SVENSKA ARALSJÖSÄLLSKAPET

Swedish Aral Sea Society

Water use and management
–
Cleaner production

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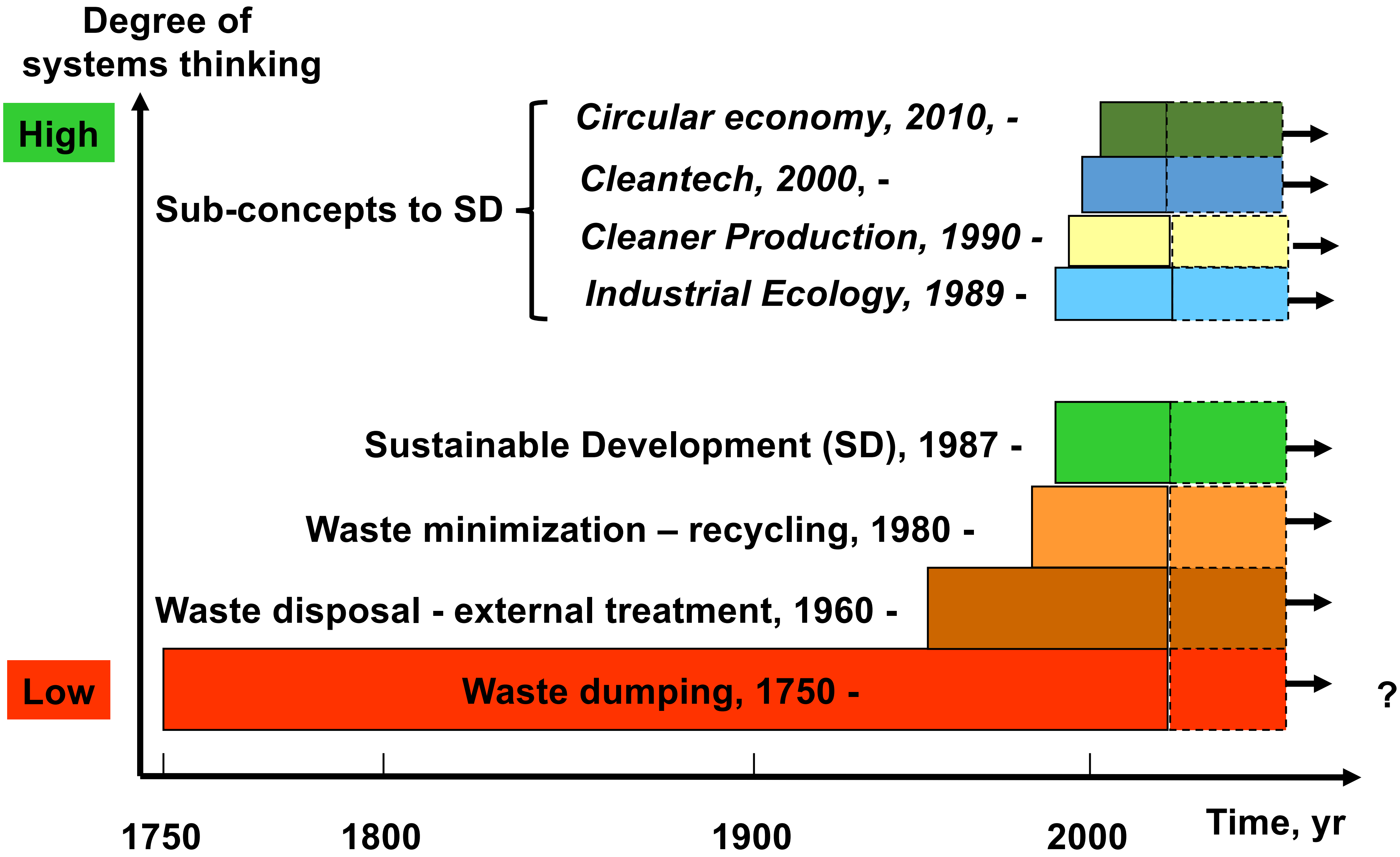
Part 1
Environmental management

Development of the industrial approach to environmental management 1750 - 2020



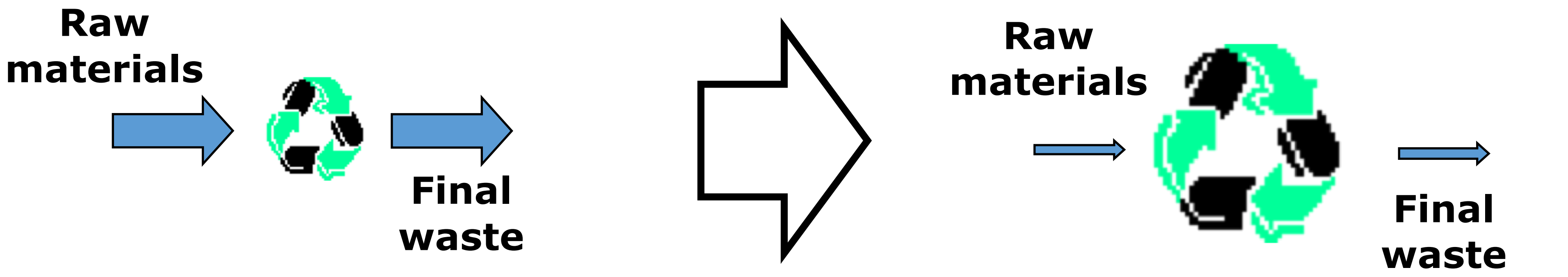
Material flows and ecocycles – now and in the future

Now

Society

Future

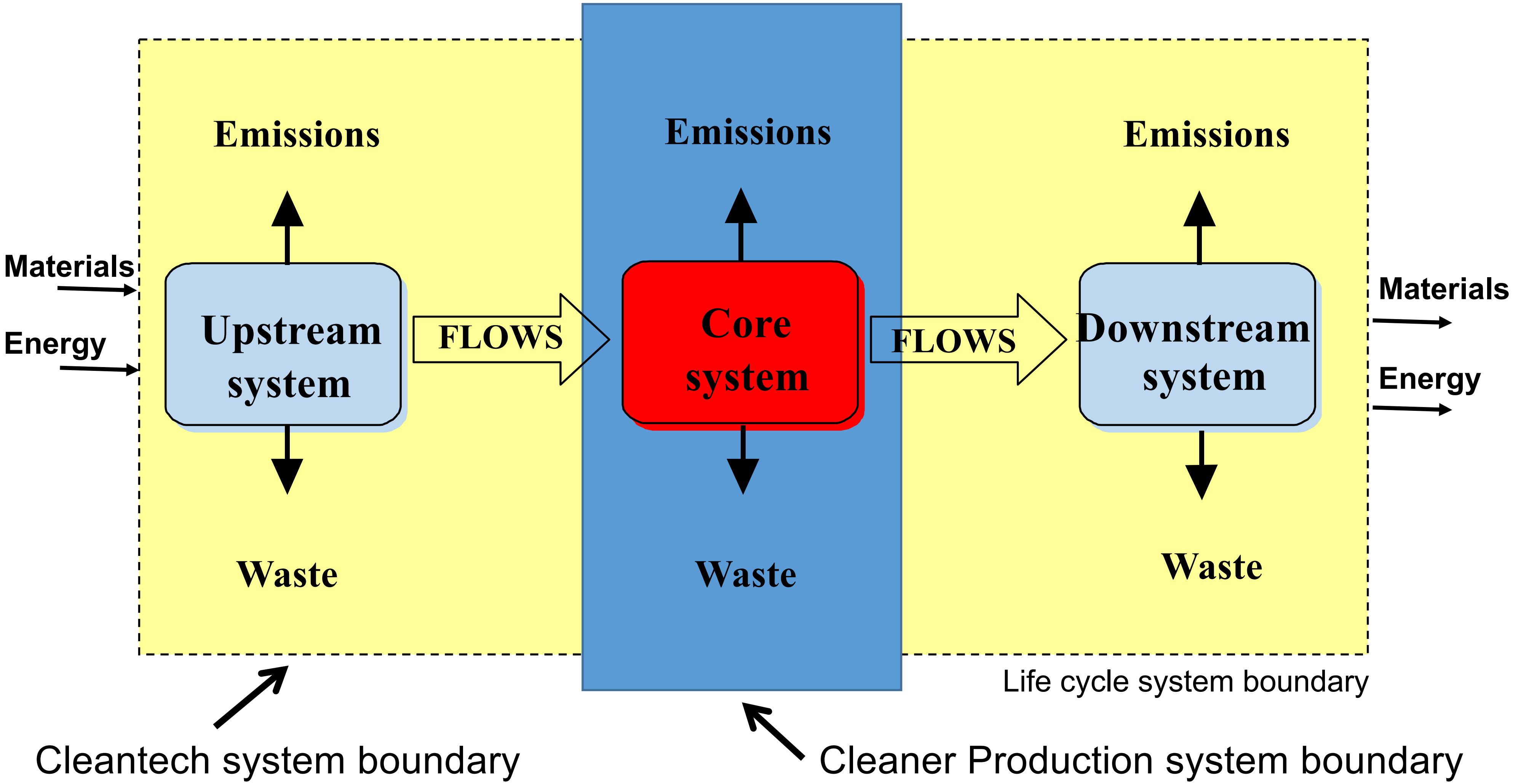
Society



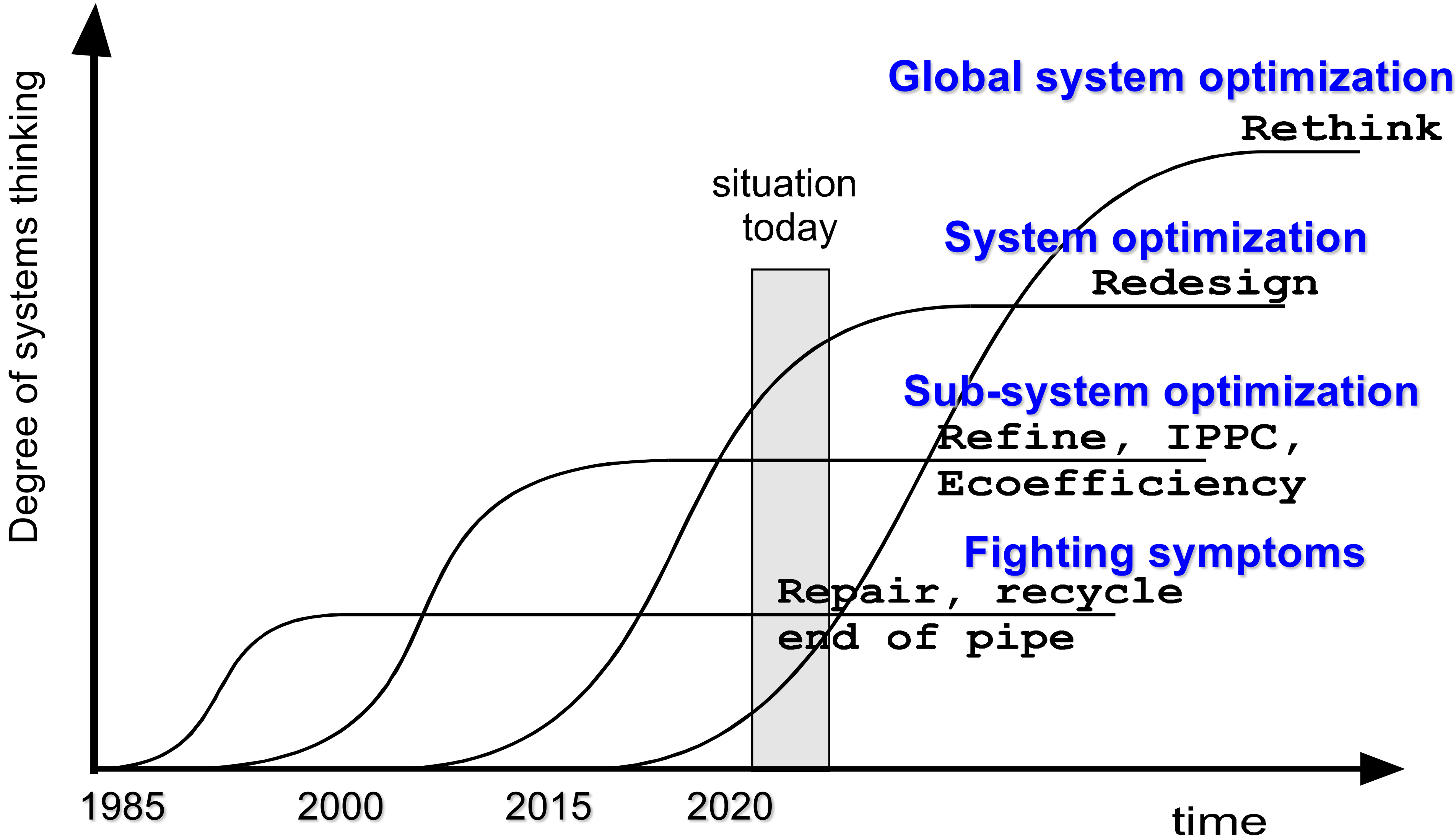
High raw material use
Low degree of recycling

Low raw material use
High degree of recycling

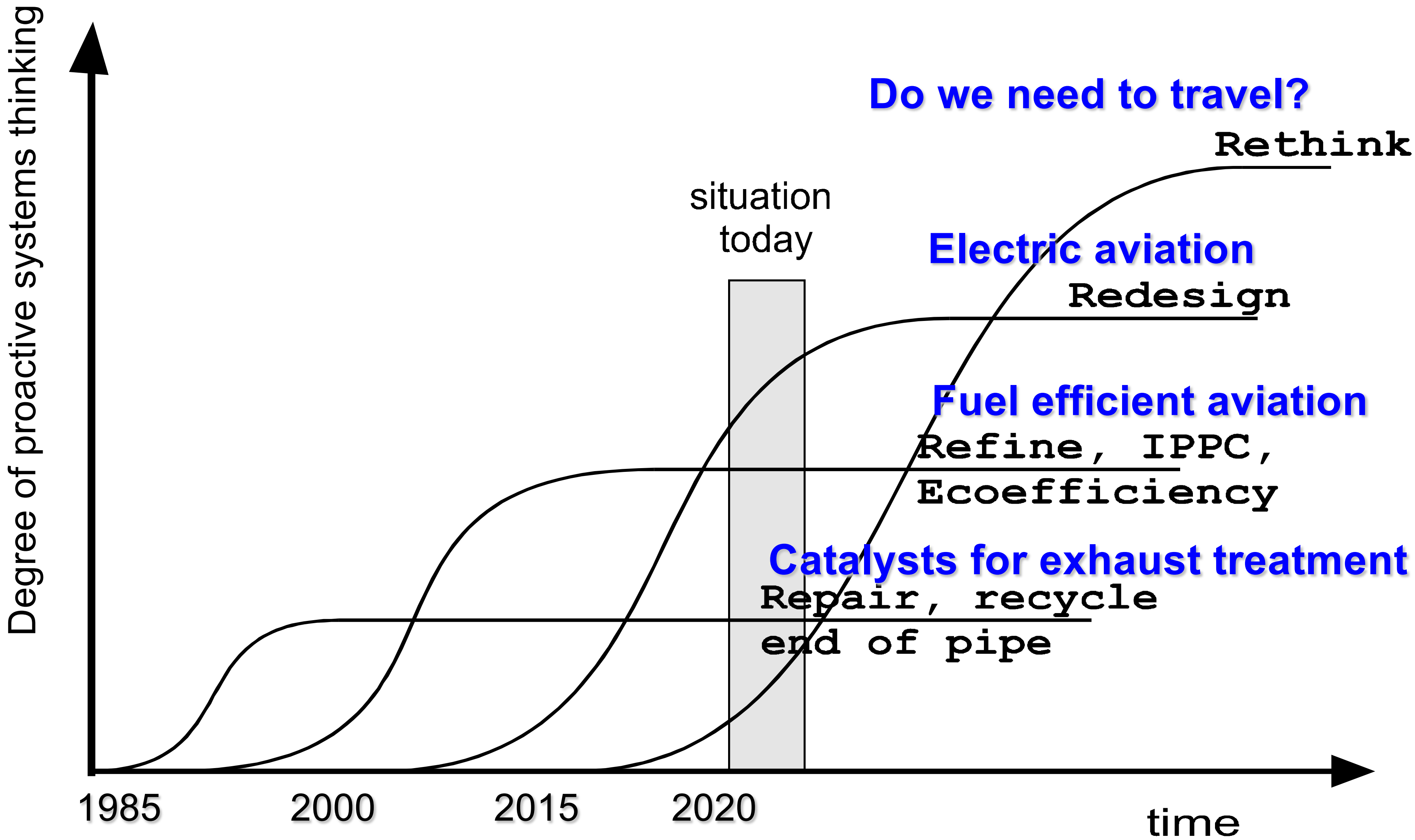
The Life Cycle Perspective
Cleantech and Cleaner Production



The paradigm shift in ecologic thinking



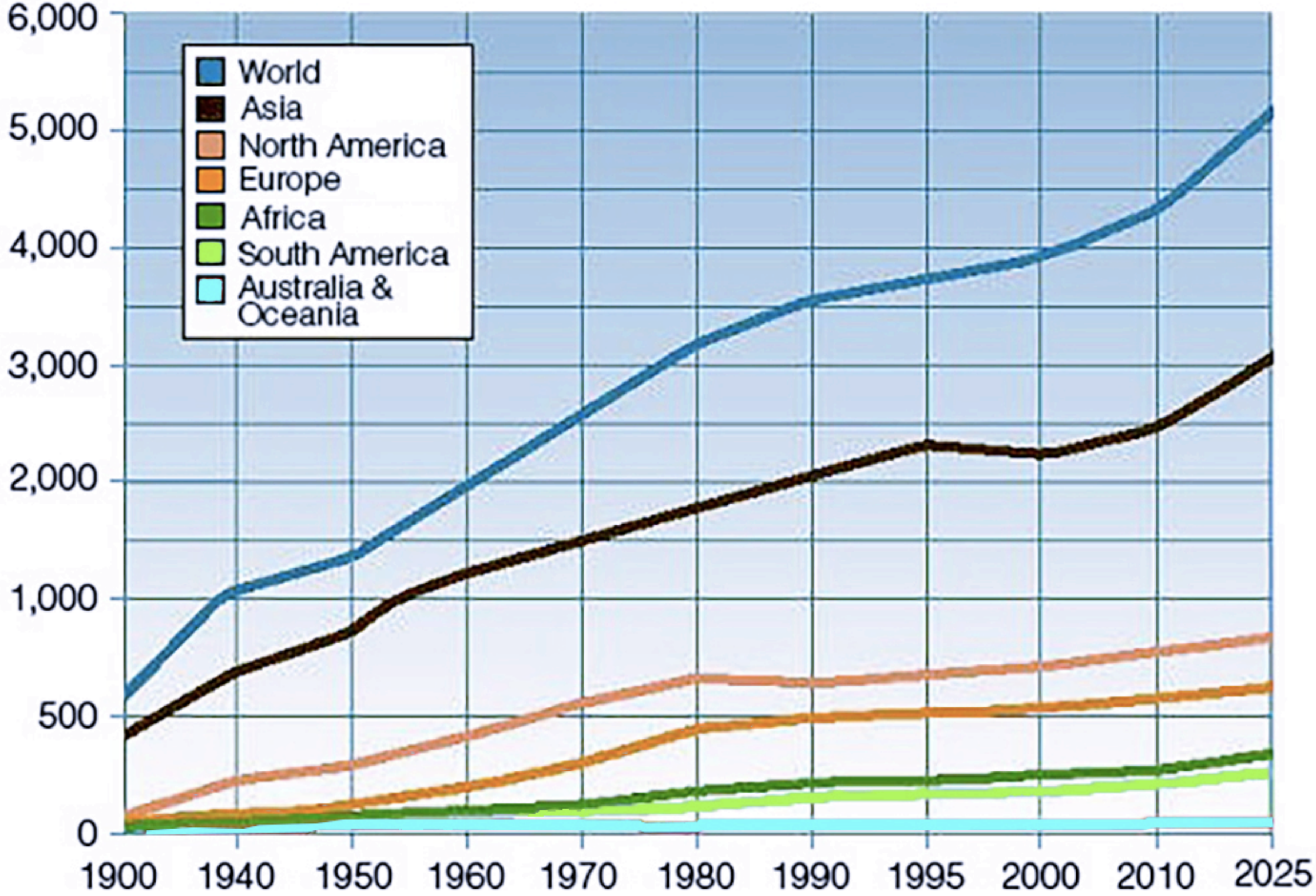
The paradigm shift applied for international cooperation travel



Part 2
Water use and management

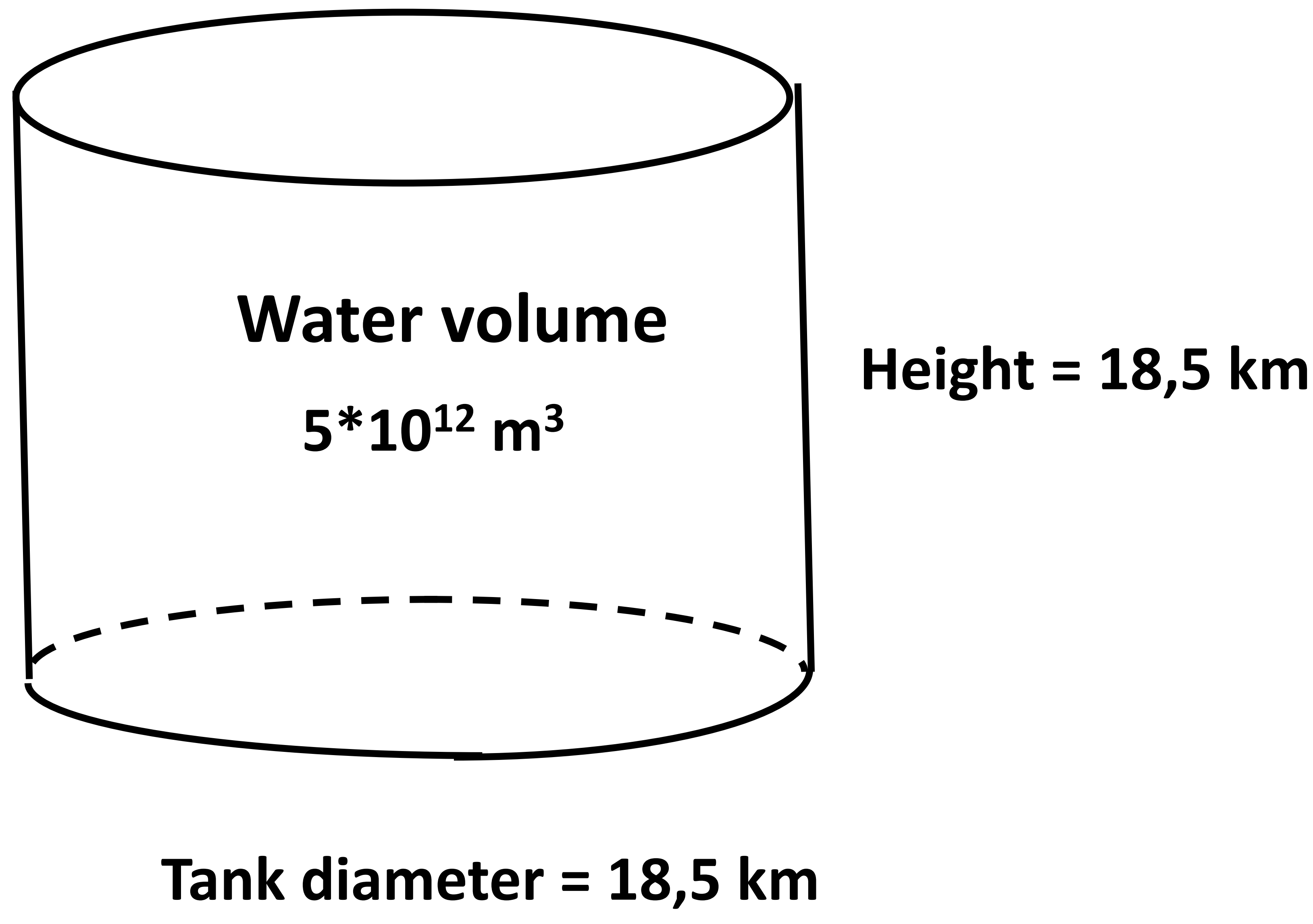
Global Water Consumption 1900 – 2025

(by region, in billions of m^3 per year)



https://upload.wikimedia.org/wikipedia/commons/4/4f/Annualglobalwaterconsumption.jpg

How much is 5 trillion m^3 water per year



Important Global Water Consumption Statistics 1

- 70% of the world's fresh water use is in agriculture
- 22% of the world's fresh water use is in industry
- 8% of the world's fresh water use is for domestic purpose

Source: C.f. https://gitnux.org/global-water-consumption-statistics

Important Global Water Consumption Statistics 2

- 4 billion people face water scarcity at least one month per year.
- About 29% of the total global population lacks access to safely managed drinking water.
- 36% of the global population lives in water-scarce regions.
- By 2025, half of the world's population will be living in water-stressed areas.
- It takes 15,000 liters of water to produce one kilogram of beef.
- Green water (rainwater stored in the soil) accounts for 61% of global agricultural water consumption.
- 1 in 4 people worldwide live in areas where groundwater is over-extracted faster than it is replenished.
- The global water market is valued at approximately $850 billion as of 2021.
- 748 million people lack access to safe drinking water, leading to 1.5 million preventable child deaths per year.

Source: C.f. https://gitnux.org/global-water-consumption-statistics

Water use in three countries 2002 and 2017

Water withdrawal in Uzbekistan, USA and Sweden 2002 and 2017							
Parameter type	**Parameter**	**Uzbekistan 2002**	**USA 2002**	**Sweden 2002**	**Uzbekistan 2017**	**USA 2017**	**Sweden 2017**
Absolute	Agricultural water, 10^9 m^3/yr	53,7	195	0,135	54,4	176	0,075
Absolute	Industrial water, 10^9 m^3/yr	2,14	301	1,50	2,13	210	1,35
Absolute	Municipal water, 10^9 m^3/yr	3,61	64,6	1,04	2,41	58,4	0,96
Absolute	Total withdrawal, 10^9 m^3/yr	59,4	561	2,68	58,9	444	2,38
Relative	Agricultural water, m^3/cap*yr	2123	677	15,2	1679	542	7,5
Relative	Industrial water, m^3/cap*yr	85	1045	168	66	646	135
Relative	Municipal water, m^3/cap*yr	143	224	117	74	180	96
Relative	Total withdrawal, m^3/cap*yr	2348	1948	301	1818	1366	238
Population, millions		25,3	288	8,91	32,4	325	10,0

Examples of water saving measures

1. Start to monitor water use carefully
2. Install valves to close water when not used
3. Fix “low hanging fruits” (leaks etc)
4. Reuse of wastewater (down-classing of water)
5. Recirculate cooling water after cooling (closed cooling water system)
6. Install recirculation of process water (after specific purification)
7. Redesign processes (e.g install counter current rinsing)

Ortviken paper mill in Sundsvall, Sweden – a major water user that emits* a lot of water as steam

* The paper mill is nowadays retrofitted to other uses due to decreased consumption of newsprint

Field irrigation system in Uzbekistan

Part 3
Cleaner Production

Cleaner Production

UNEP (United Nations Environmental Program) definition of Cleaner Production

"C*leaner production means the continuous application of an integrated, preventative environmental strategy to processes, products and services to increase eco-efficiency and reduce risks to humans and the environment*"

Cleaner Production may be regarded not only as a goal but rather as a journey towards shaping a more efficient physical resource metabolism in industrial activities

Cleaner Production – priorities

In the work towards Cleaner Production – especially when considering processes that are open and discontinuous – it is important to establish a list of priorities between different potential and desirable measures. Such a priority list would normally consider health and process accident risks before environmental risks according to the following:

Priority 1:	**Health aspects for the workers**
Priority 2:	**Process accident risks**
Priority 3:	**Risks for local environmental impact**
Priority 4:	**Risks for regional environmental impact**
Priority 5:	**Risks for global environmental impact**

The Cleaner Production Project

1. Issue raised
2. Management decision
3. Cleaner production group assigned
4. Mass and energy balances established
5. Improvement alternatives selected
6. Feasibility of alternatives assessed
7. Selection of preferred alternative
8. Project implementation
9. Project evaluation

Cleaner Production in practice – the necessity to integrate auditing, monitoring and practical measures

In practice, it is absolutely necessary to integrate the work with monitoring, evaluation and auditing in Cleaner Production. Without this integration, there will be a suboptimisation of the work with Cleaner Production. Two important Initial considerations are:

1. **With primitive processes – (i) open and/or (ii) non-continuous it will be necessary to reconsider the design of the processes themselves**

2. **With advanced processes (closed and/or continuous the work with Cleaner Production can be based on the establishment of mass- and energy balances**

Basic Approaches to Cleaner Production

In order of complexity, time and investment

1. Good Housekeeping (actions without investment)
2. Improved process monitoring and control
3. Input-Substitution (less polluting/toxic raw materials)
4. In-situ recycling (e.g. water and chemicals)
5. Technological optimisation (Process modification)
6. Redesign of product, by-products and or packaging
7. Off-site recycling (e.g. aluminium or paper)

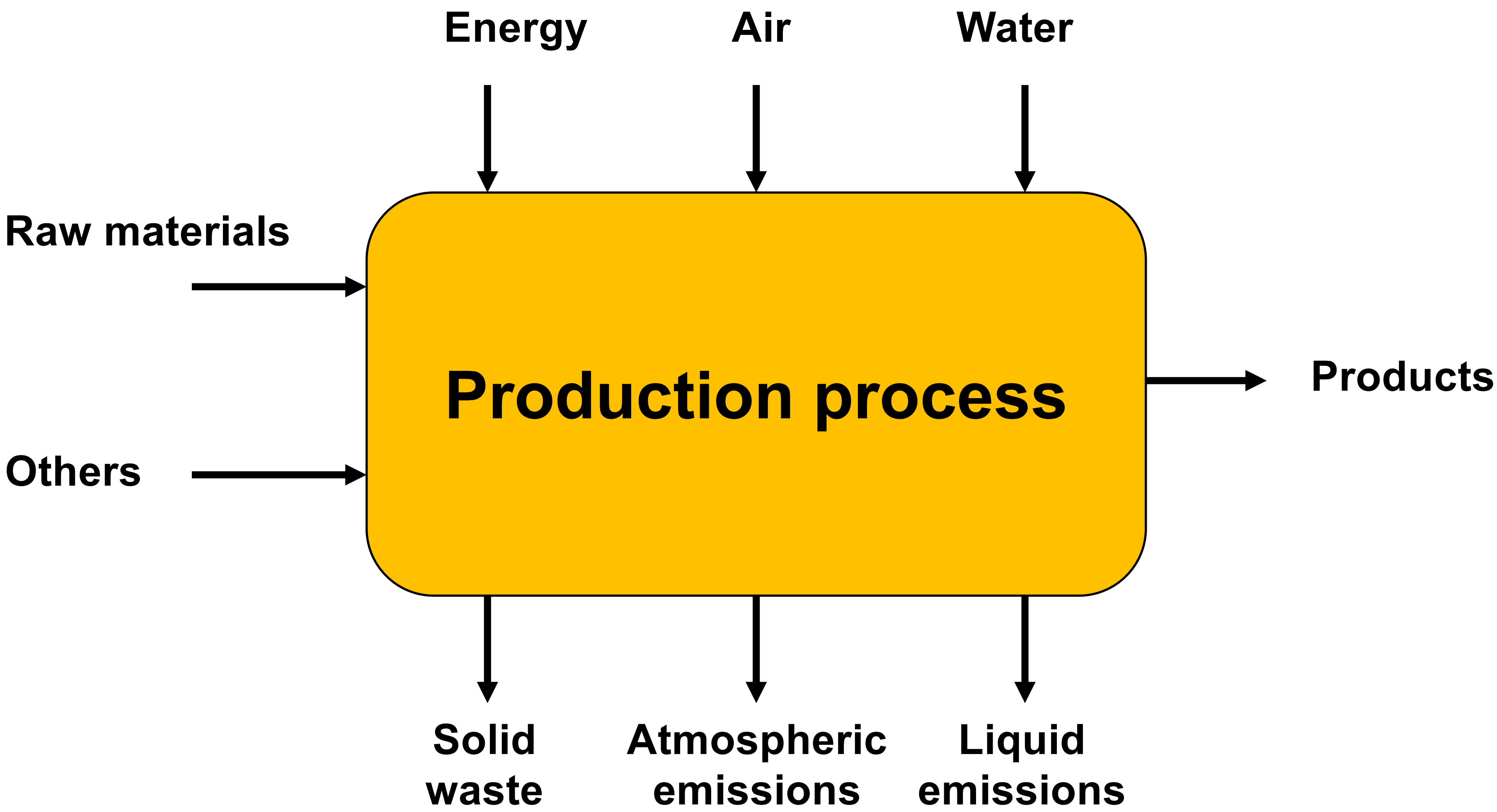
Mass and energy balances as a basis for Cleaner Production measures

It is necessary to establish mass and energy balances in order to set up appropriate priorities for Cleaner Production measures. It is very important to consider this in the planning of both initial and permanent monitoring programs for the activity in focus. At least two levels of balances will have to be established:

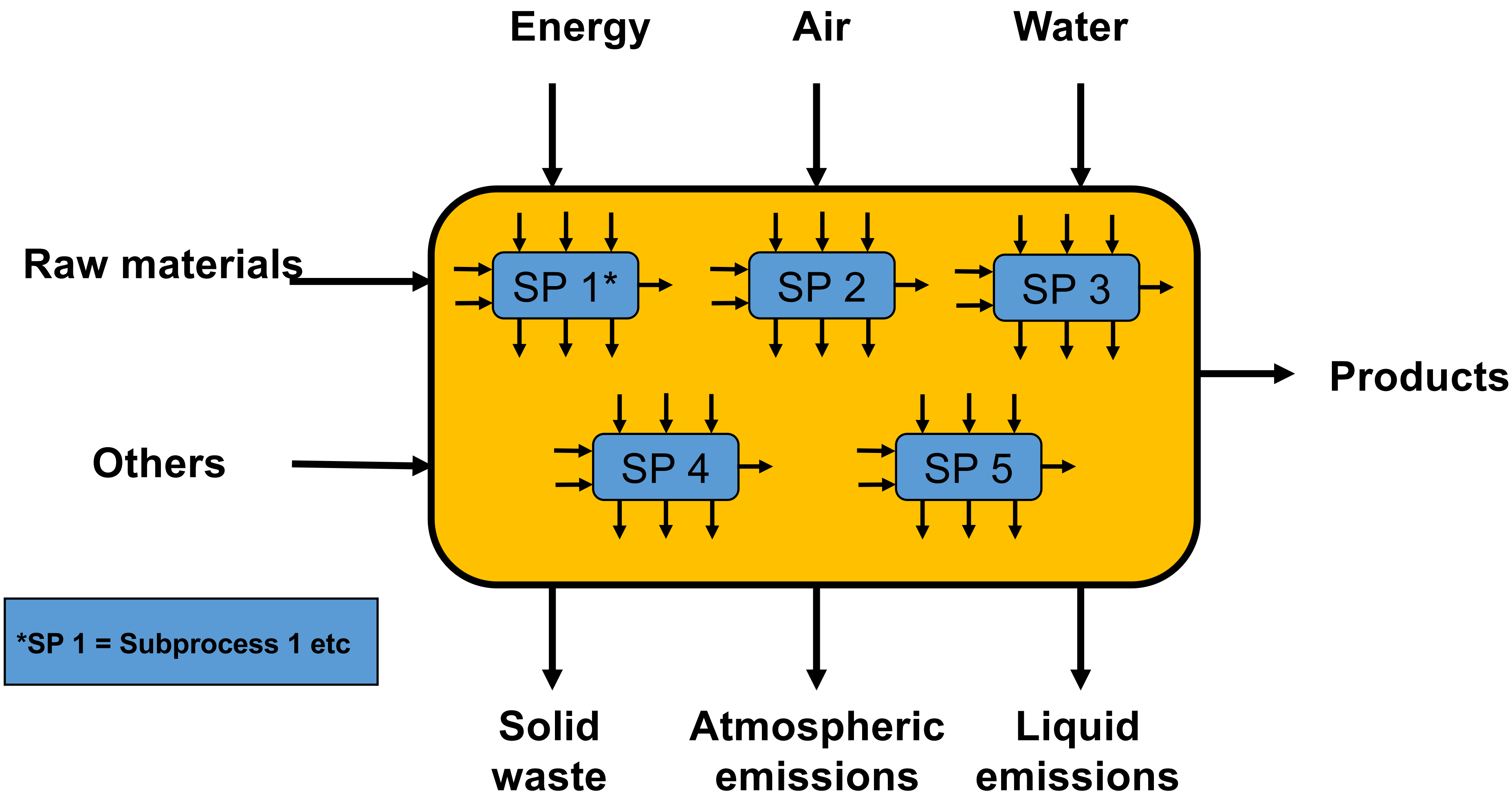
First step: **Balances for the entire process the factory**

Second step: **Balances for the most important sub processes**

Mass and energy balances – fundamental approach 1



Mass and energy balances – fundamental approach 2

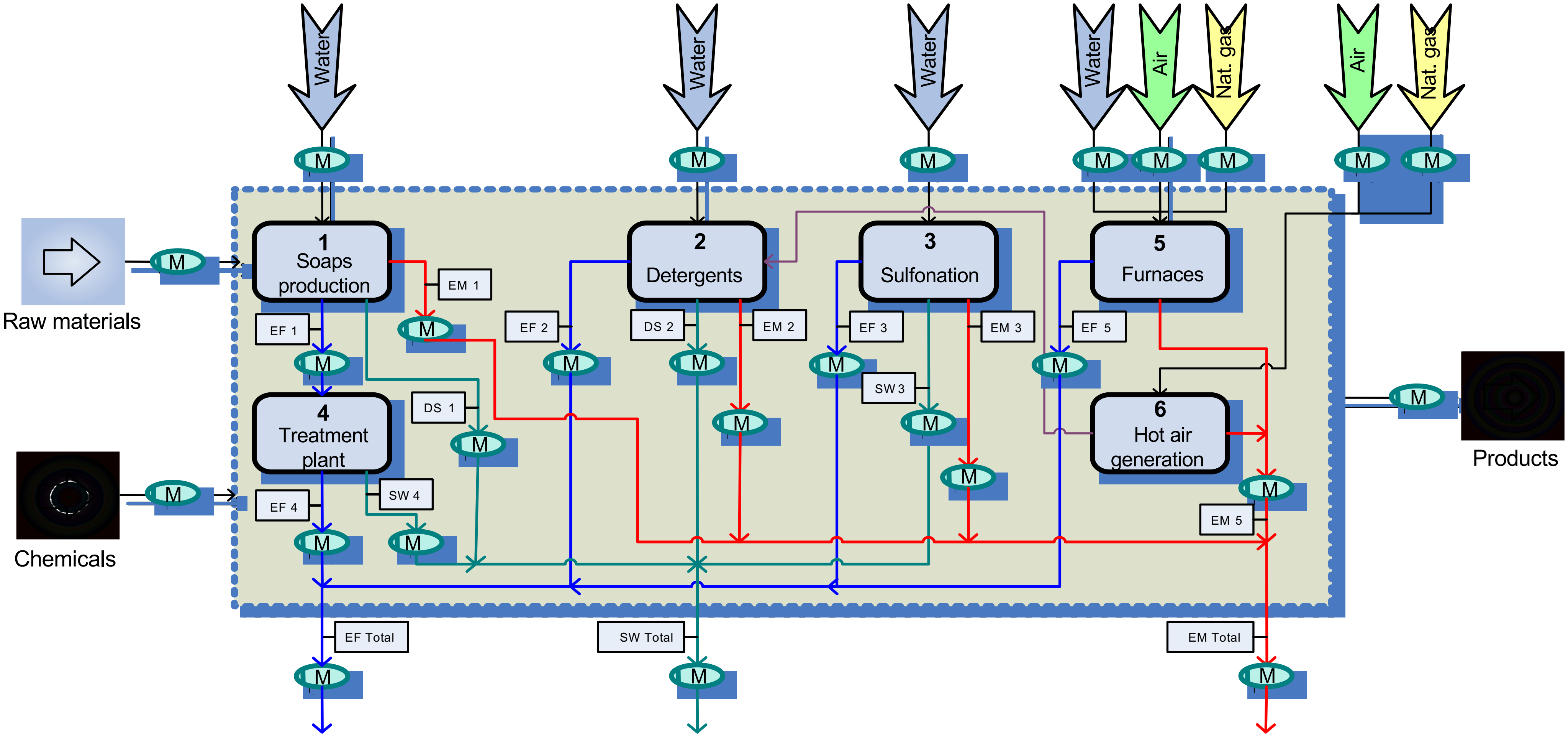


Cleaner Production Mass and Energy Balances Methodology

1. Aim of the study
2. System boundaries
3. Materials considered
4. Processes/subsystems included
5. Time span
6. Quantification of flows and stocks
7. Presentation of results
8. Conclusions from results

Example – Detergent factory

Code Description
EF = Effluents
SW= Solid wastes
EM = Atmospheric Emissions
M = Monitoring point



Examples of results from Cleaner Production Projects

Contribution from different measures and payback period

Product area	Metal working	Dairy products	Car components	Beverages	Paints	Fine Chemicals	Average, %
Good housekeeping, %	42	53	44	55	48	15	**43**
Source reduction, %	0	0	0	0	0	45	**8**
Process modification, %	0	26	36	13	30	0	**18**
Materials substitution, %	12	5	4	0	3	0	**4**
In-situ recycling, %	0	16	12	13	16	35	**15**
Off-site recycling, %	4	0	4	11	3	5	**5**
Product Modification, %	42	0	0	8	0	0	**8**
Payback time, yrs*	**1,0**	**0,3**	**3,2**	**6,2**	**0,43**	**8,0**	**3**

* Without interest

Source: www.un.org/esa/sustdev/sdissues/technology/cleanerproduction.pdf

Lead battery recycling in Cochabamba, Bolivia 2004

Lecture break discussion topics

1. What main conclusion can be drawn from the water withdrawal numbers presented for Uzbekistan, USA and Sweden?

2. Name three policies that could be identified to combat Uzbek water challenges?

Suggested reading on Cleaner Production

www.un.org/esa/sustdev/sdissues/technology/cleanerproduction.pdf

Thank you!

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