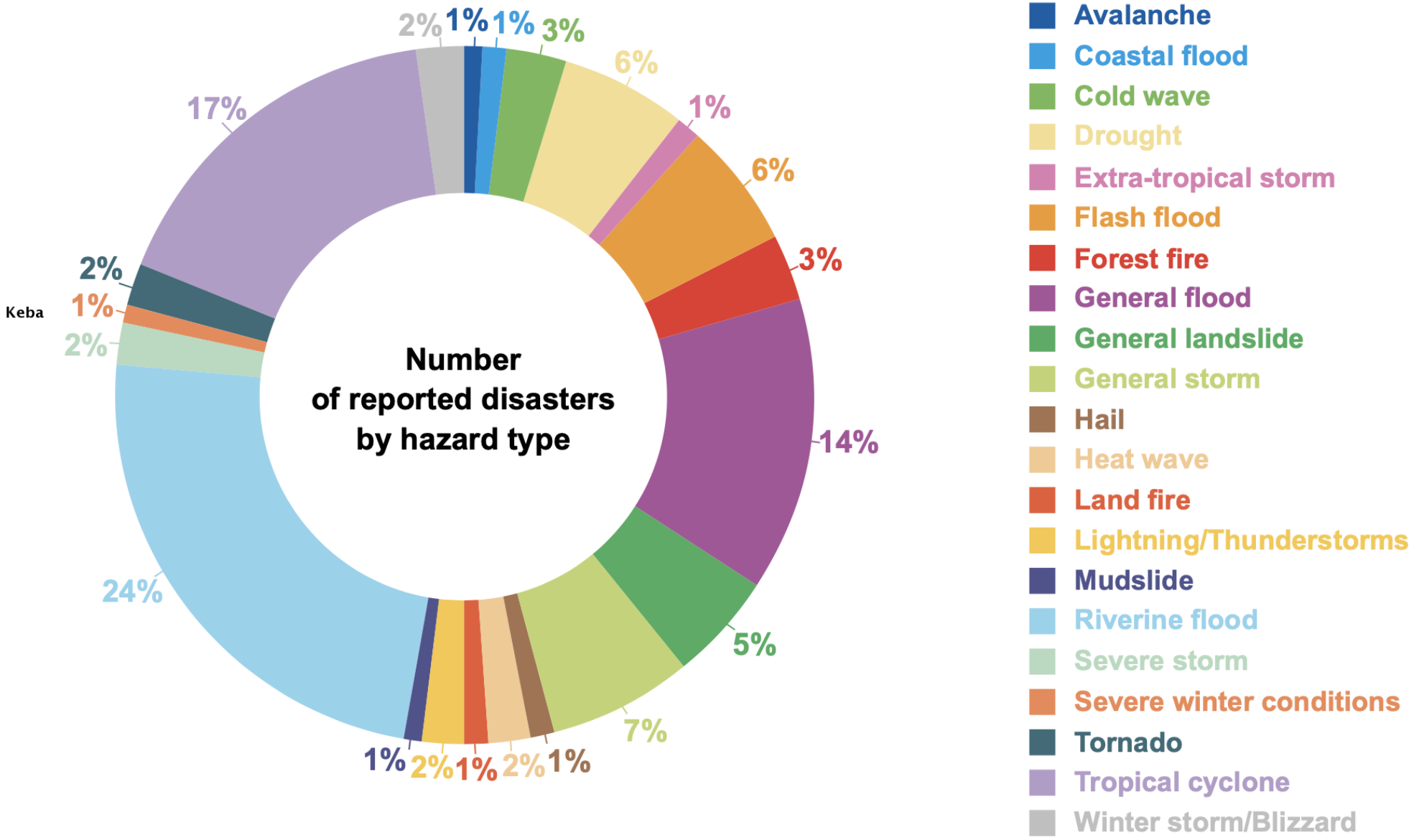


The Heat is On

Land Use Land Use Change Forestry

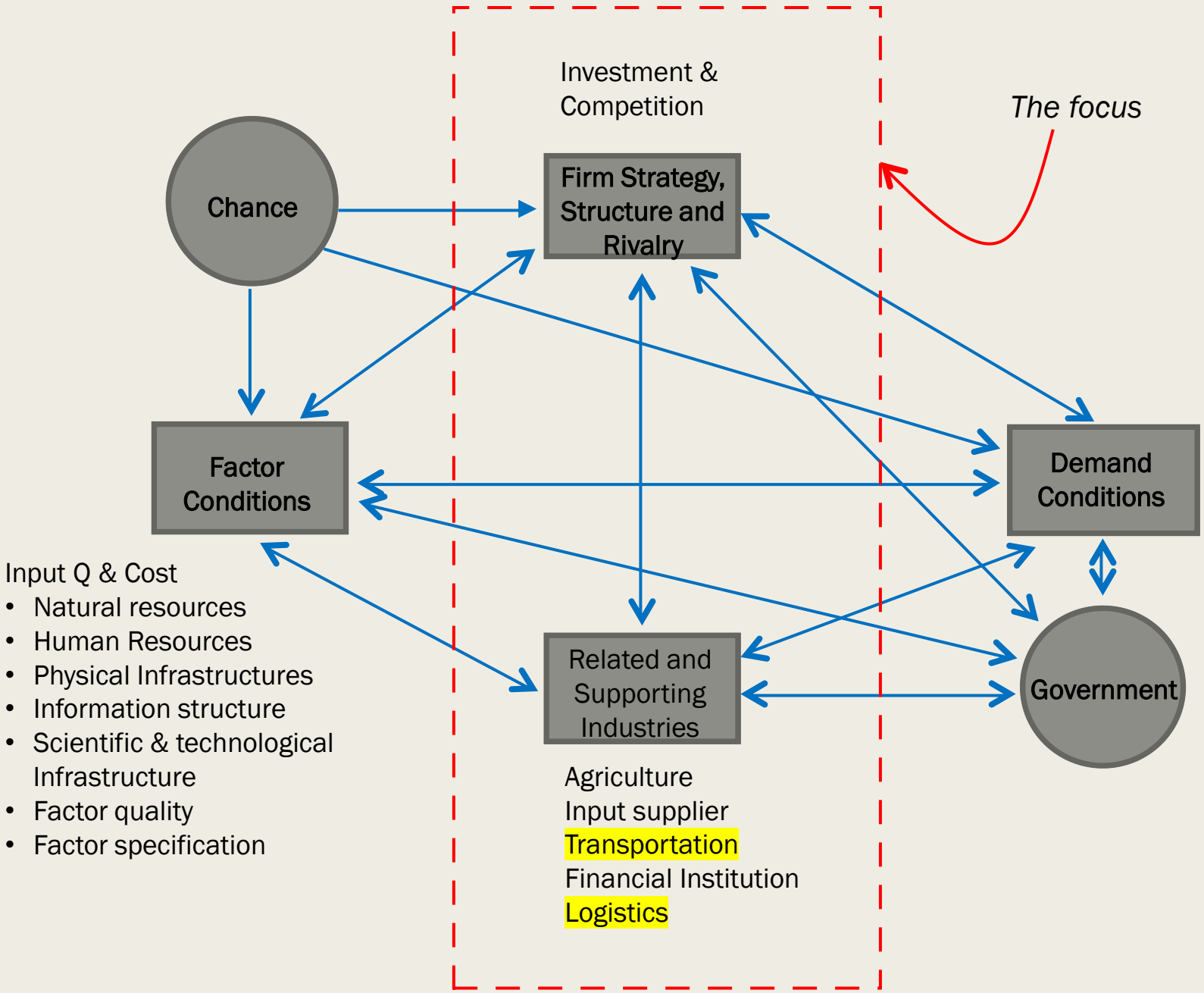
Prof. Yonny Koesmaryono

PERSENTASE BENCANA GLOBAL



Dimensi

Sector Linkages – no any single industry/sector is stand alone



Porter's Diamond

SECTOR LINKAGES - THE PILLARS

LOGISTICS

WATER

CHEMICALS

AGRICULTURE

AGROINDUSTRY

COMMERCE

ENERGY

SPACE

TRANSPORTATION

Sustainable components/actors

- Raw material supply should always be enough and produced by sustainable agriculture
- Additional and supporting materials should not endanger environment, safe agro-industrial processes
- Production process should be effective, efficient and no harmful material
- Emission must be minimized
- All wastes must be reused or recycle as much as possible to optimize the usefulness and create additional benefit as input or product as output
- Non-usable materials may be used for input of another (agro)-industry or must be treated before disposal
- No-part of the product (packaging, label, etc.) harm the environment.
- Transportation and logistic activities along value chain must also be operated under the principle of sustainable development.

The industry Dilemma

The Problem

- Exploiting resources (raw material, support materials, additional materials)
- Polluting the environment (air, water, and soil pollutions)

The need

- Provide employment
- Fulfil the need of human being

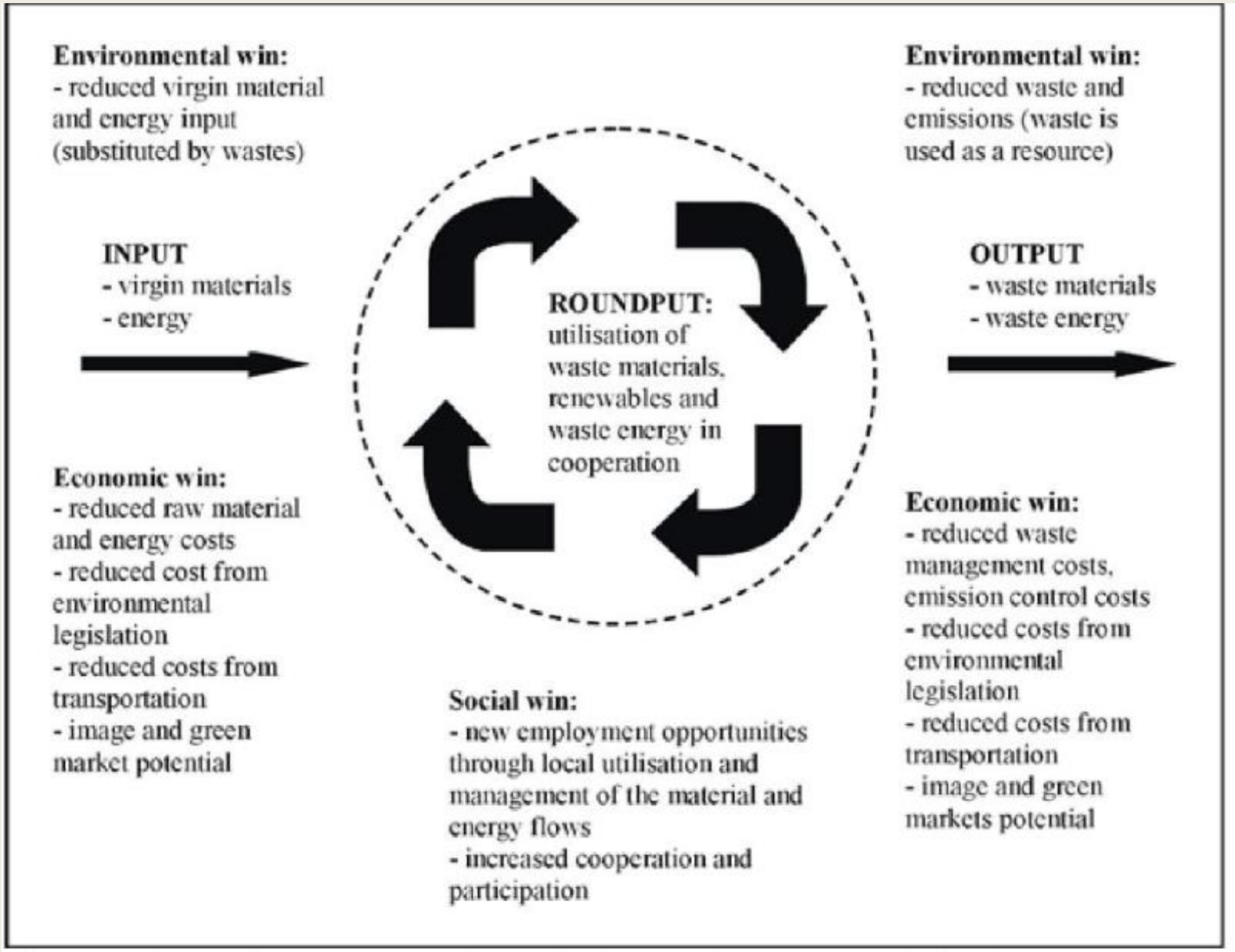
Penyelesaian

The *Solution* – industrial perspectives

Close loop Supply Chain

Closed Production System

Manfaat Penerapan daur ulang akan Memberikan (Saikku 2006)



1. CLOSING SUPPLY CHAIN

Basic Principles – 4R+TD

- Re-use
- Re-manufacturing
- Re-conditioning
- Recycling
- Treatment &
- Disposal

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Closed Loop Supply Chain (from consumption back to origin)

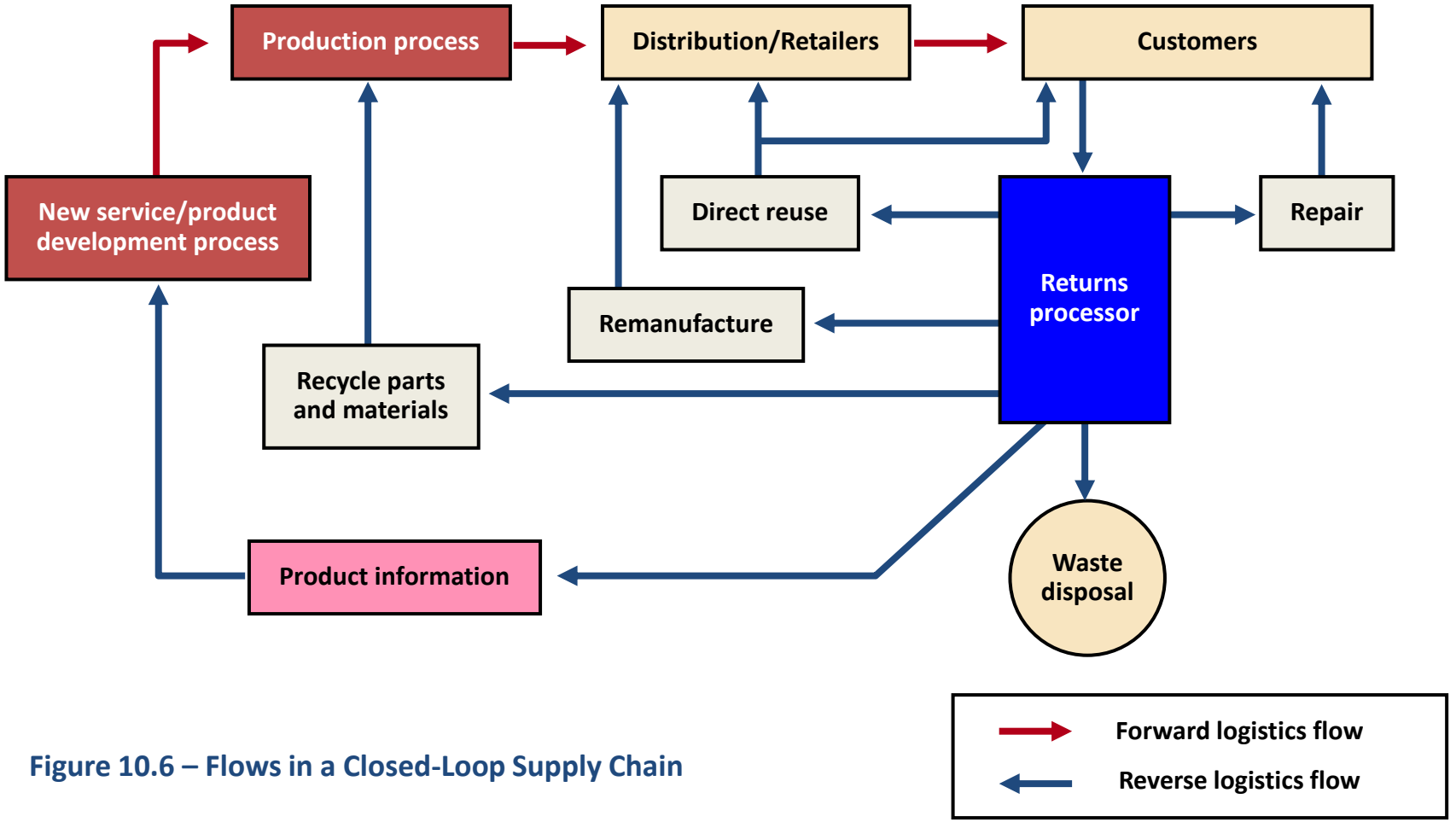

Figure 10.6 – Flows in a Closed-Loop Supply Chain

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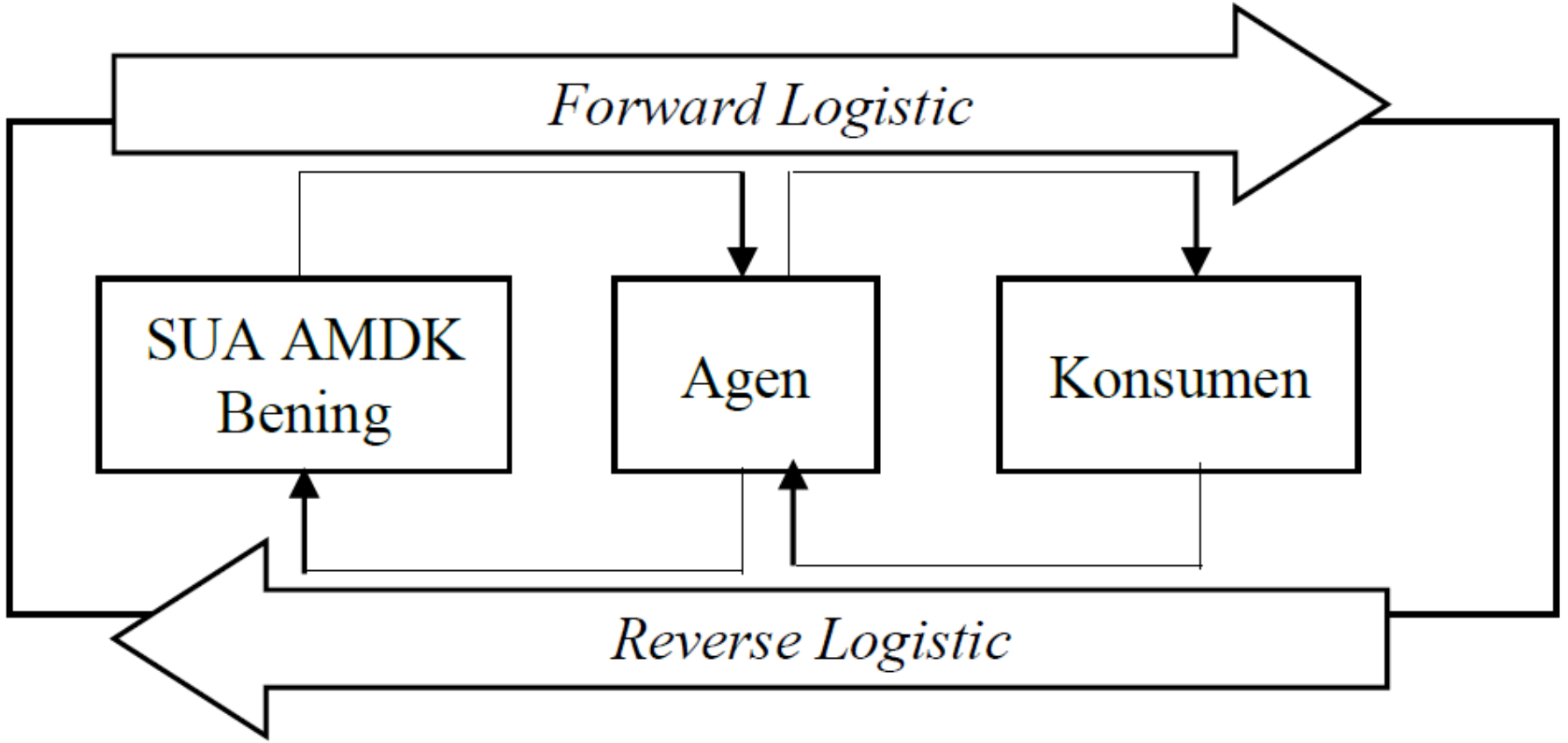
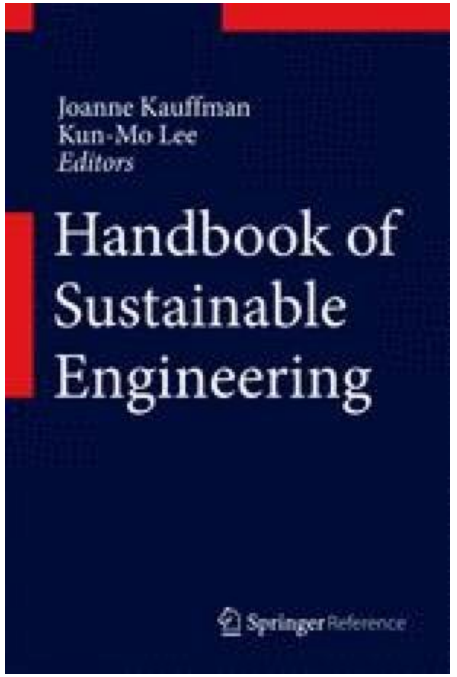


Gambar 18 Alur proses distribusi AMDK RGB

Remanufacturing - Cannibal

Remanufacturing is a comprehensive and rigorous industrial process by which a previously sold, worn, or non-functional product or component is returned to a "like-new" or "better-than-new" condition and warranted in performance level and quality.



Remanufacturing is not the same as "recycling" or "repairing".

Remanufacturing means using a mix of used and new parts to make products.

Reverse Logistics Systems

- Reverse flows are goods and materials moving upstream in the supply chain.
- Reverse flows were traditionally ignored, but regulation and economics have increased attention on them.
- Traditionally, reverse flows were not viewed as adding value for customers or revenue for the manufacturer or producer.
- Information and financials (cash) are important dimensions of reverse logistics and closed loop supply chains.
- Global supply chains present challenges and opportunities for reverse flows Including green laws.

Importance and Magnitude of Reverse Flows

- Estimates are that returns range from 3 – 50% depending on the product.
- Retailers lose 3 to 5% of gross sales to returns, accounting for about 4.5% of the cost of logistics.
- Internet returns are about double the counter sale returns.

Categories of reverse flows

1. Products that have failed; are unwanted, damaged, or defective; but can be repaired or remanufactured and resold.
2. Products that are old, obsolete, or near the end of their shelf life but still have some value for salvage or resale.
3. Products that are unsold from retailers, usually referred to as overstocks that have resale value.
4. Products being recalled due to a safety or quality defect that may be repaired or salvaged.
5. Products needing “pull and replace” repair before being put back in service.
6. Products that can be recycled such as pallets, containers, computer inkjet cartridges, etc.
7. Products or parts that can be remanufactured and resold.
8. Scrap metal that can be recovered and used as a raw material for further manufacturing.

Reverse vs. Closed-Loop Logistics Systems

- Reverse logistics—The process of moving or transporting goods from their final destination for the purpose of capturing value or for proper disposal.

  Reserve logistics involves the processes for sending new or used products “back up stream” for repair, reuse, refurbishing, resale, recycling, or scrap/salvage.

- Closed loop supply chains—Designed and managed to explicitly consider both forward and reverse flows activities in a supply chain.

  Explicitly designed and managed for both flows

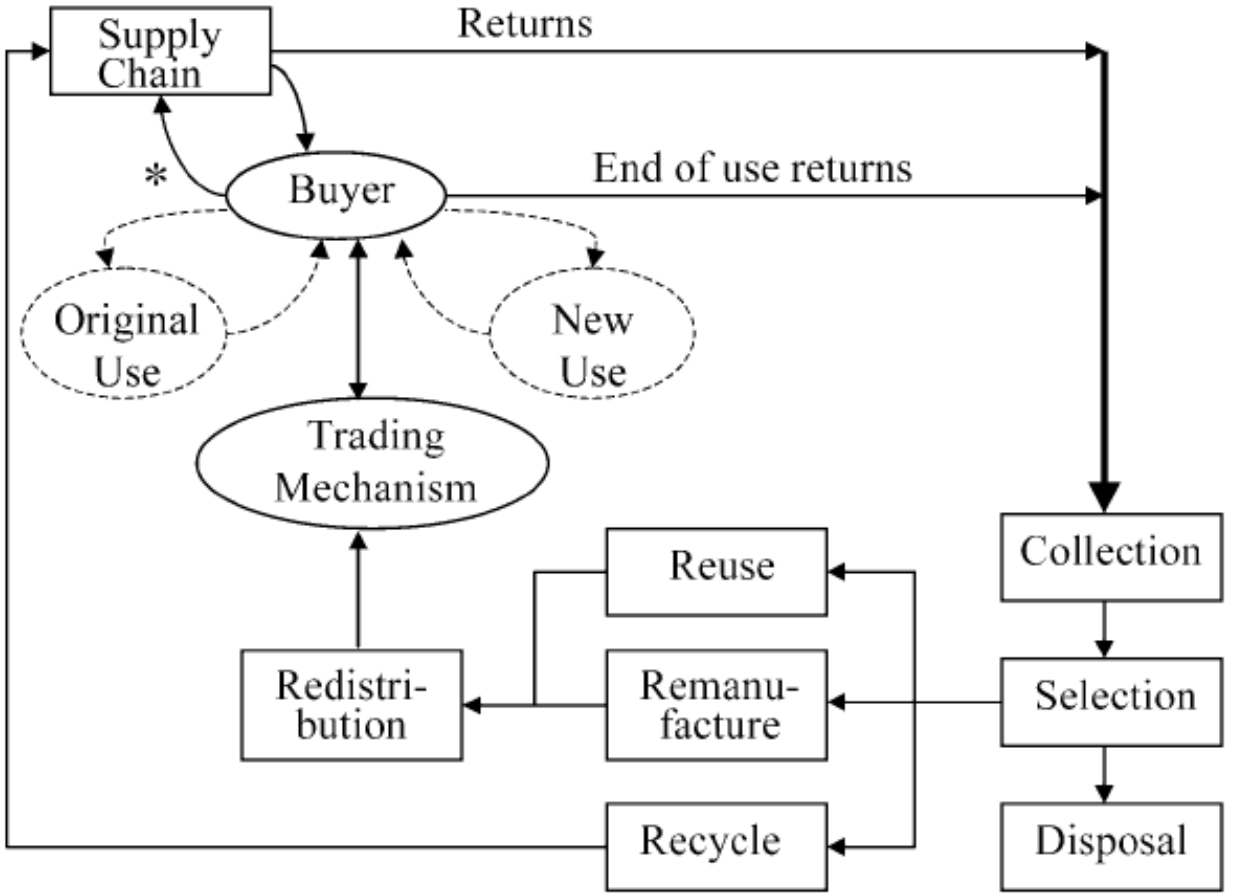


Figure 1 A closed-loop supply chain

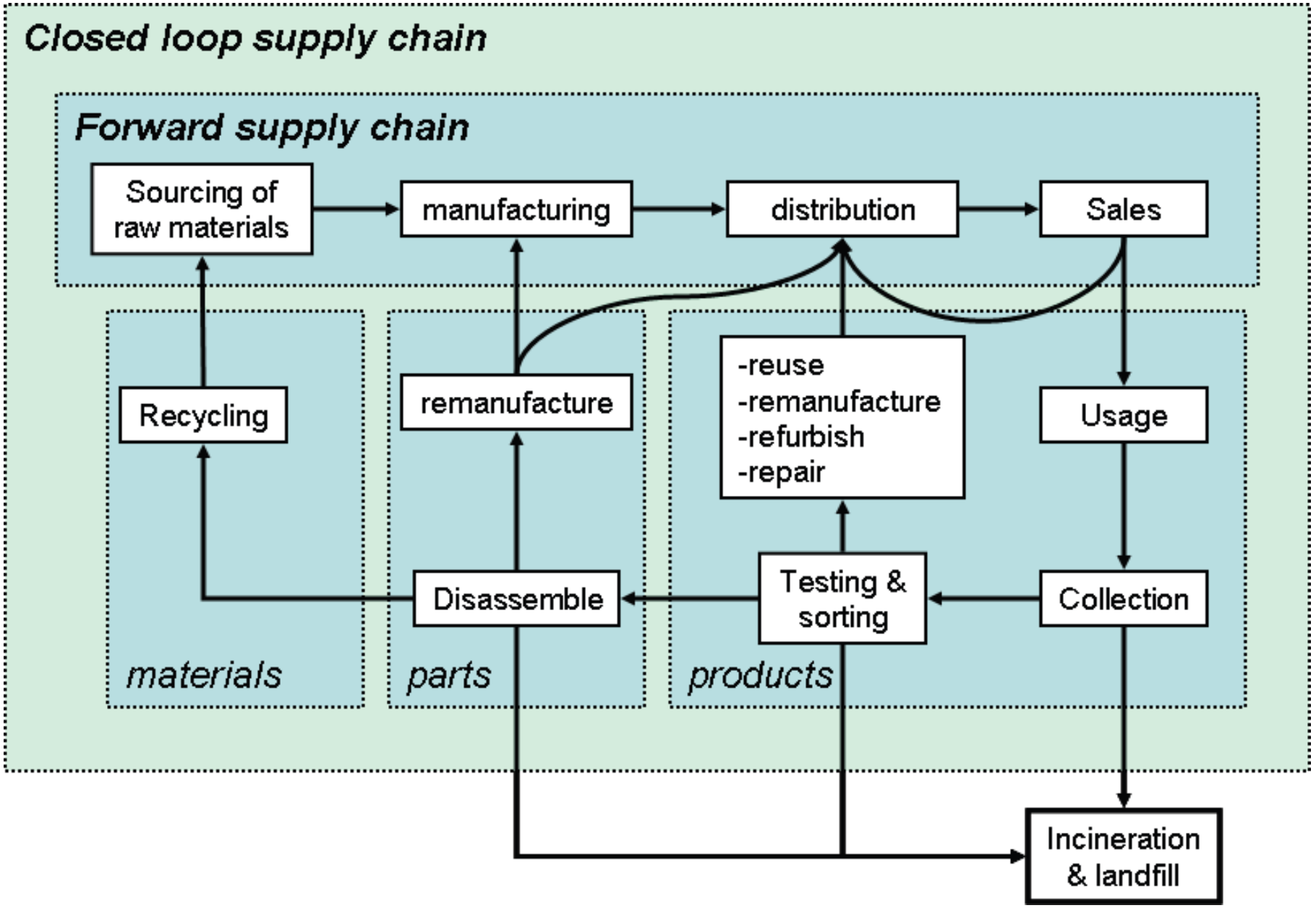
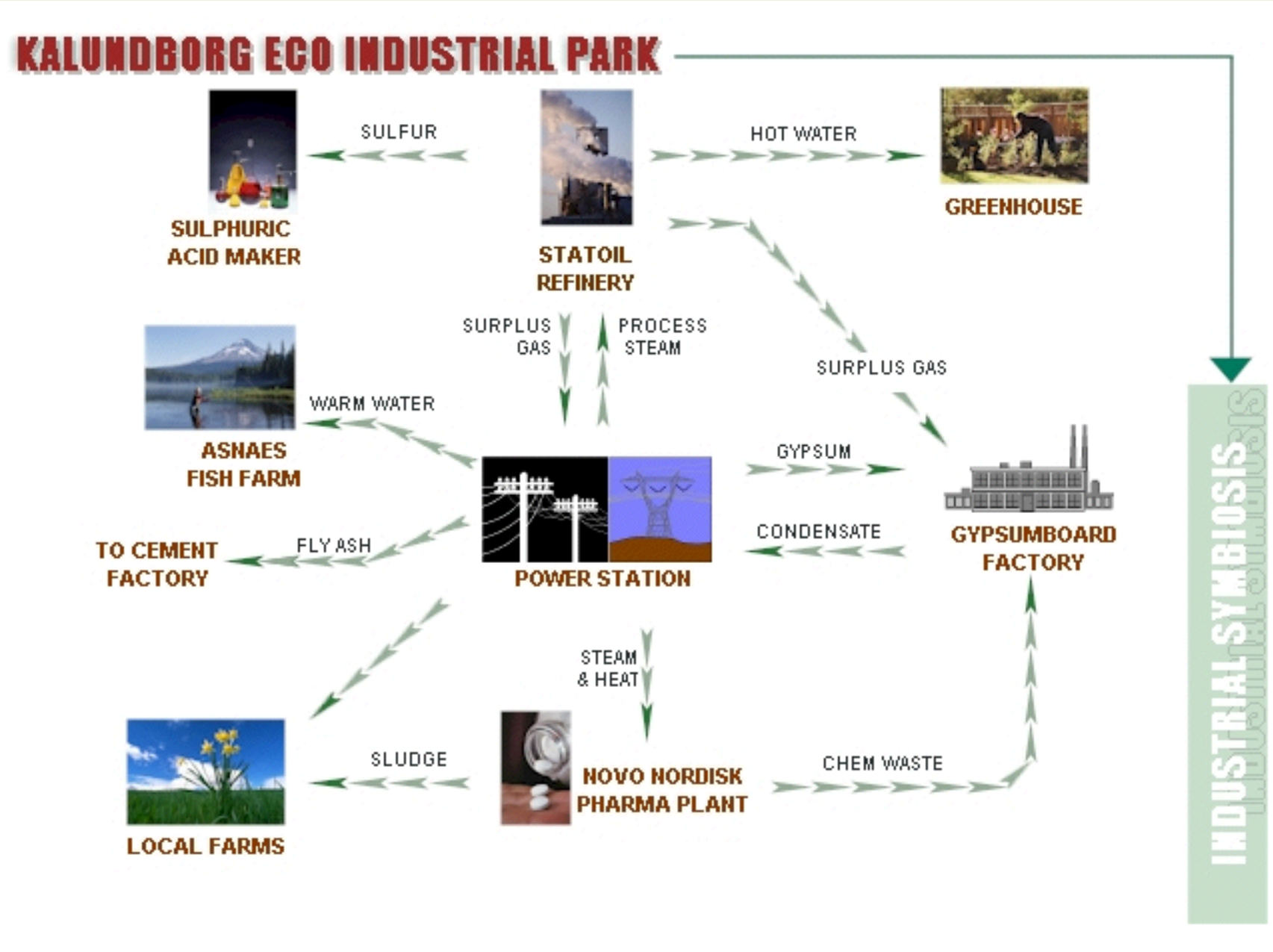
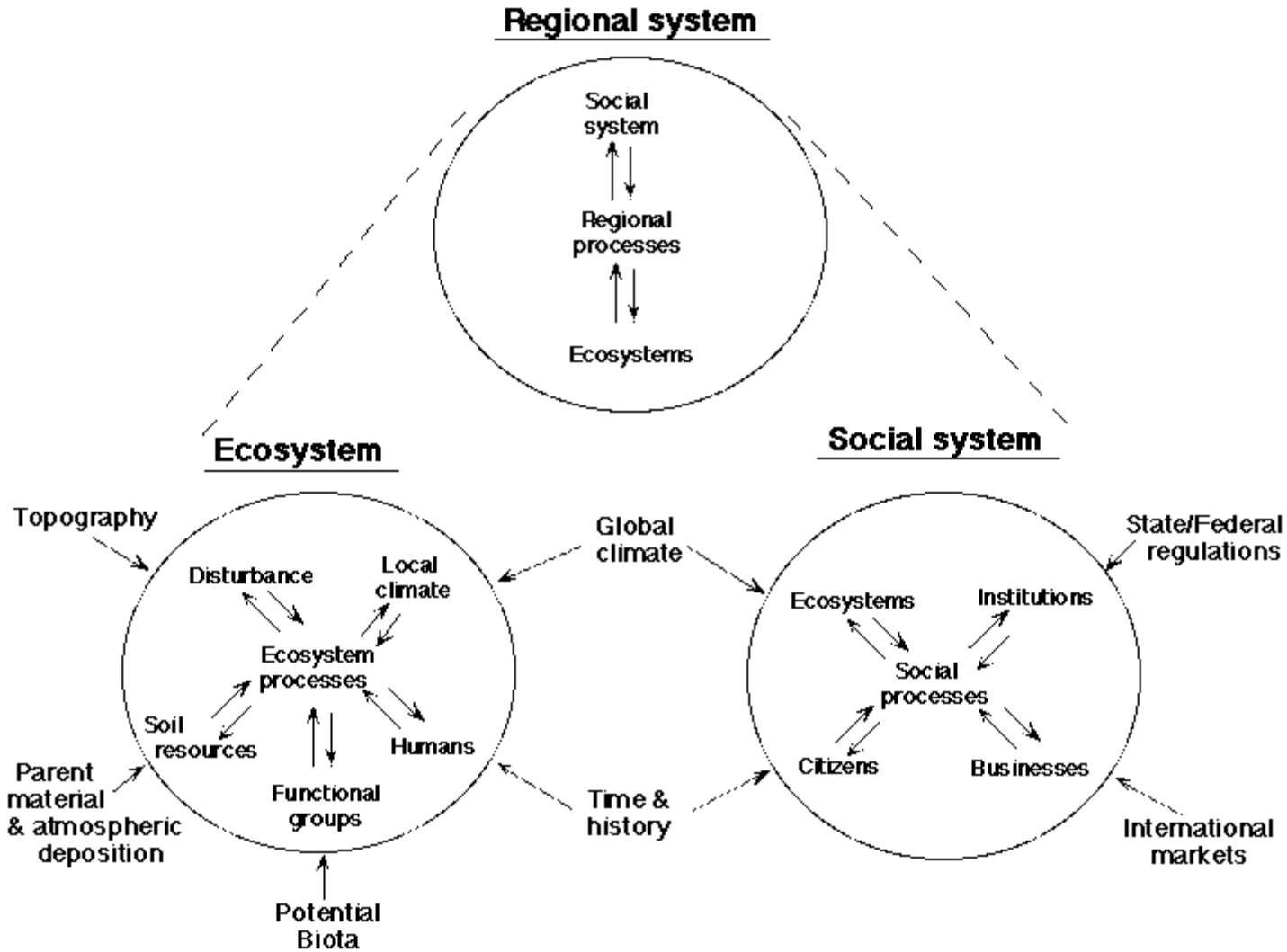


Figure 1: The processes of a closed-loop supply chain

Industrial Symbiosis (Kalundborg, Denmark)





Pengembangan industri berbasis wilayah berorientasi ekosistem

Considerations

- **Customer Returns**

  A variety of reasons for customer returns can be given (as indicated previously) including defective or unwanted items, warranty problems, recalls, and miss-shipments.

- **Environmental Challenges**

  Recycling and environmental concerns are frequently viewed simultaneously because of their association with regulatory policy at the local, state, and/or federal level.

- **Economic Value**

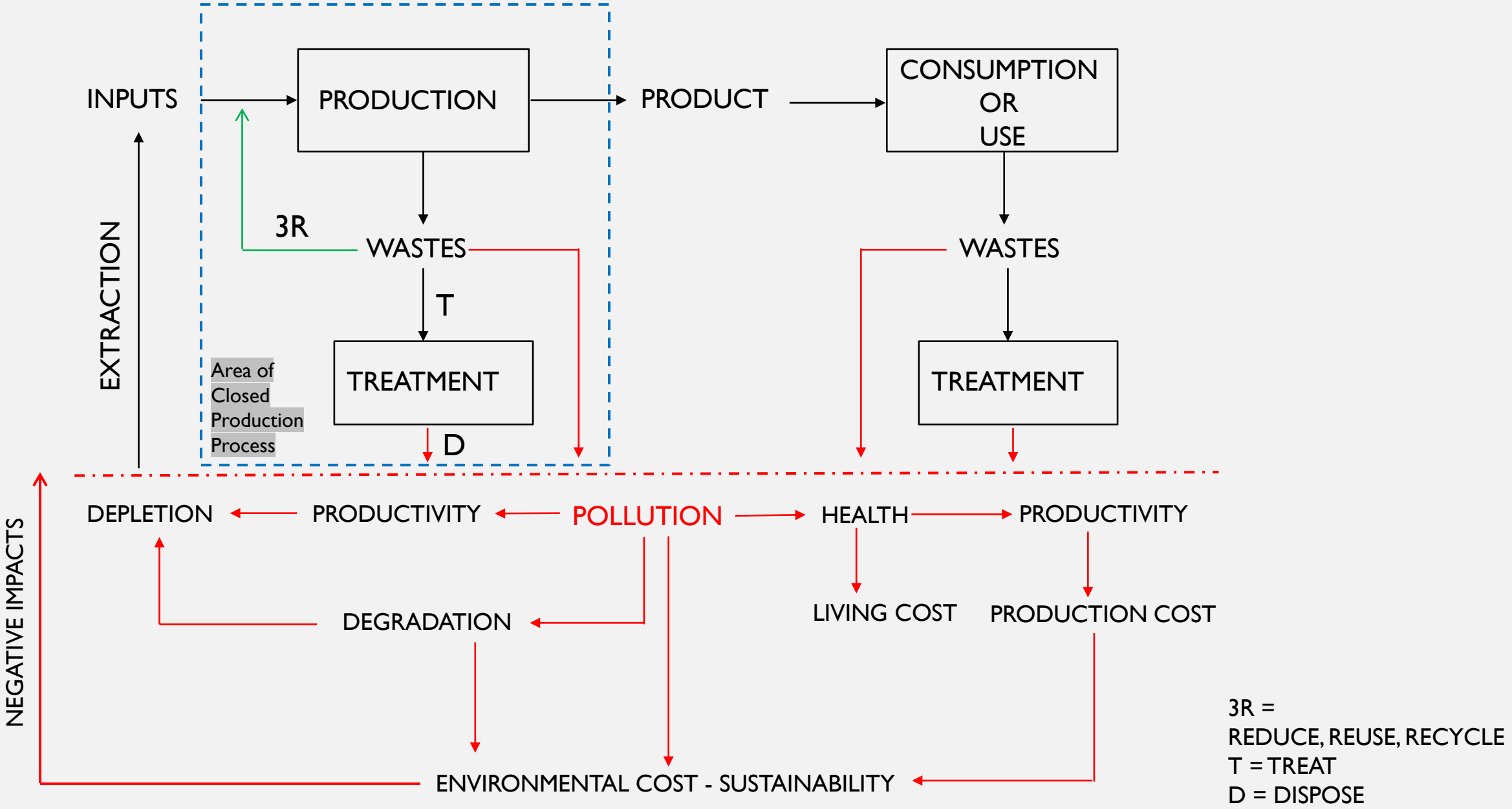
  Value has become an important for businesses and even some nonprofit organizations.

  Making reverse flows profitable is a challenge as well as an opportunity.

2. CLOSED PRODUCTION PROCESS

THE FRAMEWORK OF THINKING – THE LOGIC OF 3R+T+D CONCEPT

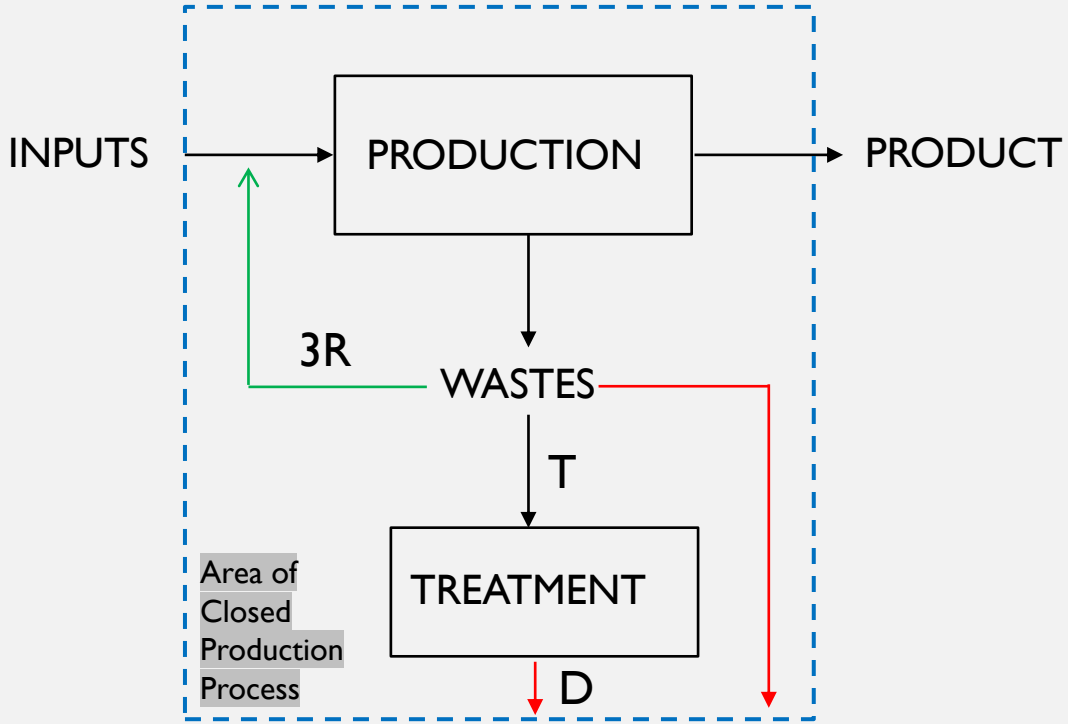
Perspective/Synopsis



3R =
REDUCE, REUSE, RECYCLE
T = TREAT
D = DISPOSE

AN APPROACH TO DEVELOP CLOSED PRODUCTION PROCESS

3R = REDUCE, REUSE, RECYCLE
T = TREAT
D = DISPOSE



REDUCE: Optimise the conversion process, Improve the machineries efficiency, avoid the use of hazardous materials, process only clean material, etc. ------ less waste volume

REUSE: don't waste any usable materials, use as much as possible reusable materials (reactants, packaging materials), glass/can container, incomplete processed material, etc.

TREAT: Unusable materials must be treated before disposal. In some cases, a treatment generates benefit to support the process (methane generation) in addition to make a more safer disposal

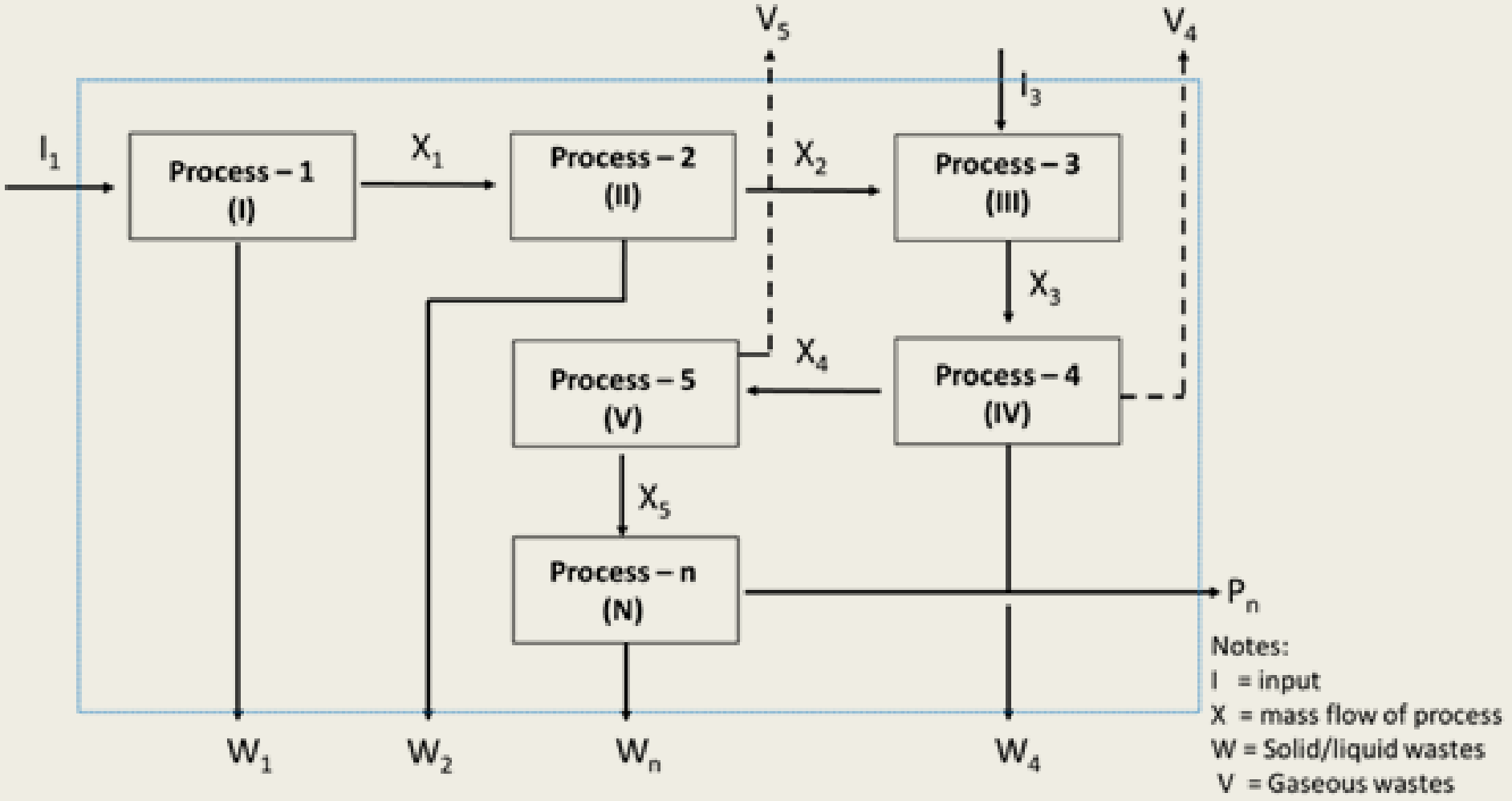
DISPOSE: Un-reusable and non-recyclable materials must be Disposed after treated at right time and in right place.

RECYCLE: re-extract the main content of material, return the waste to the process as much as possible, convert the waste into useful material (energy source, a new raw material) within or out the factory.

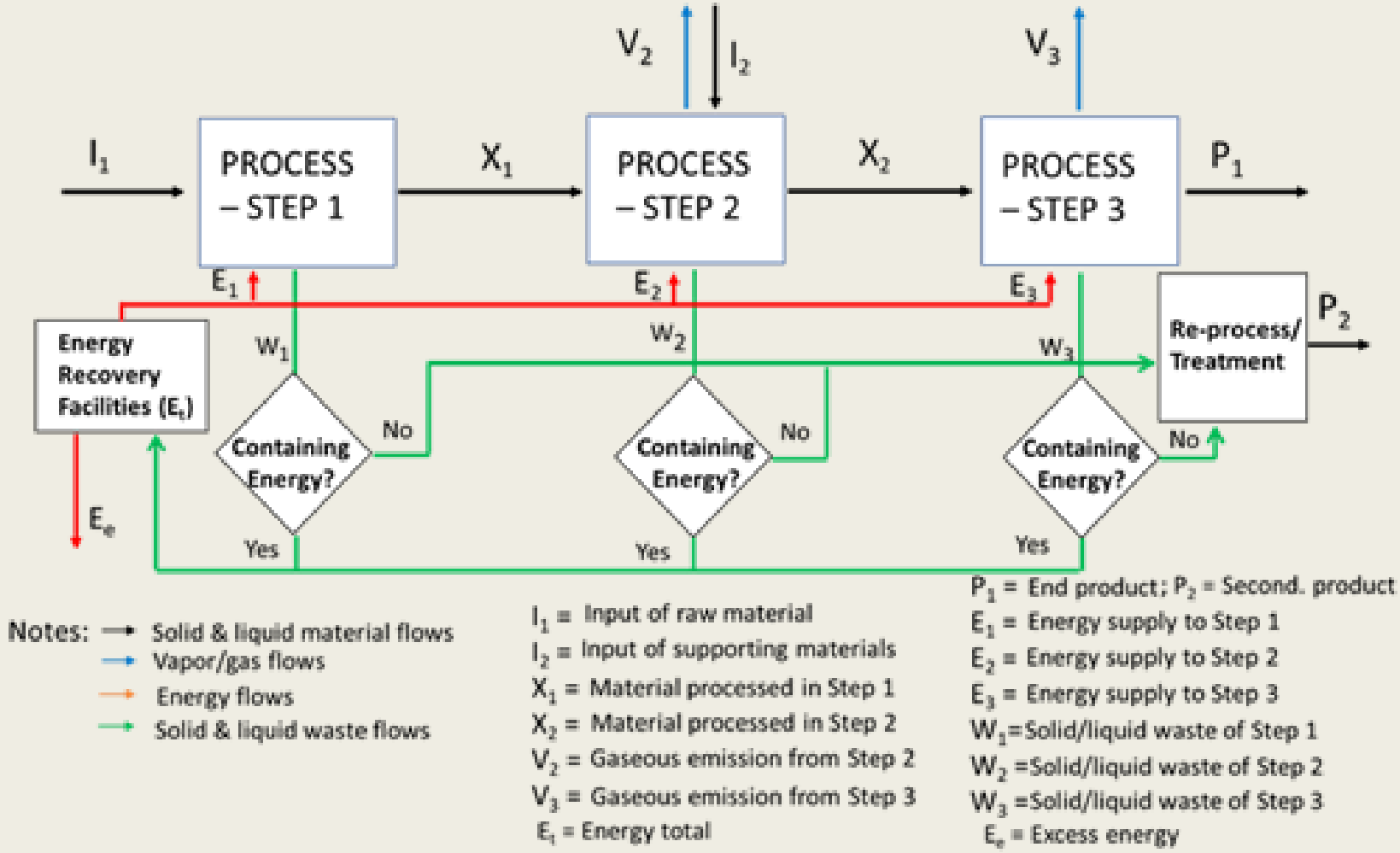
CLOSED PRODUCTION PROCESS: Integrating 3R+TD in the factory (in situ)

STEPS OF DEVELOPING CLOSED PRODUCTION PROCESS

1. Understanding the production process
2. Assess the input (raw and additional) materials and output (product)
3. Compare output to input, significant?
4. Gather information about the waste (solid, &liquid)
5. Find out the composition (content) of each waste
6. Look for energy content of each waste
7. Establish the process flow diagram
8. Assess the energy requirement of each and total process
9. Create material balance of the production process
10. Calculate potential energy of the wastes
11. Convert the energy into type of used
12. Compare the total energy used to potential energy
13. Deciding the energy sufficiency level
14. Mapping the energy flow to the process diagram



A hypothetical process stages of an agroindustry



Steps to develop energy independent agroindustry

Quantification of “not yet used” Resources

Wastes generation and their calorific value

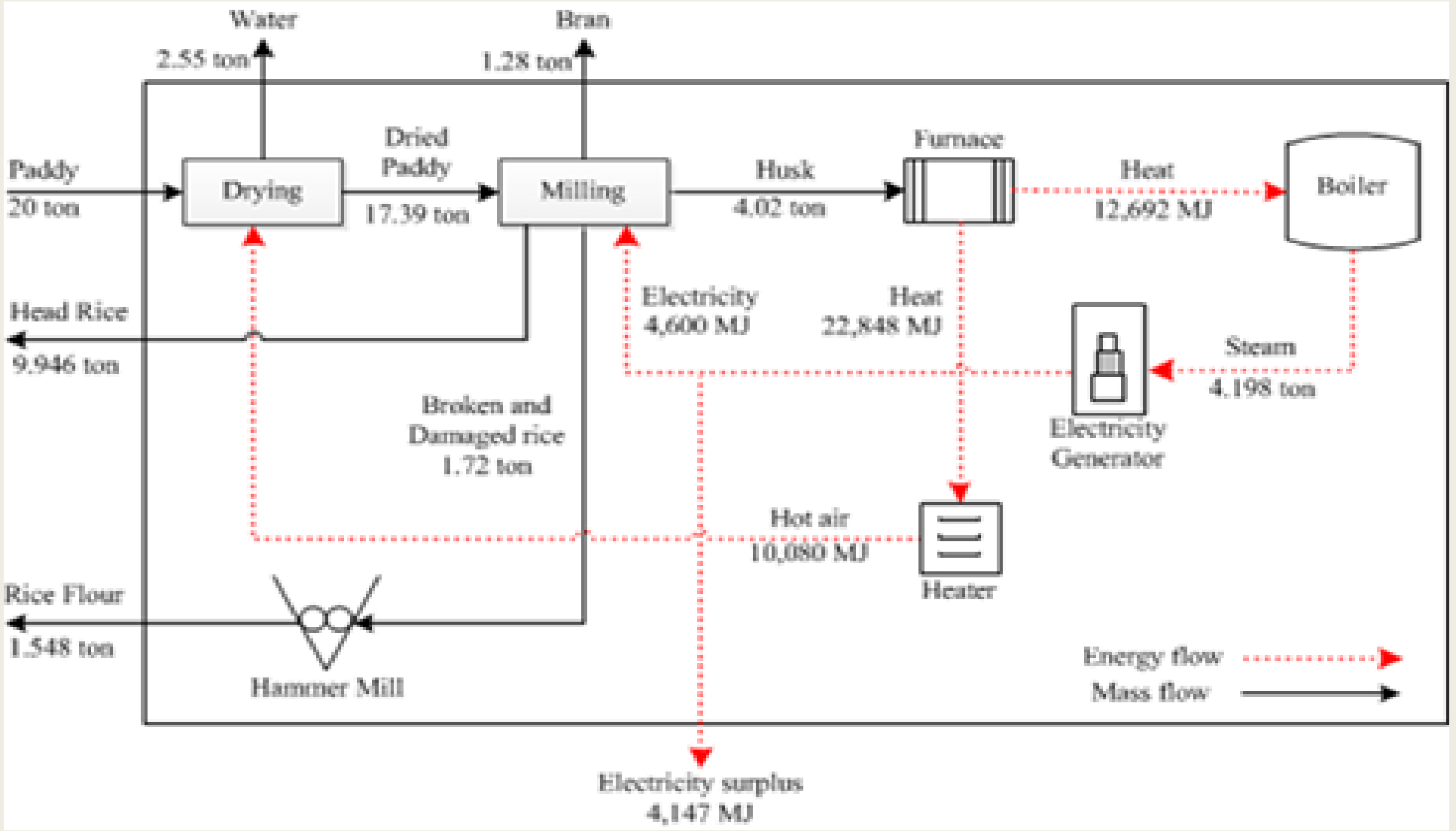
Agroindustry	Waste Generation			Reference Capacity	Reference
	Type	Volume (ton)	Calorific Value (kcal/kg)		
Sugar mills	Bagasse	1042.98	2,019	3,000 ton cane/day	[9]
	Filter cake	81.75	3,319		
	Molasses	62.10	2,700		
Rice Mills	Rice husk	4,020	3,489	20 ton paddy/day	[10]
CPO mills	Empty Fruit Bunches	14,265	2,294	60 ton Fresh Fruit Bunches/hour	[8]
	Nut shells	1,959	5,114		
	Fibre	4,613	4,589		
	Effluent	21,058	52[a]		
Tapioca	Stockpile Cassava peel	533.4 117	2,484 707	1,000 ton fresh cassava/day	[29]
Corn Flour	Corn husk	1.632	3,500	12 ton fresh corn/day	[28]
	Corn cob	1.298	4,500		

Energy Content of "NYU" Materials

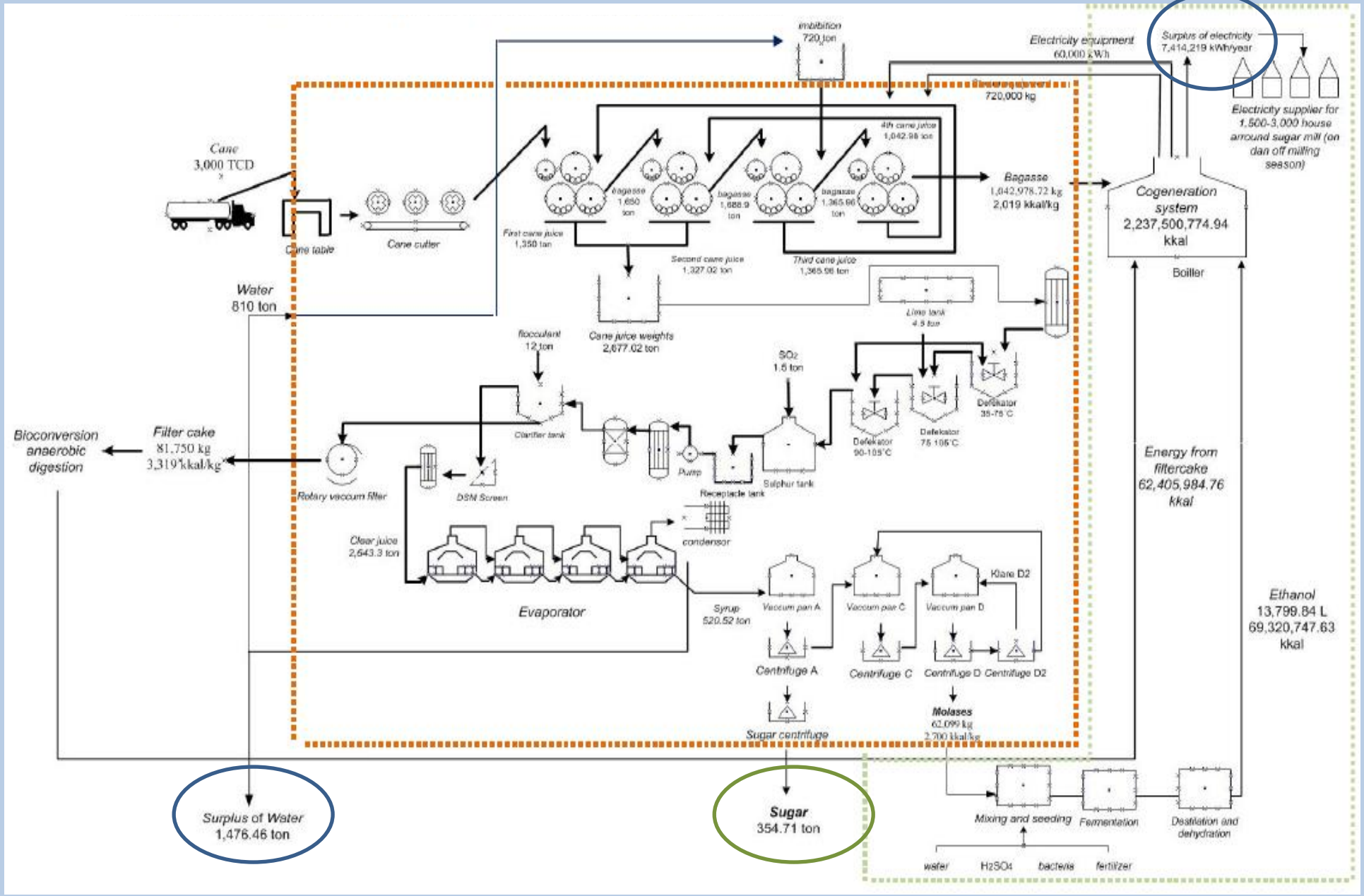
Energy generation, need and surplus of selected agroindustry

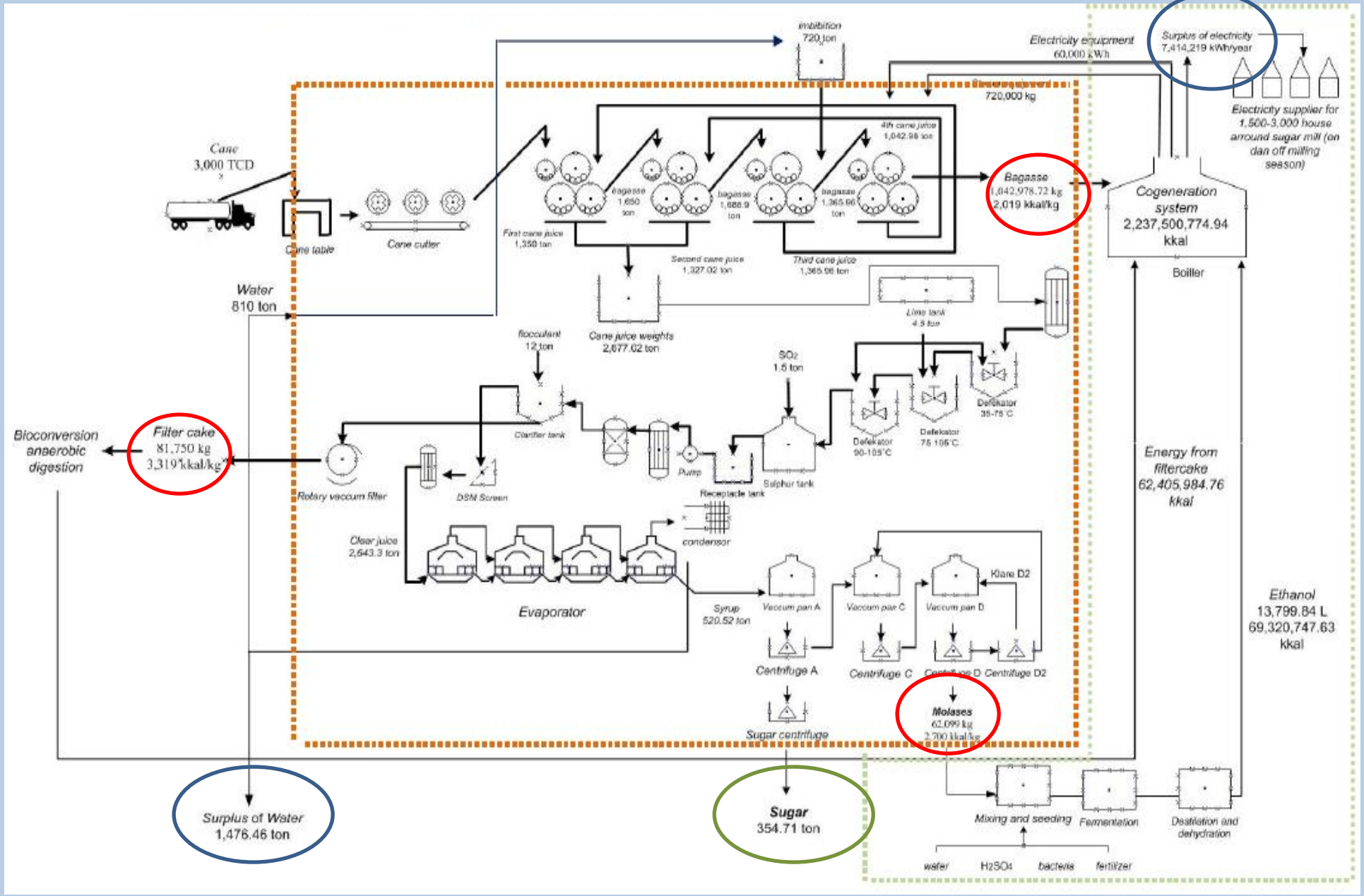
Agroindustry	Energy of wastes (kcal)	Energy need		Surplus (KWH)	Conclusion	Reference
		Steam (kcal)	Electricity (KWH)			
Sugar Mills (3000 TCD)	**2,237,500,774[1]**	**482,349,600**	**60,000**	**55,942**	**Surplus**	**[9]**
Rice Mill (20 ton/day)	**8,496,654[2]**	**2,409,178**	**1,278**	**1,152**	**Surplus**	**[10]**
CPO mills (60 ton FFB/hour)	**65,006,768[3]**	**20,097,900**	**1,020**	**1,022**	**Surplus**	**[8]**
Tapioca (1,000 ton fresh cassava/day)	**1,407,714,408[4]**		**99,261**	**11,735**	**Surplus**	**[29]**
Corn Flour (12 ton fresh corn/day)	**3,329,828**		**1,177**	**2,692**	**Surplus**	**[28]**

Notes: [1]Including bagasse, filter cake, and bioethanol from molasses; [2]Husk only, [3]Empty fruit bunches, fibre, kernel shell and biogas from wastewater by anaerobic digestion; [4]Stock pile and cassava peel, [5]Corn husks and cob.



Self-sufficient energy closed production system of rice mill [10]


Imbibition
720 ton
Electricity equipment
60,000 kWh
Surplus of electricity
7,414,219 kWh/year
720,000 kg
Electricity supplier for
1,500-3,000 house
around sugar mill (on
dan off milling
season)
Cane
3,000 TCD
Cane table
Cane cutter
4th cane juice
1,042.98 ton
Bagasse
1,650
ton
Bagasse
1,688.9
ton
Bagasse
1,365.66
ton
Bagasse
1,042,978.72 kg
2,019 kkal/kg
First cane juice
1,350 ton
Second cane juice
1,327.02 ton
Third cane juice
1,365.98 ton
Cogeneration
system
2,237,500,774.94
kkal
Boiler
Water
810 ton
Lime tank
4.5 ton
Flocculant
12 ton
Cane juice weights
2,677.02 ton
SO2
1.5 ton
Defekator
35-75°C
Defekator
75-105°C
Defekator
90-105°C
Clarifier tank
Pump
Sulphur tank
Receptacle tank
Bioconversion
anaerobic
digestion
Filter cake
81,750 kg
3,319 kkal/kg
Rotary vaccum filter
DSM Screen
Energy from
filtercake
62,405,984.76
kkal
Clear juice
2,643.3 ton
condensor
Evaporator
Syrup
520.52 ton
Vaccum pan A
Vaccum pan C
Vaccum pan D
Klare D2
Centrifuge A
Centrifuge C
Centrifuge D
Centrifuge D2
Ethanol
13,799.84 L
69,320,747.63
kkal
Molases
62,099 kg
2,700 kkal/kg
Sugar centrifuge
Mixing and seeding
Fermentation
Destilation and
dehydration
water
H2SO4
bacteria
fertilizer
Surplus of Water
1,476.46 ton
Sugar
354.71 ton


Imbibition
720 ton
Electricity equipment
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Surplus of electricity
7,414,219 kWh/year
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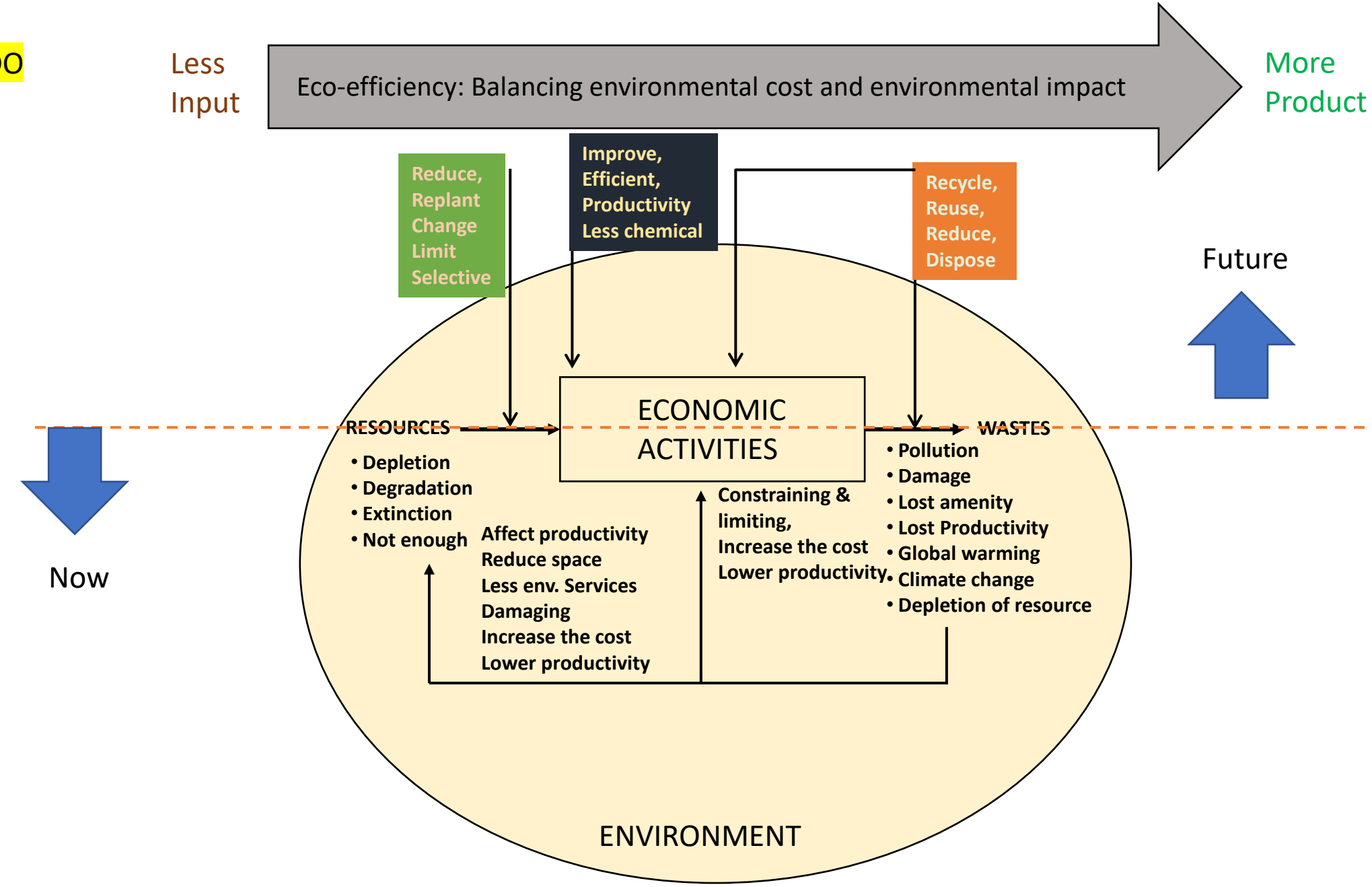
Electricity supplier for
1,500-3,000 house
around sugar mill (on
dan off milling
season)
Cane
3,000 TCD
Cane table
Cane cutter
4th cane juice
1,042.98 ton
bagasse
1,650
ton
bagasse
1,688.9
ton
bagasse
1,365.66
ton
First cane juice
1,350 ton
Second cane juice
1,327.02 ton
Third cane juice
1,365.66 ton
Bagasse
1,042,978.72 kg
2,019 kkal/kg
Cogeneration
system
2,237,500,774.94
kkal
Boiler
Water
810 ton
Cane juice weights
2,677.02 ton
Lime tank
4.5 ton
flocculant
12 ton
SO2
1.5 ton
Defekator
35-75°C
Defekator
75-105°C
Defekator
90-105°C
Clarifier tank
Pump
Sulphur tank
Receptacle tank
Rotary vaccum filter
DSM Screen
Bioconversion
anaerobic
digestion
Filter cake
81,750 kg
3,319 kkal/kg
Energy from
filtercake
62,405,984.76
kkal
Clear juice
2,643.3 ton
condensor
Evaporator
Syrup
520.52 ton
Vaccum pan A
Vaccum pan C
Vaccum pan D
Klare D2
Centrifuge A
Centrifuge C
Centrifuge D
Centrifuge D2
Molases
62,099 kg
2,700 kkal/kg
Sugar centrifuge
Ethanol
13,799.84 L
69,320,747.63
kkal
Surplus of Water
1,476.46 ton
Sugar
354.71 ton
Mixing and seeding
Fermentation
Destilation and
dehydration
water
H2SO4
bacteria
fertilizer

WHAT TO DO


Less Input
Eco-efficiency: Balancing environmental cost and environmental impact
More Product
Reduce, Replant Change Limit Selective
Improve, Efficient, Productivity Less chemical
Recycle, Reuse, Reduce, Dispose
Future
Now
RESOURCES
• Depletion
• Degradation
• Extinction
• Not enough
ECONOMIC ACTIVITIES
WASTES
• Pollution
• Damage
• Lost amenity
• Lost Productivity
• Global warming
• Climate change
• Depletion of resource
Affect productivity
Reduce space
Less env. Services
Damaging
Increase the cost
Lower productivity
Constraining & limiting,
Increase the cost
Lower productivity
ENVIRONMENT

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Songonima sian hu jalo asi
Mauliate godang