Sustainable SCM

Tools to put it in practice

Class lesson

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TOPICS COVERED

- A GENERAL OVERVIEW
- WHAT TRIGGERS THE LAUNCH OF A SUSTAINABILITY PROGRAM
- VISION AND LEADERSHIP TO MAKE THINGS HAPPEN
- THE CORPORATE SUSTAINABILITY MODEL
- THE SUSTAINABILITY PERFORMANCE MEASUREMENT SYSTEM
- RISK MGMT TOOLS (incl. Social, Political) – indirectly
- ***NPD (New Products)***
- ***LCA (Environment, Costs)***
- ***SUSTAINABLE SCOR (GRI, SCOR Improvement Program)***
- ***A SC driven CASE STUDY to develop in teams and discuss in Group***

SUPPLY CHAIN MGMT

- ***3BL – SOCIAL, ECONOMICAL, ENVIRONMENT***
- ***All Corporate Functions must operate synergically***

- ✓ <u>BACKGROUND: The Supply Chain Professional Role</u>
- ✓ Sustainability is a compelling and critical factor influencing our life and the one of future generations.
- ✓ It is a now a concern, as climate change is increasing and the Nature deterioration is visible (ex.ice melting, storms, species disappearing, etc)
- ✓ However we should consider sustainability as an opportunity to improve.

As future SC Professionals, your role will consist in capturing the <u>drivers</u> for sustainability, <u>measuring,</u> assessing and reducing the level of emissions from the operations, while <u>monitoring</u> the social and economic impact. Upgrading (and/or design) the processes toward zero emissions will result in an enormous opportunity for <u>Continuous Improvement</u>.

SUSTAINABILITY: a first definition

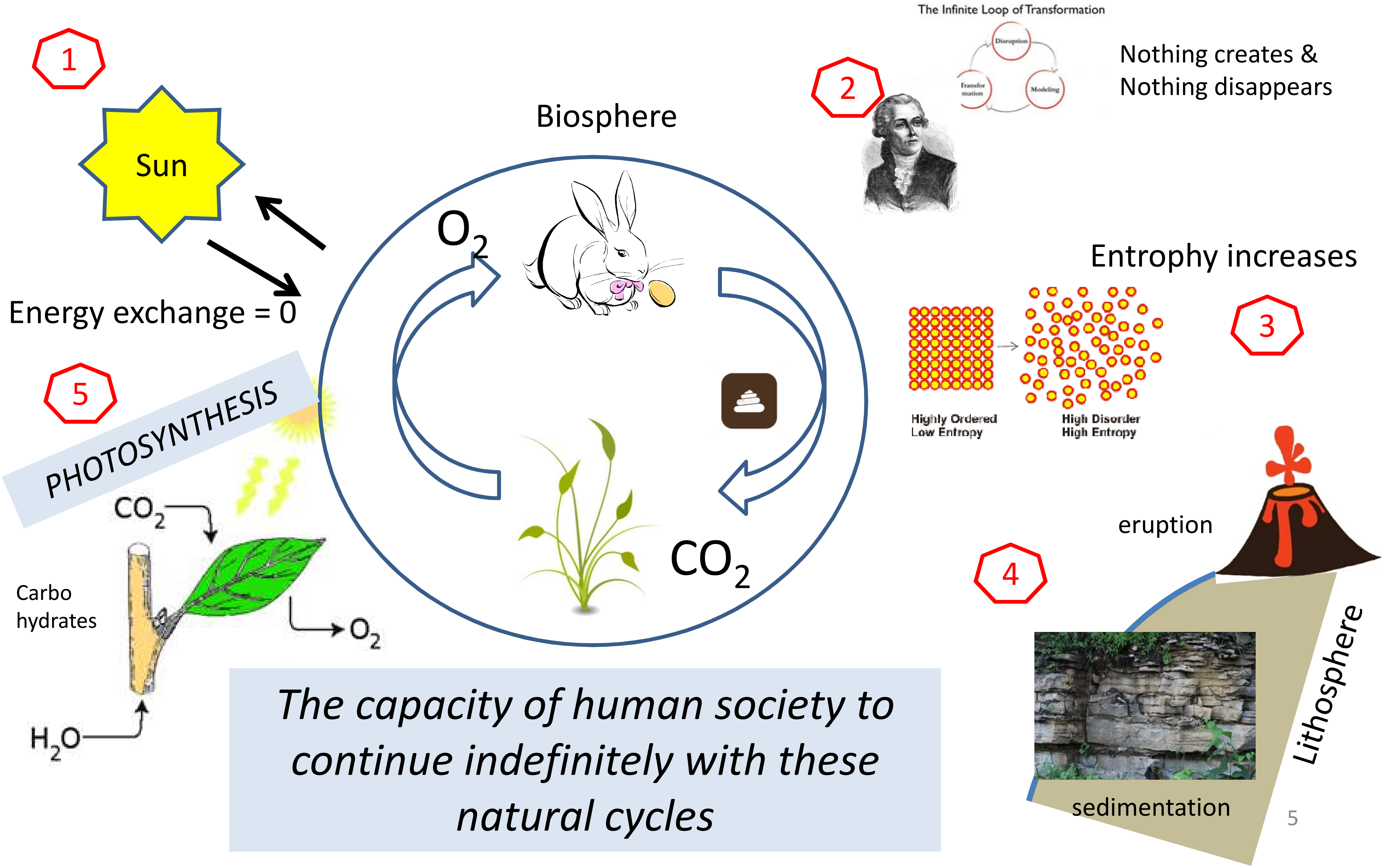
Sustainability is the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs.

Also a list of Principles about:

- Ethics
- Governance
- Transparency
- Business relationships
- Financial Return
- Communities involvement
- Value of products/Services
- Employment practices
- Environment protection

Adapted from Epstein and Roy – Improving Sust.Performance

SUSTAINABILITY: a second definition from the Natural Laws



Outcome: The SUSTAINABILITY 4 PRINCIPLES

With the objective of keeping the natural cycles up and running, in a Sustainable Society Nature is not subject to systematically increasing:

1. Concentrations of substances extracted from the Earth crust (oil, metals, creating degenaration)

2. Concentrations of substances produced by Society (and that Nature is not «familiar» with, as CFC)

3. Degradation by physical means (as deforestation reducing CO_2 absorption and O_2 generation)

4. Undermine the capacity of human beings to meet targets (example of precious metals on smartphones, gold in luxury undermining local communities in Africa and S.America)

Source:adapted from amcreative.org/

A case study: Whistler 2010 Winter Olympic Games

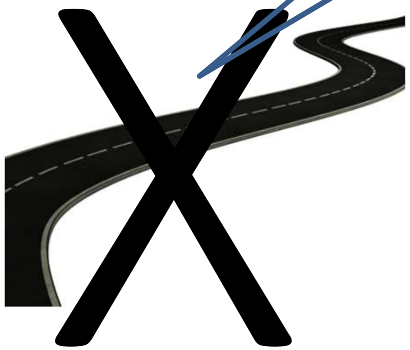
1. Propane not sufficient

2. Use natural resource CH_4

Setting the right direction
(creating the Vision)

3a. Avoid new roads Construction
(3rd condition)

Geo thermal as base energy supply



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3. Low pressure line and half capacity
(4th condition and ROI)

VISION 2020

- **Arts, Culture & heritage**
- Built environment
- Economic
- **Energy**
- Finance
- **health & social**
- learning
- **Materials & solid Waste**
- Natural Areas
- Partnership
- recreation & leisure
- resident Affordability
- resident housing
- Transportation
- **Visitor experience**
- **Water**

Sustainable Community:
- Primary needs
- Secondary needs
- Wish list
- Cultural needs
- Spiritual needs

ENERGY

The Energy Strategy is concerned with meeting Whistler's energy needs in an affordable, reliable and sustainable way, while managing air quality and greenhouse gas emissions and contributing to economic development. It focuses on energy supply and direct use related to the municipality's operations, the resort community, and to some degree, travel to and from Whistler.

SELECT RELATED INDICATORS

To track our performance toward, or away from, the Energy Description of Success, a number of indicators are monitored on an annual basis. Examples of related indicators are shown below. For complete indicator reports, including the most recent results and analysis, visit whistler2020.ca and go to Measuring Progress and Explorer.

- Renewable Energy
- Energy Use
- Renewable Fuel
- Greenhouse Gas Emissions
- Regional Air Quality

SELECT RELATED ACTIONS

Many Whistler organizations are taking action to make this vision a reality, including the municipality, businesses and other community organizations. To review actions that our community task forces have recommended or to find out about the status of these actions, visit whistler2020.ca and go to Actions.

DESCRIPTION OF SUCCESS

In 2020, Whistler's energy system is reliable, flexible and moving toward our sustainability objectives. By this time:

1. Whistler's energy system is supplied by a mix of sources that are local and regional wherever possible.

2. Whistler's energy system maximizes economic opportunities within the energy sector, and optimizes a balance between increasing energy efficiency and generating new supply.

3. The energy system is continuously moving towards a state whereby a build up of emissions and waste into air, land and water is eliminated.

4. The energy system is continuously moving towards a state whereby the net physical impact to land and water ecosystems is eliminated.

5. Community energy needs are met reliably and equitably.

6. Whistler's energy system is transitioning to renewable energy sources.

7. Energy is generated, distributed, and used efficiently, through market transformation, design, and appropriate end uses.

8. Residents, businesses and visitors understand energy issues.

9. Whistler's actions will positively influence other communities' and stakeholders' movement toward sustainability.

General observations on the quantitative approach:

- *SCM is overall a measurable and quantifiable discipline.*

- *SC's processes are key enablers to the physical product transformation, information and money flows, with a critical impact for any company/organization life and business.*

- *A major contribution to the results from the SC function/role is to consolidate ideas and plans into measurable actions.*
  - *Daily mgmt operations (run production activities, calibrate the resources use/mgmt, etc)*
  - *Ethical (influence Sustainable Procurement, Industrialization of sustainable products, take care of the complete Life Cycle of products – cradle to cradle, Circular Economy/Reverse Logistics)*

LEARNING OBJECTIVES:

Starting from an overall review of the Sustainability drivers, you will focus on:

1. How to define the scope and boundaries of a sustainability improvement program – the Corporate Sustainability Model for an enterprise/organization

2. How to identify, evaluate, measure and improve different potential impacts (materials, energy and wastes) associated to each one of the stages of the life cycle of a product – LCA and Sustainable SCOR will be introduced

3. How to implement an improvement program by practicing a simpified case study, working in team. You are expected to present your final case study to the extended group.

Supply Chain Sustainability in practice
Agenda

1. **Sustainability: do we need a trigger to start taking action in depth?** examples:
   - Fairtrade in South America; big Corporations as Walmart
   - The EOD - Earth Overshoot Day
2. Cultural and Managerial direction setting to make things happen
3. Sustainability Model structure:
   - convergence of Social, Environmental and Economic factors
   - Kpi's and ROI
4. The SC Manager focus on Emissions and NPD while monitoring the external social and political factors
5. LCA – Life Cycle Assessment: a methodology to measure and improve the Sustainable Supply Chain:
   - Sustainable SCOR – an holistic methodology for environmental impact accounting
   - ISO 14000 stds, GRI, Sustainable SCOR framework
6. Case study: work together to get a «feeling» on how to influence results

A TRIGGER? Fair Trade and Labor conditions
No conflict Minerals – South America – Central Africa

As a reflection of the Dodd Frank Act section 1502 – DRC and adjoining countries

EXAMPLE: The Pallaqueras of Nueva Esperanza, is an association gathering 60 women, sorting and collecting the wastes from Sotrami's mine to get additional revenues. They earn less than 2 euros / day for this part time job which is quite tough. They would now like to diversify their activities with sewing and cooking activities.

A TRIGGER? Fair Trade and Labor conditions
No conflict Metals – South America – Central Africa

Legal formalities and control

Visibility and activities records

Human and labor conditions respected

A TRIGGER? Fair Trade and Labor conditions
No conflict Metals – South America – Central Africa

RISK ANALYSIS

just examples .....

risk area		probability level	Impact level	Severity total	root cause	CONTROL	MITIGATE	REDUCE	ELIMINATE
ASM challenging conditions (economic; support; length)		3	4	12	lack of governance and control	Formalize strong agreements	Perform regular audits + actions		
Conflicting interests at ASM's (different clients)		2	2	4	Lack of adequate economic agreements	Formalize strong agreements		Certify a larger number of ASM's	
Criminal organisations		2	3	6	Local Government control		Agreements with local authorities		
Unsufficient compliance with stds		3	3	9	Missing or unsufficient rating rules	Define clear stds rating/evaluation tailored to requirements		Implement corrective action toward stds	
Economy downtum altering global conditions		3	2	6	n.a.		Dedicate emergency and provisions funds		
Gold price fluctuations		2	3	6	n.a.		Economics structure (premium) based on (example) + 120% of actual gold price		

Major activities to be established:

- Auditing system as a process to constantly monitor project performance against standards. Provide real time visibilityto stakeholders.
- Monitor/mesure and compare the financial, social, economic conditions of ASM's against stds and improvement/achievement plans.
- Implement comprehensive correcive actions
- Strong partnership with expert organisations (ARM) and collaboration with ASM's
- Incremental supply capacity network (different mines and/or regions)
- Create a own B2B model to gain contractual power and stability of performance

Figures are for illustration only

A TRIGGER?

Allocation of metal mining. Fair share according to labor conditions at different mining sites.

		Prix		Prix	Marge GbG	Prix	Montant Prime	Prix	Fee ARM	**PRIX**	**PRIMES**
	Quantity (kg)	L-1.5%		L + 3%	4.50%	L+8%	5%	L+10 %	2%		
2013	**1**	45310		47380	2070	49680	2300	50600	920		
	50	2265500		2369000	103500	2484000	115000	**2530000**	46000	**2530000**	**161000**
										2300000	
										230000	
											391,000

		Lima		Paris		Premium		ARM		TOTAL	
		Prix		Prix	Marge GbG	Prix	Montant Prime	Prix	Fee ARM	**PRIX**	**PRIMES**
	Quantity (kg)	L-1.5%		L + 2.5%	4%	L+6.5%	4%	L+8%	1.50%		
2014	**300**	13593000		14145000	552000	14697000	552000	**14904000**	207000	**14904000**	**759000**
										13800000	
										1104000	
											1,863,000

		Lima		Paris		Premium		ARM		TOTAL	
		Prix		Prix	Marge GbG	Prix	Montant Prime	Prix	Fee ARM	**PRIX**	**PRIMES**
	Quantity (kg)	L-1.5%		L + 2%	3.50%	L+4.5%	3%	L+L+5.5%	1%		
2015	**1000**	4531000		46920000	1610000	48070000	1380000	**48530000**	460000	**48530000**	**1840000**
										46000000	
										2530000	
											4,370,000

Figures are for illustration only

A TRIGGER?
1 - The WALMART case

Reputation issue as claimed by final Stakeholders and Customers

WALMART Sales Strategy: Low Cost – offering discounted products to consumers

Criticisism from the community:

- Paying employees lower than a living wage
- Challenge by activists regarding Sourcing of products + labor impact on employees in foreign countries – Reputation
- Refrain from allowing Walmart to enter some neighborhood

Environmental FOOTPRINT:

- Larger electricity US user
- Largest fleet of trucks
- 60,000 suppliers subject to potential impact

WALMART BUSINESS CASE

WALMART **reputation** and **credibility** got attacked.

ACTIONS:

- Reduce Solid Waste by 25% / 3 yrs
- Energy at Stores – 30%
- Fleet efficiency doubling in 10 yrs
- Expand the offer of Organic food

WALMART BUSINESS CASE: sustainability strategy

A specific plan was developed to guarantee sustainable fish sourcing to customers

- October 2005 – Wal-Mart announced the launch of a business sustainability strategy
- Three **goals**:
  - 100% supplied by renewable energy
  - Create zero waste
  - Sell products that sustain resources and environment

- **Objective**: differentiate itself from competition, maintain a license to grow and remain consistent to its commitment to serving customers through everyday low prices.

Source: adapted by Darpa, Anna et al

WALMART BUSINESS CASE: MSC Program

- MSC Program was started by Unilever and World Wildlife Fund in 1997.
- Provided certification standards based on a code of conduct for responsible fishing
- MSC-accredited certifying agencies audited fishery and processor compliance to ensure products were managed sustainably from boat to plate
- On average, certification took 1-2 years to complete

MSC – Marine Stewardship Council

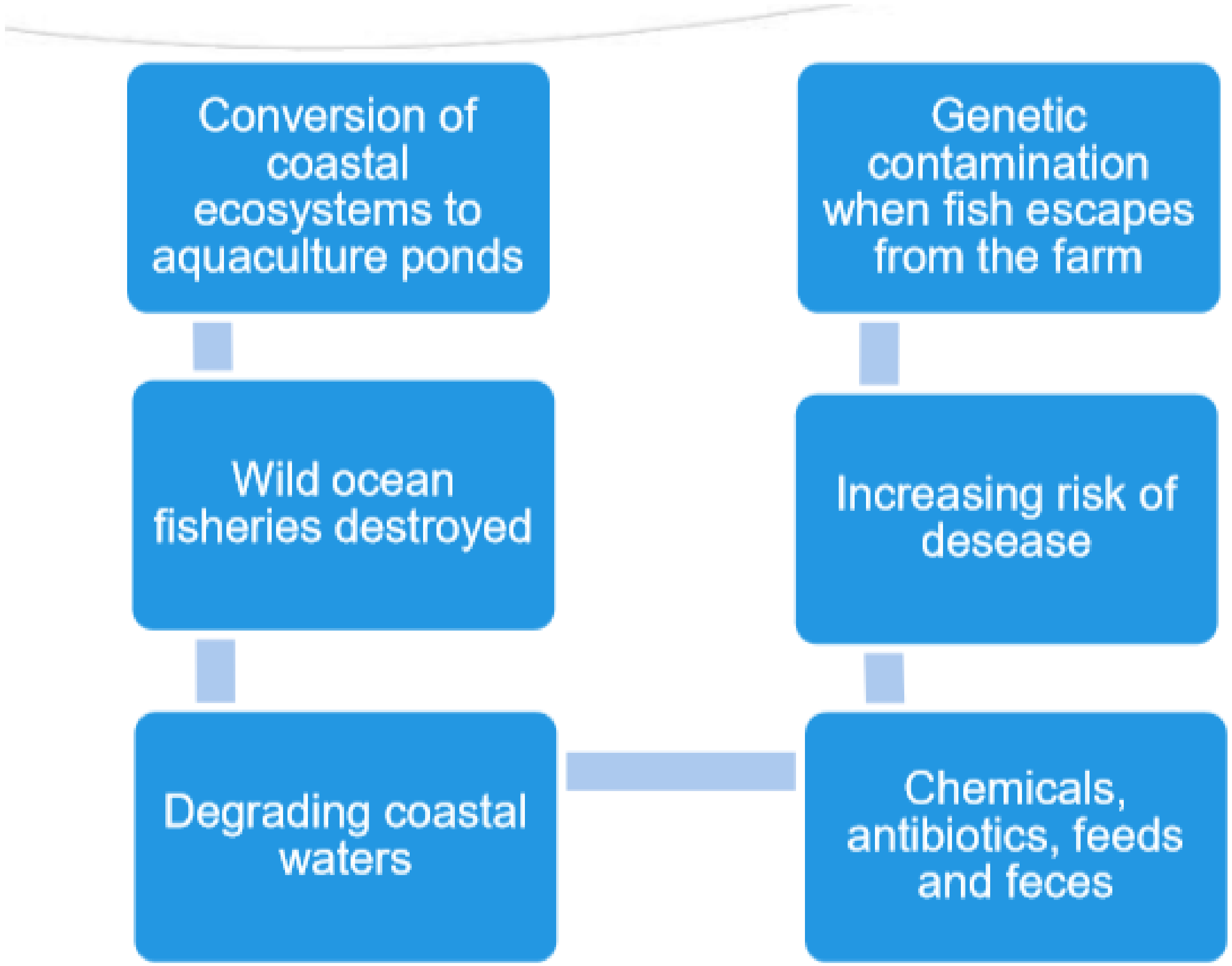
Source: adapted by Darpa, Anna et al

WALMART BUSINESS CASE: the need for the certification (MSC)

- All species of wild seafood are expected to collapse within the next 50 years.
- Fishing became an inefficient industry in terms of fuel use, approx. 13 billions gallons or 1.2% of global oil consumption.
- Increasing % of seafood supply is farm raised, which contains less nutrients and carry increased heath risks due to antibiotics and other chemicals

Source: adapted by Darpa, Anna et al

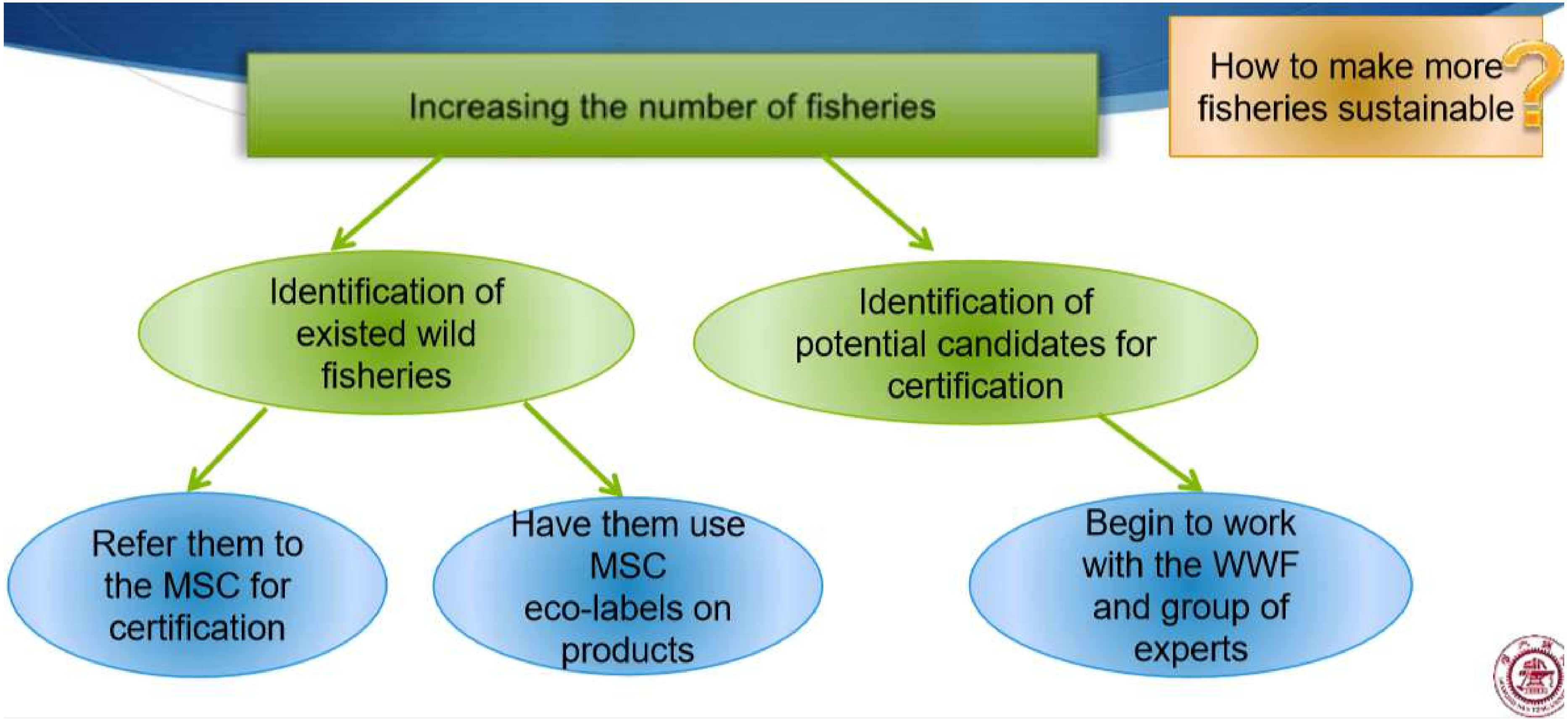
WALMART BUSINESS CASE: raising public Awareness



Source: adapted by Darpa, Anna et al

WALMART BUSINESS CASE: Implementation

Collaborate with MSC and WWF



Source: adapted by Darpa, Anna et al

WALMART BUSINESS CASE: Costs

- From 15k-120k USD
- 0.03$ per pound of fish
- Some fisheries had to reduce their catch
- Lengthy procedure

- Steps to become certified:
  - Pre-Assessment
  - Full Assessment (avg. 12 months)
  - Certification
  - Annual Audits
  - Reassessment

Source: adapted by Darpa, Anna et al

WALMART BUSINESS CASE: Benefits

- Better transparency
- Better suppliers
- Simplified Chain of Custody
- Improved environmental outcomes
- More visibility for suppliers, through Wal-Mart
- Reduced cost of production

WALMART BUSINESS CASE: recent Update

- More than 95% of Walmart U.S., Sam's Club and Asda's (U.K.) fresh and frozen, farmed and wild seafood had earned MSC by the end of 2012.
- Walmart seafood business is growing at a rate of 30% every year after 2012.
- Supply shortage because of expensive procedure.
- Collaboration with the WWF as an alternative to provide consulting for boat operators.

WWF

A sustainable business proves to become more profitable

MARINE STEWARDSHIP COUNCIL

Source: adapted by Darpa, Anna et al

WALMART BUSINESS CASE: important developments

Walmart has undertaken major sustainability projects

Project Gigaton is a Walmart initiative to avoid one billion metric tons (a gigaton) of greenhouse gases from the global value chain by 2030

Suppliers get recognized for their effort to work through sustainability actions:

- Energy
- Waste
- Packaging
- Agriculture
- Forest protection
- Product design/use

A TRIGGER ?
2 - A HIGHLY COMPELLING FACTOR:
THE EARTH «OVERSHOOT DAY» (EOD)

Earth Overshoot Day (EOD) is the calculated illustrative calendar date on which humanity's resource consumption for the year exceeds Earth's capacity to regenerate those resources that year.

Earth Overshoot Day is calculated by dividing the world Bio Capacity (the amount of natural resources generated by Earth that year), by the world ecological footprint (humanity's consumption of Earth's natural resources for that year), and multiplying by 365 (the number of days in one Gregorian common calendar year):

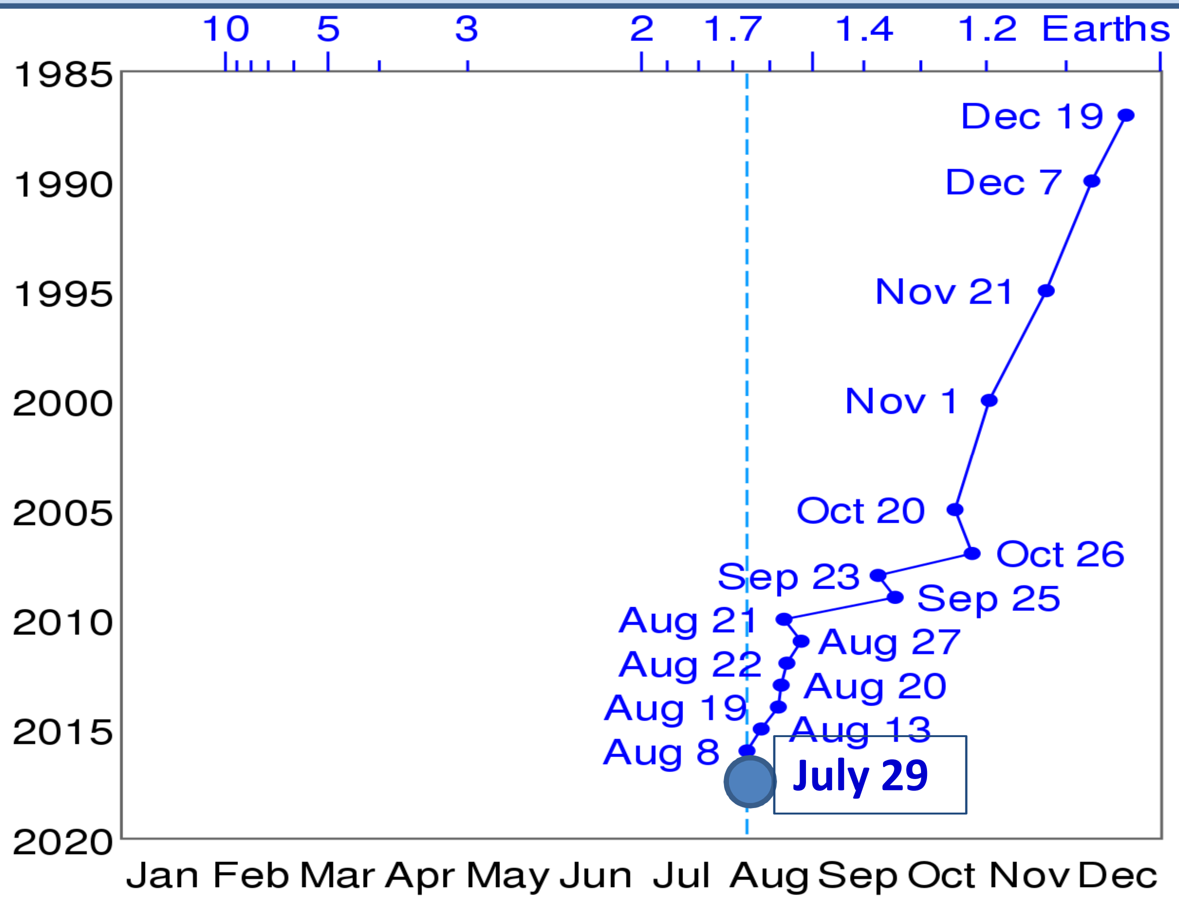
B I O = yearly BioCapacity of the Hearth
H E F = Humanity Ecological Footprint

E O D = B I O / H E F × 365

Now creating large consensus and large new attitudes

Source: Wikipedia

EARTH OVERSHOOT DAY: Evolution

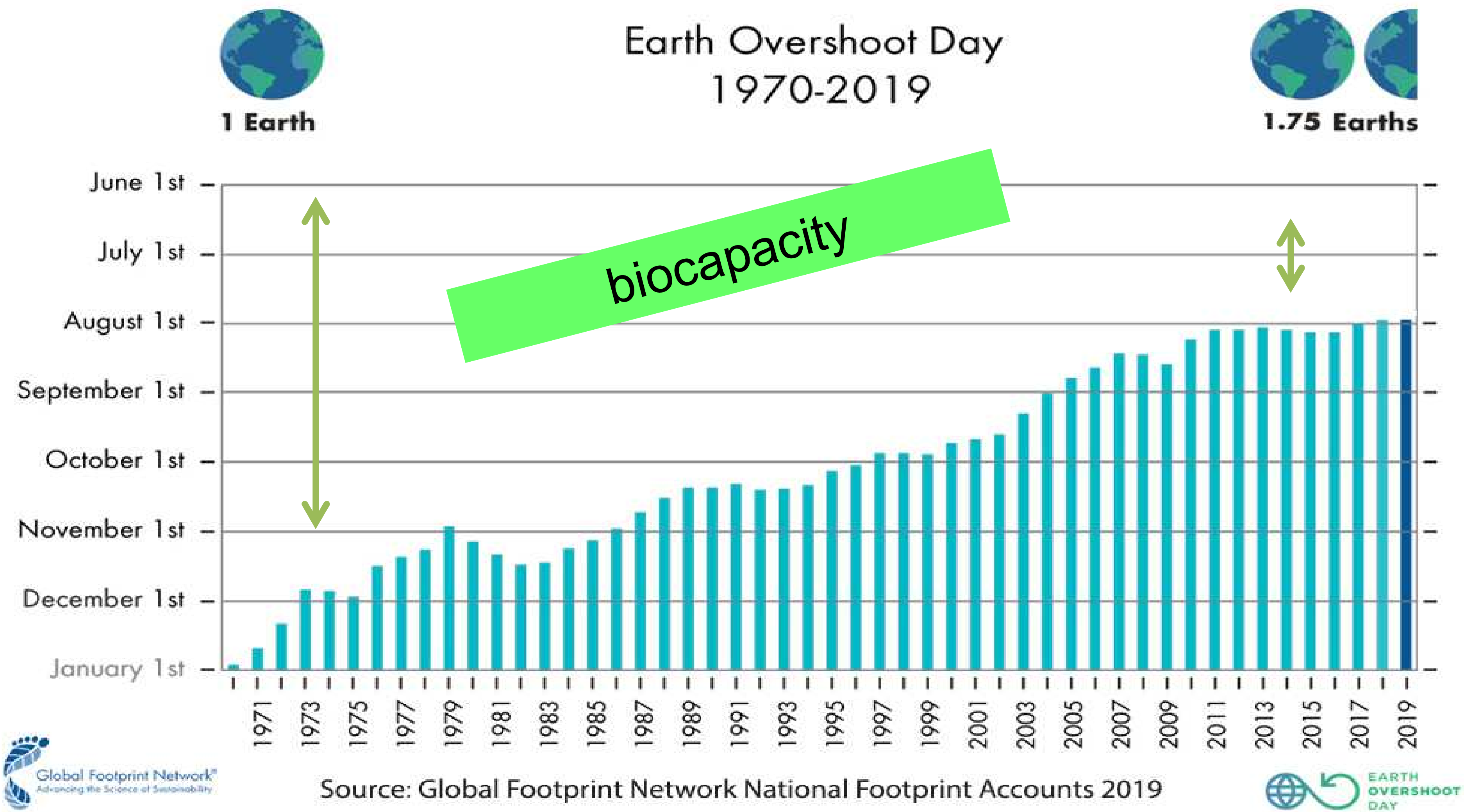


2019
JULY 29th !

Just in 1985 the EOD was at the year end, allowing the Earth to regenerate. In **2019** it has been on **July 29th**, at fast acceleration

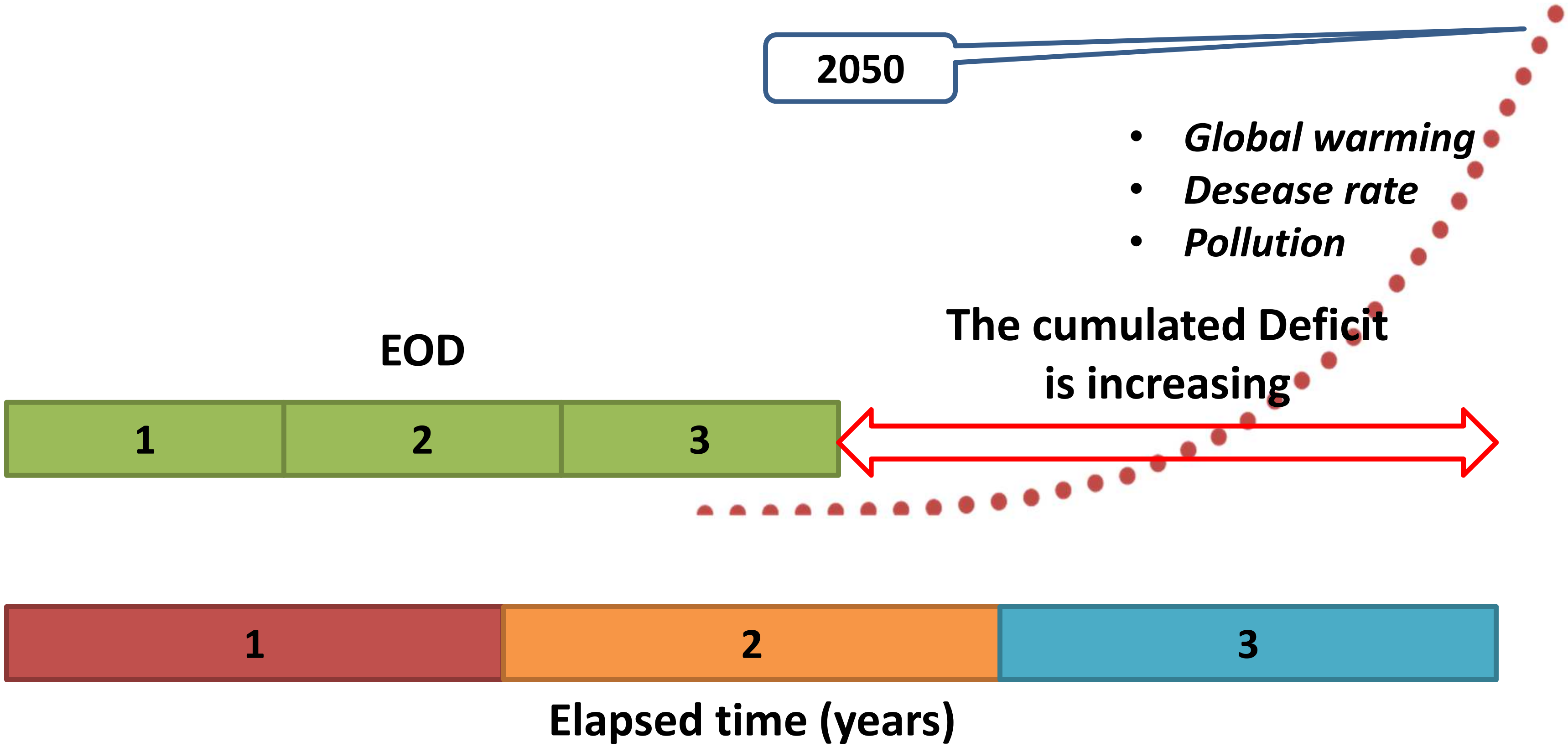
EARTH OVERSHOOT DAY

OVERSHOOT DAY: Evolution

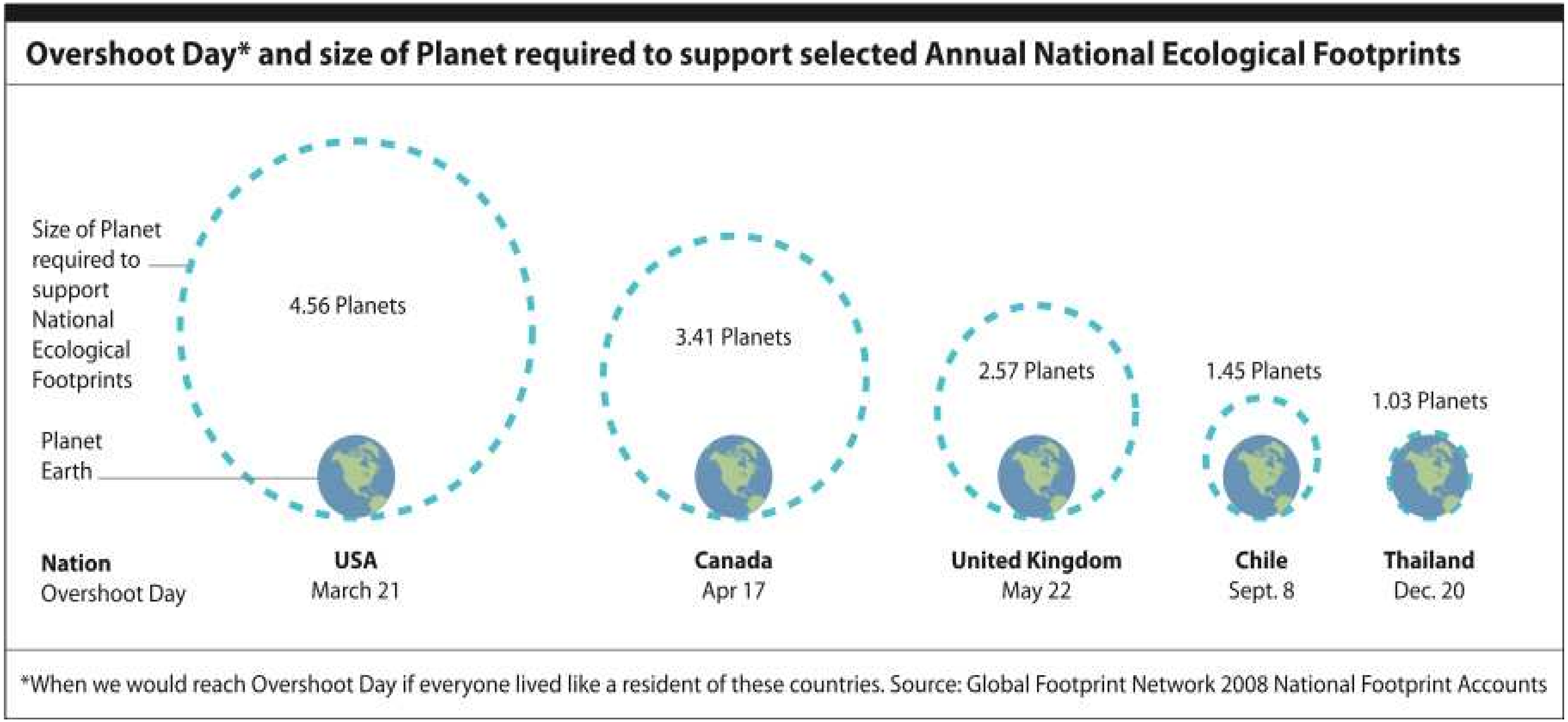


OVERSHOOT DAY

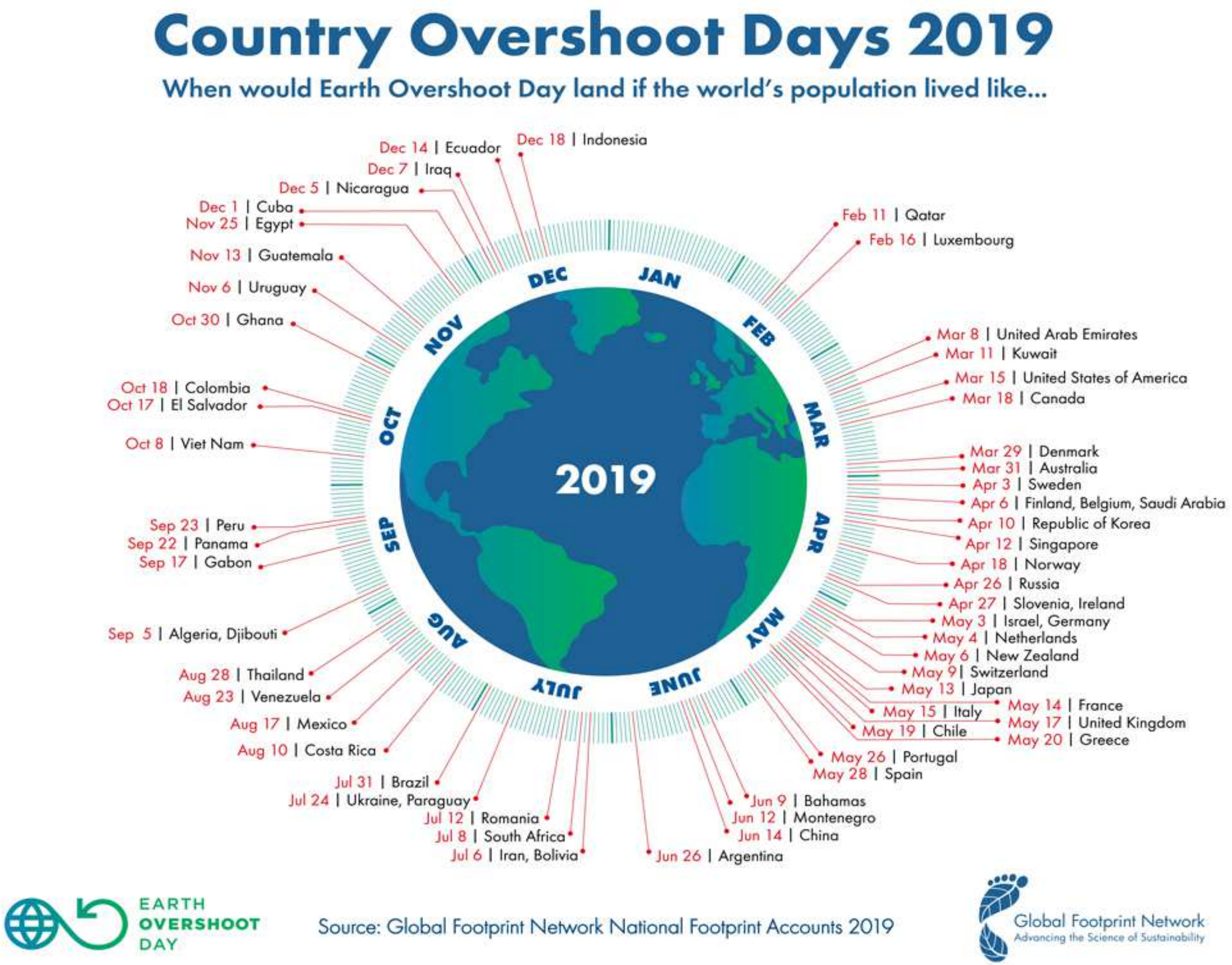
The natural resources get depleted, currently mid of the year and the phenomenon accumulates year on year, if no action



OVERSHOOT DAY: a Countries comparison



OVERSHOOT DAY: WW Countries contribution



- UAE March 8
- USA March 15
- China June 14
- Vietnam Oct.8
- Europe Apr./May

However the Globe
Is only One

Supply Chain Sustainability in practice
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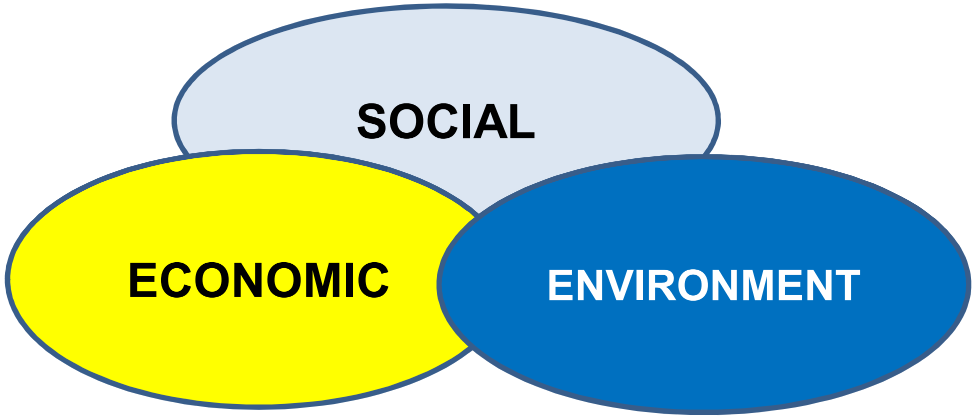
6. Case study: work together to get a «feeling» on how to influence results

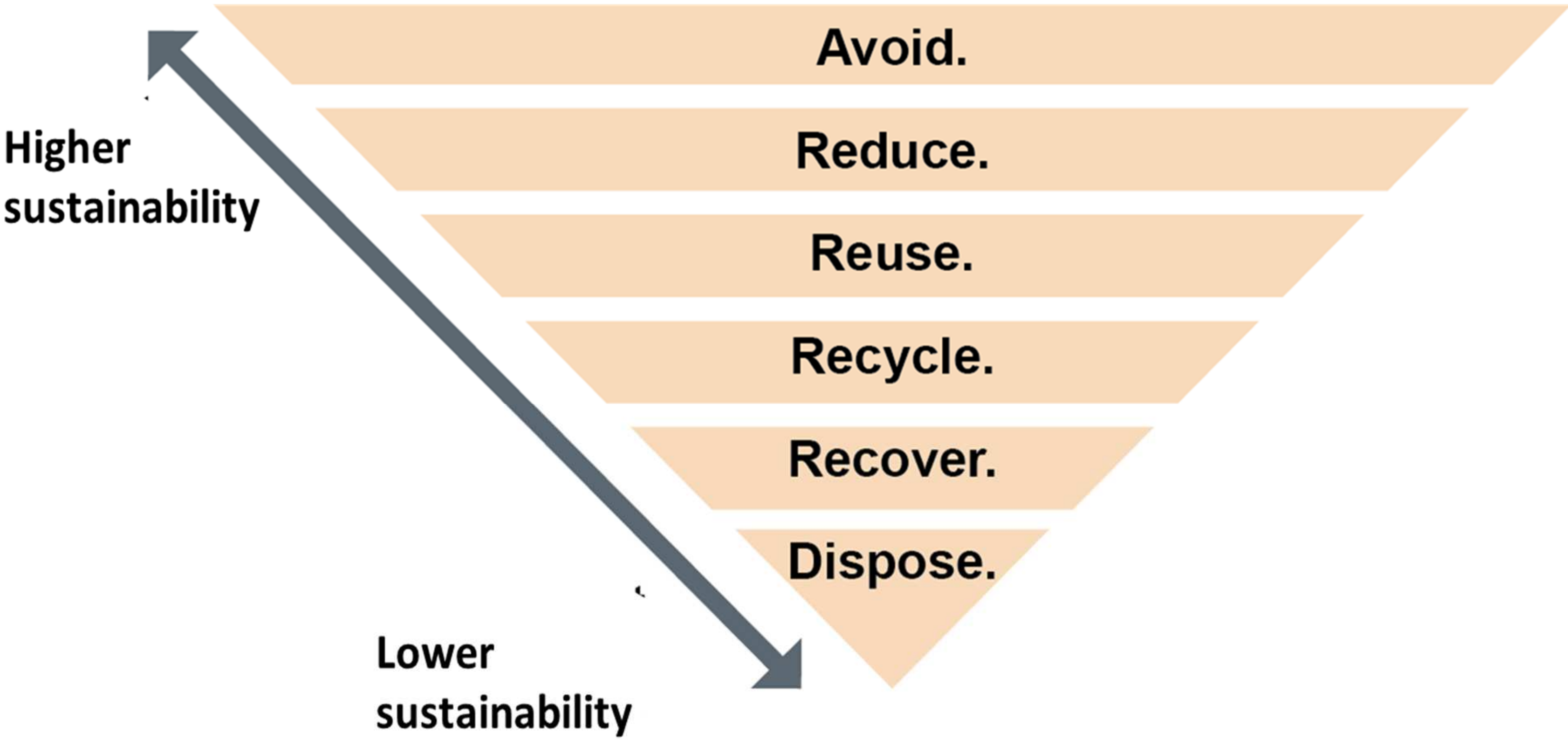
Manage the CORPORATE SUSTAINABILITY

- IT'S A TRADE OFF AMONG 3 FACTORS: **ECONOMIC, ENVIRONMENTAL AND SOCIAL – 3BL (Triple Bottom Line)**
- TRADITIONAL BUSINESS GO STRAIGHT TO PROFITS – P&L BL



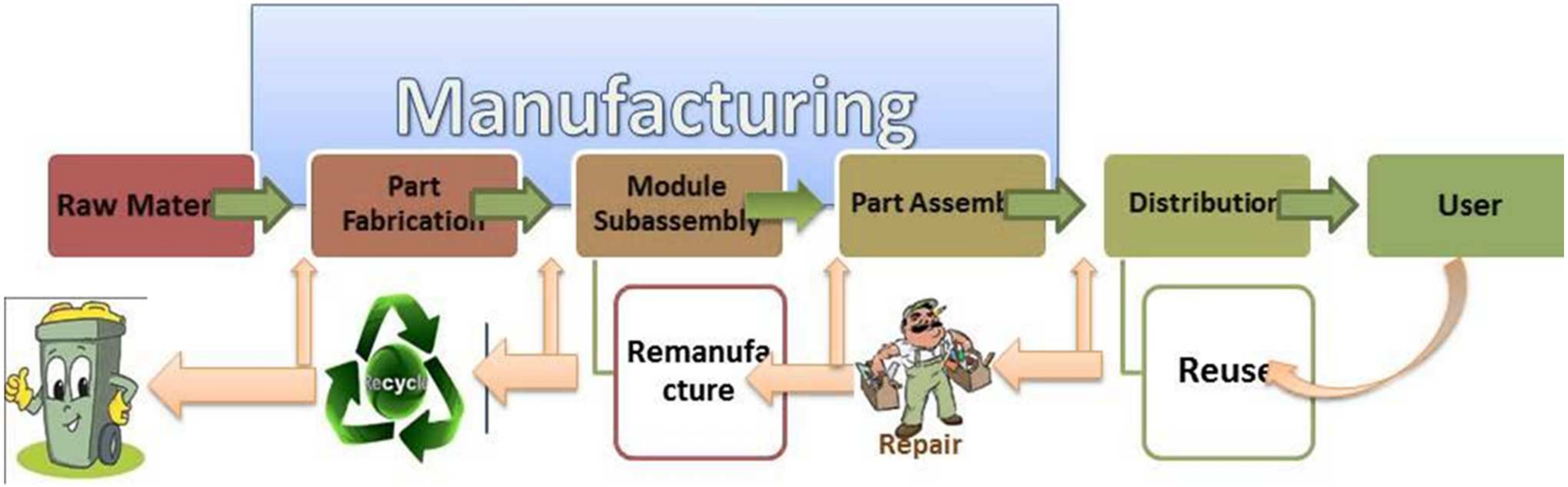
- LINKING THE THREE CAPABILITIES REQUIRES **TRADE OFF'S** among Stakeholders, **LONG implementation LEADTIMES** TO GET BENEFITS
- THE **SHAREHOLDERS REACTION** sometimes IS NOT WELL KNOWN
- THE COST OF IMPLEMENTING INITIATIVES CHANGE AND THE **ROI IS CHALLENGED**

The Circular Economy and the Waste Hierarchy



CIRCULAR ECONOMY and REVERSE LOGISTICS

A complete supply chain dedicated to the reverse flow of products and materials for the purpose of returns, repairs, remanufacture, and/or recycling. It is often different from the Forward Supply Chain



Some SUSTAINABILITY drivers

REGULATIONS:

Non Compliance Costs

- Penalties/fines
- Legal costs
- Lost productivity
- Potential operations closure
- Effects on Corporate reputation

COMMUNITY RELATIONS

Good performance means positive reputation and fostering relations (NGO, Stakeholders)

SOCIAL/MORAL OBLIGATIONS

The effect on Environment and Society create commitment and sense of urgency

COST & REVENUES IMPERATIVES

Enhance Revenues (by higher reputation) and lower costs (efficiency)

LEADERSHIP

Identify, measuring and reporting social and environmental impacts cannot begin until the CEO and the Board are committed to improved sustainability.

VISION: must be created and communicated in the whole organisation

LEADERSHIP: Mgmt must exercise it constantly both «soft» - culture, passion, commitment and «hard» – compensation, incentives, performance evaluation/salary

STRATEGY: incorporate investments, plans and budgets into medium-long term business plans. Covers:
a) Regulatory (ISO, SA8000, UN GC, etc); b) Gain competive advantage (gain efficiency, reputation); c) Integrate the 3 BL (product design, reduce waste, investments)

A succesfull plan requires «day by day» activities, constant tracking, monitoring and adaptation to changes – external and internal

VISION, VALUES AND CODE OF CONDUCT
(example of Fujitsu Group)

Corporate Vision

Through our constant pursuit of innovation, the Fujitsu Group aims to contribute to the creation of a networked society that is rewarding and secure, bringing about a prosperous future that fulfills the dreams of people throughout the world.

Corporate Values

What we strive for:

Society and Environment	In all our actions, we protect the environment and contribute to society.
Profit and Growth	We strive to meet the expectations of customers, employees and shareholders.
Shareholders and Investors	We seek to continuously increase our corporate value.
Global Perspective	We think and act from a global perspective.

What we value:

Employees	We respect diversity and support individual growth.
Customers	We seek to be their valued and trusted partner.
Business Partners	We build mutually beneficial relationships.
Technology	We seek to create new value through innovation.
Quality	We enhance the reputation of our customers and the reliability of social infrastructure.

Principles

Global Citizenship	We act as good global citizens, attuned to the needs of society and the environment.
Customer-Centric Perspective	We think from the customer's perspective and act with sincerity.
Firsthand Understanding	We act based on a firsthand understanding of the actual situation.
Spirit of Challenge	We strive to achieve our highest goals.
Speed and Agility	We act flexibly and promptly to achieve our objectives.
Teamwork	We share common objectives across organizations, work as a team and act as responsible members of the team.

Code of Conduct

- We respect human rights.
- We comply with all laws and regulations.
- We act with fairness in our business dealings.
- We protect and respect intellectual property.
- We maintain confidentiality.
- We do not use our position in our organization for personal gain.

In evidence:

INNOVATION
ENVIRONMENT
EMPLOYEES
BUSINESS PARTNERS
CITIZENSHIP
HUMAN RIGHTS

VISION, VALUES AND CODE OF CONDUCT

H.Schultz – Starbucks We've always believed that leadership companies must set higher stds on how business is done. And we want to assure we remain committed to our values and business….while honoring contributions of the farmers and our people who make our success possible

R.Walton – Walmart We have a responsibility and an opportunity to improve the quality of life in every community we serve. Our efforts, some of which are already in place, are designed to help conserve and sustain the natural resources of our planet in the future, as well as save money for the Company and ultimately our Customers.

A.Jacobs - BP The Board believes that our org. is now better placed to develop our business for the future… At the heart of those challenges is the need to find and develop the resources to meet the growth of global demand. We will also need to produce those resources in a way that minimizes the effect on the environment.

Triple Bottom Line

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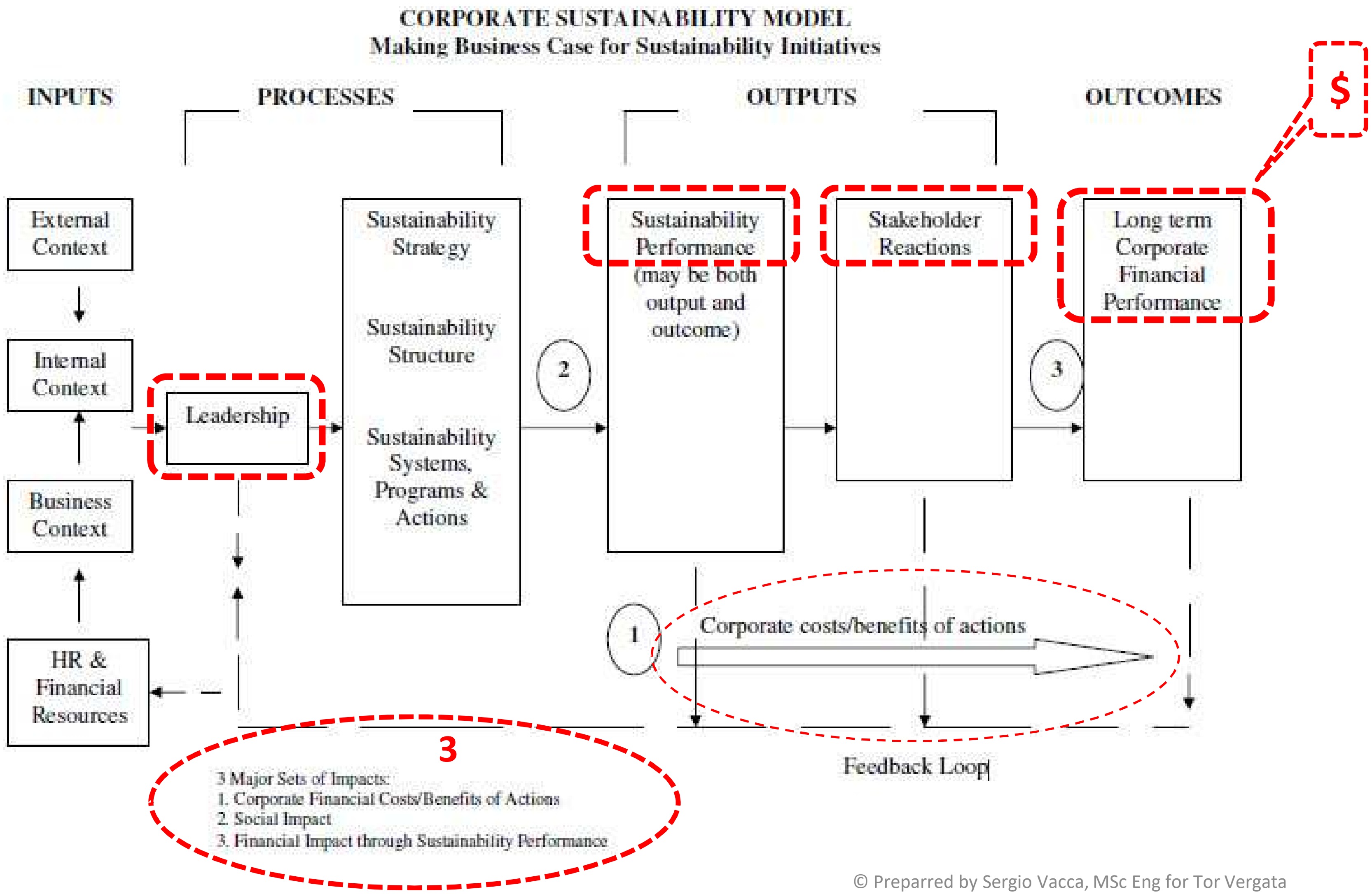
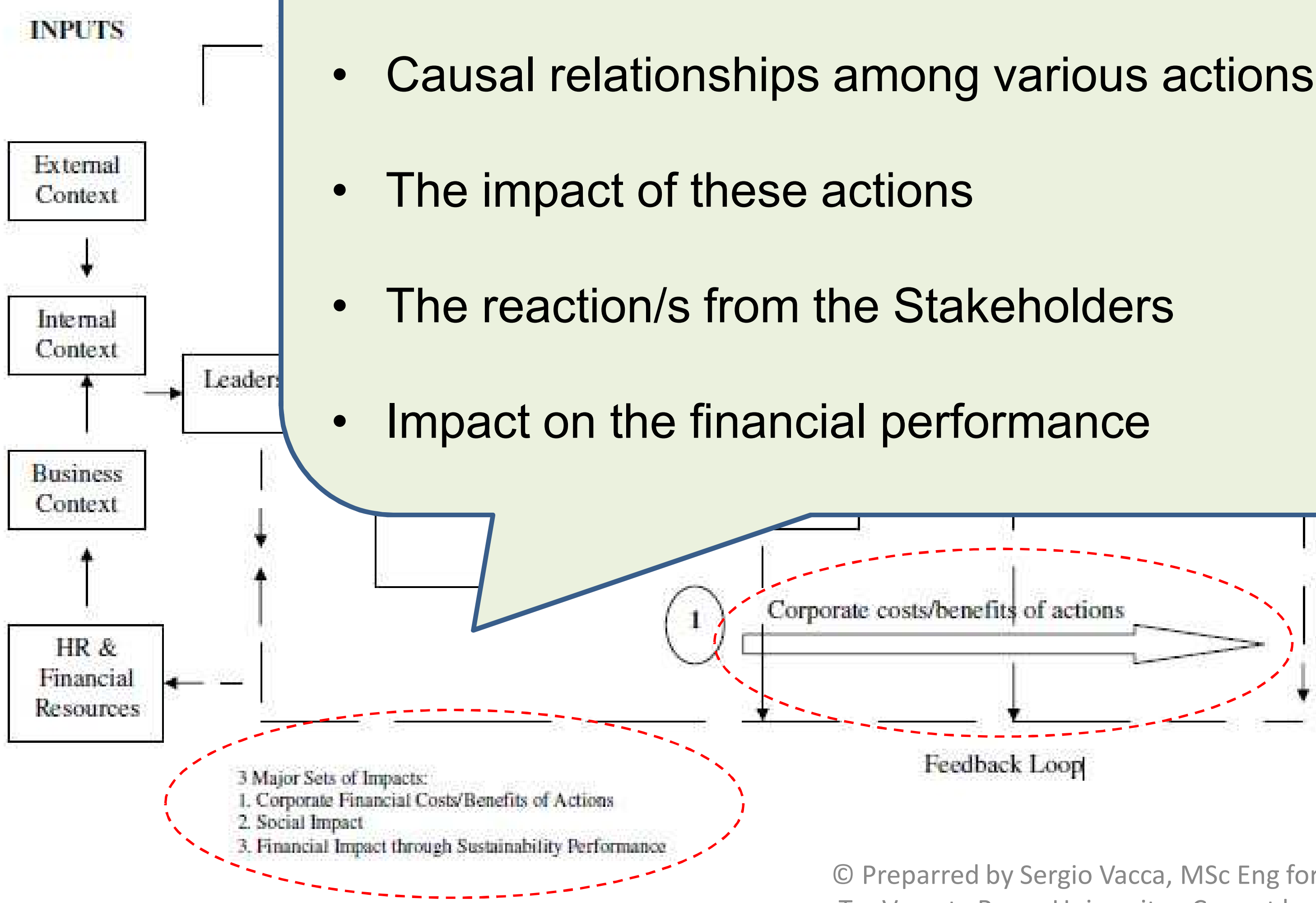
SUSTAINABILITY MODEL



Source: Marc.J.Epstein

SUSTAINABILITY MODEL

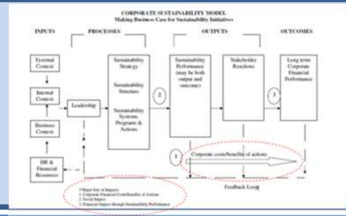


Managers need to understand:

- Causal relationships among various actions
- The impact of these actions
- The reaction/s from the Stakeholders
- Impact on the financial performance

Source: Marc.J.Epstein

SUSTAINABILITY MODEL



INPUTS

<u>External Context</u>: Government regulations, pollution stds, regulatory, employment rules, culture in the Marketplace encouraging/disencouraging sustainability

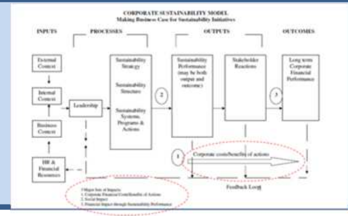
<u>Internal Context</u>: BU missions, strategies, structures, systems. By these the company impacts onto human rights, employees and environment

<u>Business Context</u>: business sector, products, customers. Risks vary depending on Brand exposure (consumer goods), big impact (oil companies), natural resources (fish, food, wood), regulatory (automotive emissions, electronics WEEE, etc).

Subject to pressures as labor practices, environment. Code of Conduct should respond to such pressures.

<u>Human and financial resources</u>; are relevanto to the available and needed resources as well as trained and educated professionals

SUSTAINABILITY MODEL



PROCESSES

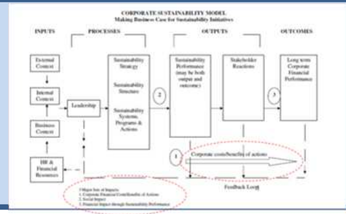
Leadership: show commitment from the top, scan business environment to prevent risks and catch opportunities, lead the change. Create ad hoc commitees.

Strategy: develop and act following a mission statement, consider regulations and impact of social investors

Structure; integrated throughout the organisation, effective use of human resources, manager access to top mgmt, alignment

Systems, Programs and Actions: costing/capital investment systems, risk mgmt, performance evaluation/reward, measurement and metrics system, feedback, reporting/auditing and verification. Adopt ISO 14001 EMS

SUSTAINABILITY MODEL



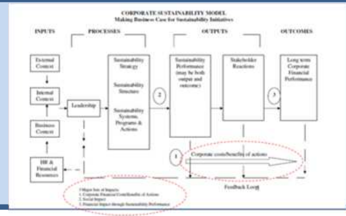
OUTPUTS

<u>Performance</u>: must be related to the Triple Bottom Line, however Social and Environment (child labor, emissions, packaging, etc) can be more or less linked to profits. When related, it become a business case. *<u>As SC professional the focus stays with the process monitoring and reduction of emissions first, in full compliance with the social and economic aspect, expecially towards Suppliers (responsible Procurement).</u>*

<u>Stakeholders</u>: are critical as they determine the financial performance through their reactions.

- Customers: loyalty and long term purchasing
- Employees: service, reliability
- Shareholders: capital investment, towards ethics

SUSTAINABILITY MODEL



OUTCOMES

<u>Financial Performance</u>: it is often recognized as the driver for success of the sustainability initiatives.

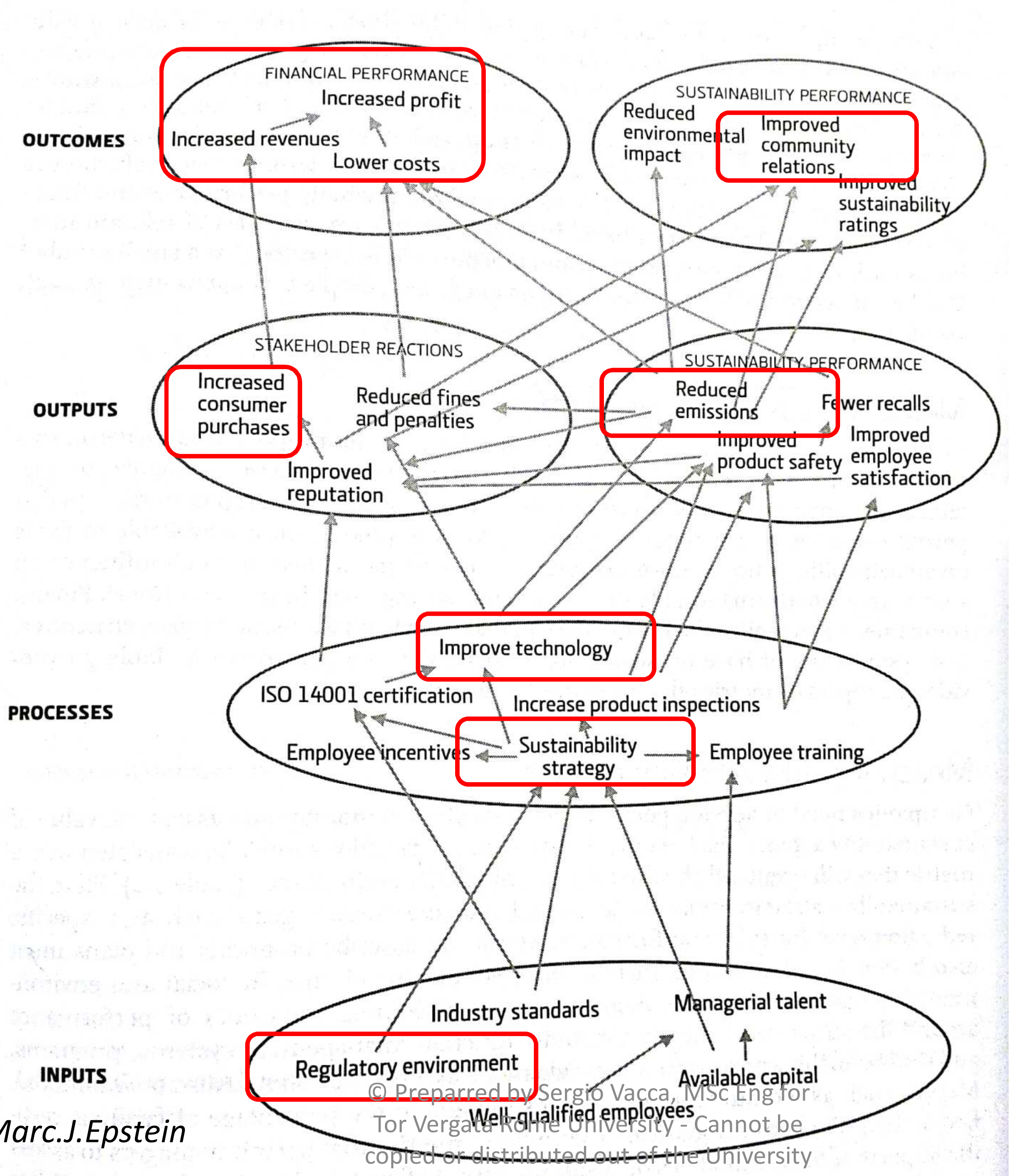
Revenues are impacted by reputational effects and green initiatives. Cost are reduced by efficiencies, lean programs, materials mgmt, absenteism, healthcare.

<u>Feedback</u>: it is essential to guarantee the up to date practices and procedures. Potential environment and social feedbacks should timely be reported as well as internal practices should capture the level of satisfaction of employees and all stakeholders.

A feedback system also addresses product re-design, zero waste strategies and collaborative SC relationships.

DRIVERS &

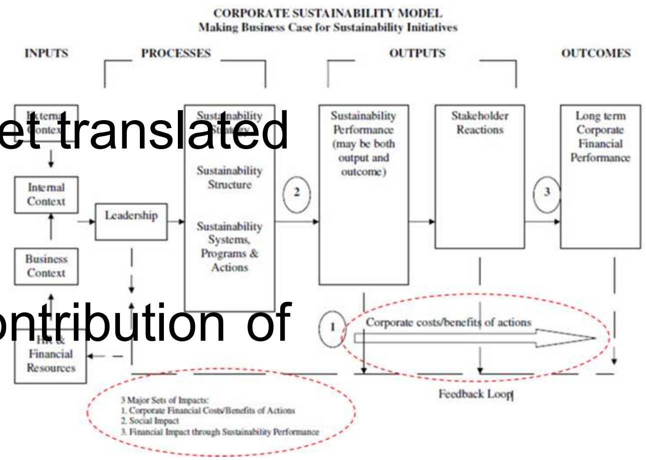
SYSTEM DYNAMICS



Source: Marc.J.Epstein

SUSTAINABILITY MODEL
KPI's

- Appropriate Metrics allow to allocate the proper resources on projects
- Social and Environmental indicators normally get translated into financial and monetary terms
- Leadership and direction setting shapes the contribution of alla areas and should be always quantified



The SC Professional is expected to quantify, measure and improve the performance of emission, wastes, energy, recycling in a E2E approach, adopting the correct KPI's and Metrics.

SUSTAINABILITY MODEL
KPI's example

emissions

Indicator ENVIRONMENT	2016	2015	2014	GRI
Indirect emissions of greenhouse gases (purchases of electricity, steam, hot water) for the entire Group of the concerned sites*	3.2 Mt eq.CO_2	3.3 Mt eq.CO_2	3.5 Mt eq.CO_2	EN16
Indirect emissions of greenhouse gases (purchases of electricity, steam, hot water) for the entire Group at actual scope**	3.6 Mt eq.CO_2	3.5 Mt eq.CO_2	4.2 Mt eq.CO_2	EN16
Annual variation of indirect emissions of greenhouse gases (purchases of electricity, steam, hot water) for the entire Group at actual scope**	0.1 Mt eq.CO_2 (+3%)	(0.7) Mt eq.CO_2 (-17%)	(0.6) Mt eq.CO_2 (-13%)	EN19
CO_2 impact on Group annual turnover (value in 2010: 0.47 kg CO_2/€)	0,34 kgCO_2/€	0,33 kgCO_2/€	0,40 kgCO_2/€	EN18
OTHER AIR EMISSIONS				
SO_2 emissions from the concerned sites in the Pipe and Glass Activities*	11,187 t	13,150 t	15,230 t	EN21
NO_x emissions from the concerned sites in the Pipe and Glass Activities*	17,824 t	18,679 t	19,972 t	EN21
Dust emissions from the concerned sites of the Pipe and Glass Activities*	3,140 t	5,201 t	7,810 t	EN21
WATER				
Water withdrawal from the concerned sites*	50.9 M of m^3	64.0 M of m^3	63.9 M of m^3	EN8
Total water withdrawal for the entire Group at actual scope**	53.6 M of m^3	66.9 M of m^3	69.7 M of m^3	EN8
Rainwater withdrawal for the entire Group at actual scope**	0.7 M of m^3	0.7 M of m^3	0.7 M of m^3	EN8
Municipal water withdrawal for the entire Group at actual scope**	15.4 M of m^3	14.3 M of m^3	15.9 M of m^3	EN8
Surface water withdrawals for the entire Group at actual scope**	15.6 M of m^3	29.6 M of m^3	28 .9 M of m^3	EN8
Ground water withdrawal for the entire Group at actual scope**	20.3 M of m^3	19.8 M of m^3	22.7 M of m^3	EN8
Total water discharge from concerned sites*	28.0 M of m^3	37.9 M of m^3	39.2 M of m^3	EN22
Total water discharge for the entire Group at actual scope**	29.4 M of m^3	39.1 M of m^3	42.8 M of m^3	EN22
Water discharges into the surrounding environment for the entire Group at actual scope**	19.3 M of m^3	29.5 M of m^3	32.1 M of m^3	EN22
Water discharges into the municipal waste water collection system for the entire Group at actual scope**	9.5 M of m^3	8.8 M of m^3	10.2 M of m^3	EN22

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SUSTAINABILITY MODEL
KPI's example

expenses

Indicator				
ENVIRONMENT	**2016**	**2015**	**2014**	**GRI**
ENVIRONMENTAL MANAGEMENT				
Total environmental expenditure, of which*:	127.1 M€	127.4 M€	123.6 M€	EN31
◆ Salaries and other payroll expenses for environmental officers	26.1 M€	27.0 M€	25.1 M€	
◆ ISO 14001 and EMAS environmental certification and renewal costs	3.5 M€	2.6 M€	2.9 M€	
◆ Environmental taxes	6.9 M€	5.8 M€	8.9 M€	
◆ Insurance and warranties	8.4 M€	6.1 M€	4.3 M€	
◆ Environmental fines	0.3 M€	0.1 M€	0.1 M€	EN29
◆ Cost of environmental incidents	3.9 M€	0,3 M€	0.9 M€	
◆ Cost of technical measures	6.7 M€	6.0 M€	7.1 M€	
◆ Environmental R&D budget	59.7M€	61.8 M€	59.0 M€	
◆ Soil decontamination, site remediation and other clean-up costs	18.4 M€	17.7 M€	15.1 M€	
Capital expenditure on environmental protection measures	78.8 M€	63.3 M€	52.1 M€	
Provisions for environmental risks	180.3 M€	163.3 M€	155.2 M€	
Number of sites certified for Environment management (ISO 140001 or EMAS)	83%	83%	81%	
Number of sites certified for Energy management (ISO 50001)	85	77	53	
Number of sites certified for Quality (including ISO 9001)	673 (619)	659 (603)	643 (591)	

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SUSTAINABILITY MODEL
KPI's

wastes

	2016	2015	2014	GRI
RAW MATERIALS AND PRODUCTION WASTE				
Quantity of non-recovered production waste from the concerned sites*	0.482 Mt	0.469 Mt	0.490 Mt	EN23
Quantity of non-recovered hazardous production waste from the concerned sites*	0.029 Mt	0.033 Mt	0.036 Mt	EN23
Consumption of primary raw materials in glass furnaces, concerned sites*	6.50 Mt	6.50 Mt	6.47 Mt	
Consumption of cullet in glass furnaces, concerned sites* *The internal cullet is the cullet generated and reused in the same industrial site.*	1.72 Mt of internal cullet, and 1.17 Mt of external cullet	1.69 Mt of internal cullet 1.09 Mt of external cullet	1.64 Mt of internal cullet and 0.99 Mt of external cullet	EN2
Percentage of ton of finished product from primary melt of cast iron produced, concerned sites*	82.1%	83.2%	77.7%	EN2
Percentage of recycled material in each ton of finished product of cast iron produced, concerned sites*	45%	42%	44%	EN2
Percentage of recycled material in each ton of finished product of gypsum produced, concerned sites*	34%	36%	36%	EN2
ENERGY				
Total energy consumption of concerned sites*	147,543 TJ	147,026 TJ	148,732 TJ	EN3
Total energy consumption of entire Group at actual scope of reporting**	161,588 TJ	156,308 TJ	202,840 TJ	EN3
Annual variation in energy consumption of entire Group at scope**	5,280 TJ (+3.4%)	(46,532) TJ (-22.9%)	(10,006) TJ (-4.7%)	EN6
Total indirect energy consumption of entire Group at actual scope**	35,177 TJ	33,289 TJ	39,826 TJ	EN3
Annual variation in indirect energy consumption of entire Group at actual scope**	1,888 TJ (+5.7%)	(6,537) TJ (-16.4%)	(3,662) TJ (-8.4%)	EN6
Electricity consumption of entire Group at actual scope**	34,370 TJ	32,501 TJ	38,767 TJ	EN3
Steam and hot water consumption of entire Group at actual scope**	794 TJ	789 TJ	1,060 TJ	EN3
Direct total energy consumption of entire Group at actual scope**	126,412 TJ	123,019 TJ	163,014 TJ	EN3
Annual variation in direct total energy consumption of entire Group at actual scope**	3,393 TJ (+3%)	(39,995) TJ (-25%)	(6,444) TJ (-4%)	
Coal and coke consumption of entire Group at actual scope**	20,066 TJ	21,485TJ	27,550 TJ	EN3
Natural gas consumption of entire Group at actual scope**	88,889 TJ	87,322 TJ	114,783 TJ	EN3
Petroleum products consumption of entire Group at actual scope**	12,641 TJ	12,037 TJ	20,454 TJ	EN3

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SUSTAINABILITY MODEL
KPI's example

GHG emissions

GHG EMISSIONS	2016	2015	2014	GRI
Total CO_2 emissions (scope 1 and 2) at the concerned sites*	12 Mt	12.2 Mt	12.7 Mt	
Annual variation of total CO_2 emissions (scope 1 and 2) at the concerned sites*	(0.2) Mt (-2%)	(0.5) Mt (-4%)	(3) Mt (-19%)	
Total CO_2 emissions (scope 1 and 2) at actual scope**	13.0 Mt	13.0 Mt	16.6 Mt	EN15
Annual variation of total CO_2 emissions (scope 1 and 2) at actual scope**	0 Mt (0%)	(3.6) Mt (-22%)	(1) Mt (-6%)	EN19
Direct emissions of CO_2 of the concerned sites*	8.8 Mt	8.9 Mt	9.2 Mt	EN15
Direct emissions of CO_2 for the entire Group at actual scope**	9.4 Mt	9.5 Mt	12.4 Mt	EN15
Annual variation of direct emissions of CO_2 for the entire Group at actual scope**	(0.1) Mt (-1%)	(2.9) Mt (-23%)	(0.4) Mt (-3%)	EN19
Other relevant indirect emissions (entire Group or scope of reporting concerned) of greenhouse gases, by weight (tons-equivalent of CO_2)***	Not applicable	Not applicable	Not applicable	EN15

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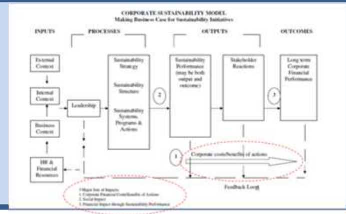
SUSTAINABILITY MODEL
KPI's



INPUTS

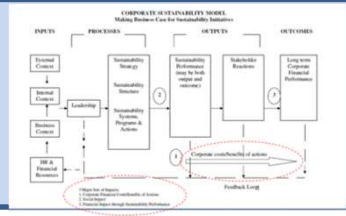
External Context Government regulations, pollution stds, employment rules, culture in the Marketplace encouraging/disencouraging sustainability	• Non discriminatory laws • Geography • Pollution/Hazard stds • Average temperature
Internal Context BU missions, strategies, structures, systems. By these the company impacts onto human rights, employees and environment	• LCA for Products • Environmental/social benchmark of competitors • Corporate code of conduct
Business Context affected by business and products. Risks vary depending on Brand exposure	• Competitive position • N° of customer channels • Geography
Human and Financial Resources are relevanto to the available and needed resources as well as trained and educated professionals	• Funds for training • N° of employees trained • Budget for R&D / NPD • Salaries

Overall Company

Supply Chain

Adapted from M.J.Epstein

SUSTAINABILITY MODEL
KPI's

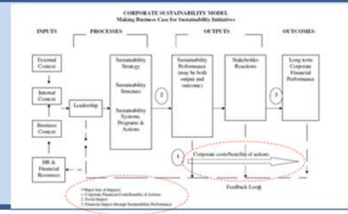


PROCESSES

Leadership show commitment from the top, scan business environment to prevent risks and catch opportunities, lead the change	• Management attention to Environmental issues • Clearly articulated vision
Sustainability Strategy develop and act following a mission statement, consider regulations and impact of social investors	• Suppliers certified • Products undergoing LCA • Diversity • Child labor • Reduce emissions • Observance of international stds
Sustainability Structure integrated throughout the organisation, effective use of human resources, manager access to top mgmt, alignment	• Mgmt with social/environmental roles – CSR • Functions with environmental roles
Sustainability systems/programs Invetsments, measures, reporting	• Educational opportunities • N° of family leave days • Investments in cleaner technology • ISO 14001certifications

Adapted from M.J.Epstein

SUSTAINABILITY MODEL
KPI's



OUTPUTS

<u>Sustainability Performance</u>

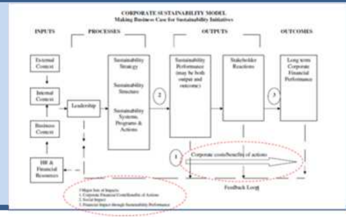
must be related to the Triple Bottom Line, however Social and Environment (child labor, emissions, packaging, etc) can be more or less linked to profits. When related, it become a business case

- Hazardous waste volumes
- % recycled materials
- Volume/cost of energy
- Water consumption
- Emissions and waste
- Landfill use and recycling
- Eco efficiency of products
- Fair Trade with partners
- Cases of bribery
- Labor violations
- Certified suppliers
- ISO 14000 certification

Overall Company
Supply Chain

Adapted from M.J.Epstein

SUSTAINABILITY MODEL
KPI's



OUTCOMES

Stakeholder reactions

are critical as they determine the financial performance through their reactions.

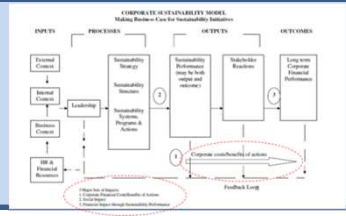
- Customers: loyalty and long term purchasing
- Employees: service, reliability
- Shareholders: capital investment, towards ethics

- Perception of corporate ethical performance
- Sales from «green» products
- Customer satisfaction surveys
- Word of mouth
- Improved image
- Market share
- Sickness days
- CSR costs
- Protests
- Plant visits
- Certifications
- Environmental reports

Overall Company
Supply Chain

Adapted from M.J.Epstein

SUSTAINABILITY MODEL
KPI's



OUTCOMES

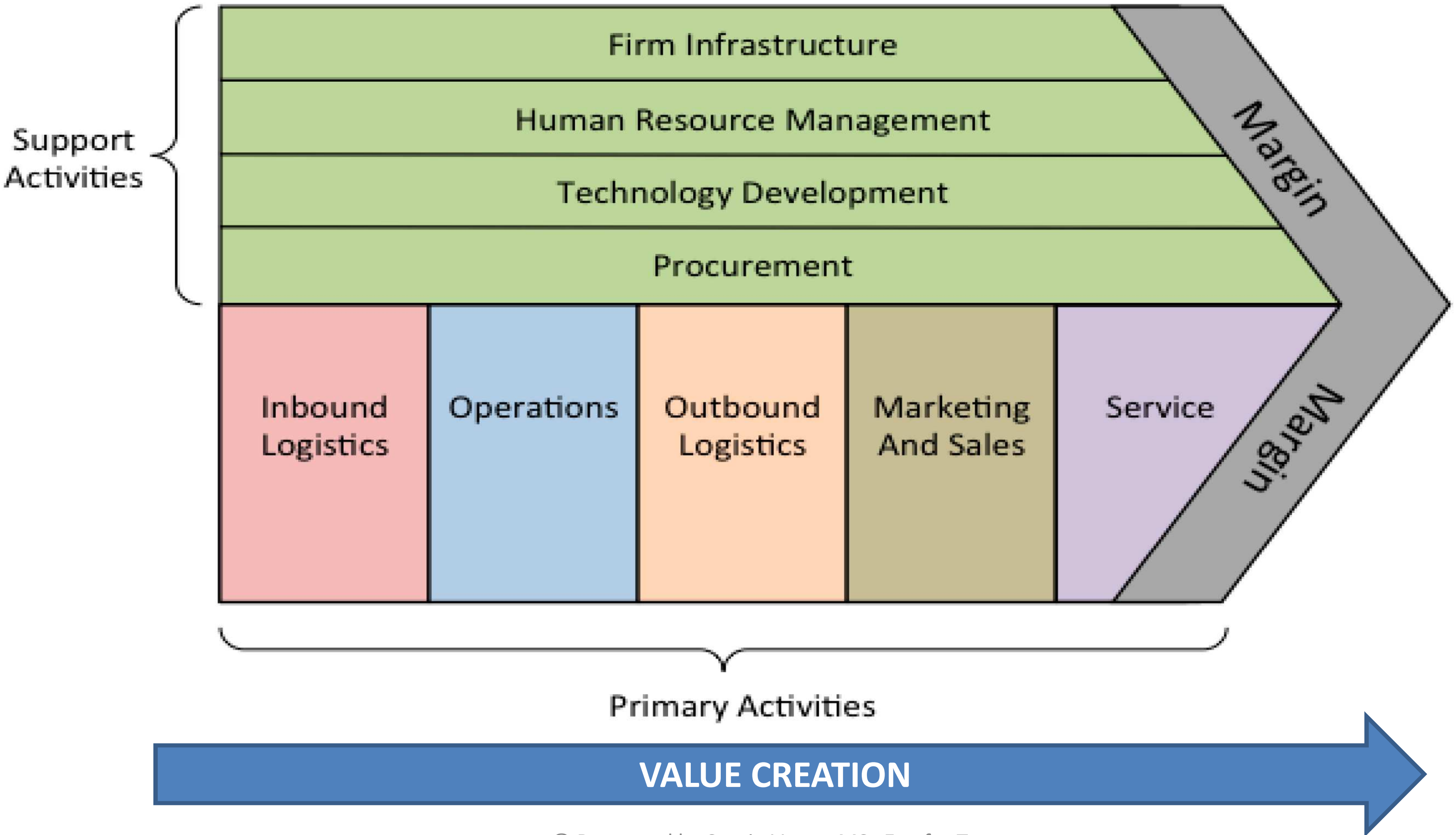
Long Term Corporate financial performance

it is often recognized as the driver for success of the sustainability initiatives.
Revenues are impacted by reputational effects and green initiatives. Cost are reduced by efficiencies, lean programs, materials mgmt, absenteism, healthcare.

- Income from «green» products
- Income from recycled products
- Increase sales from reputation
- Cost savings energy/pollution red. and environmental actions
- TSR, EVA, ROI, WACC
- Legal costs

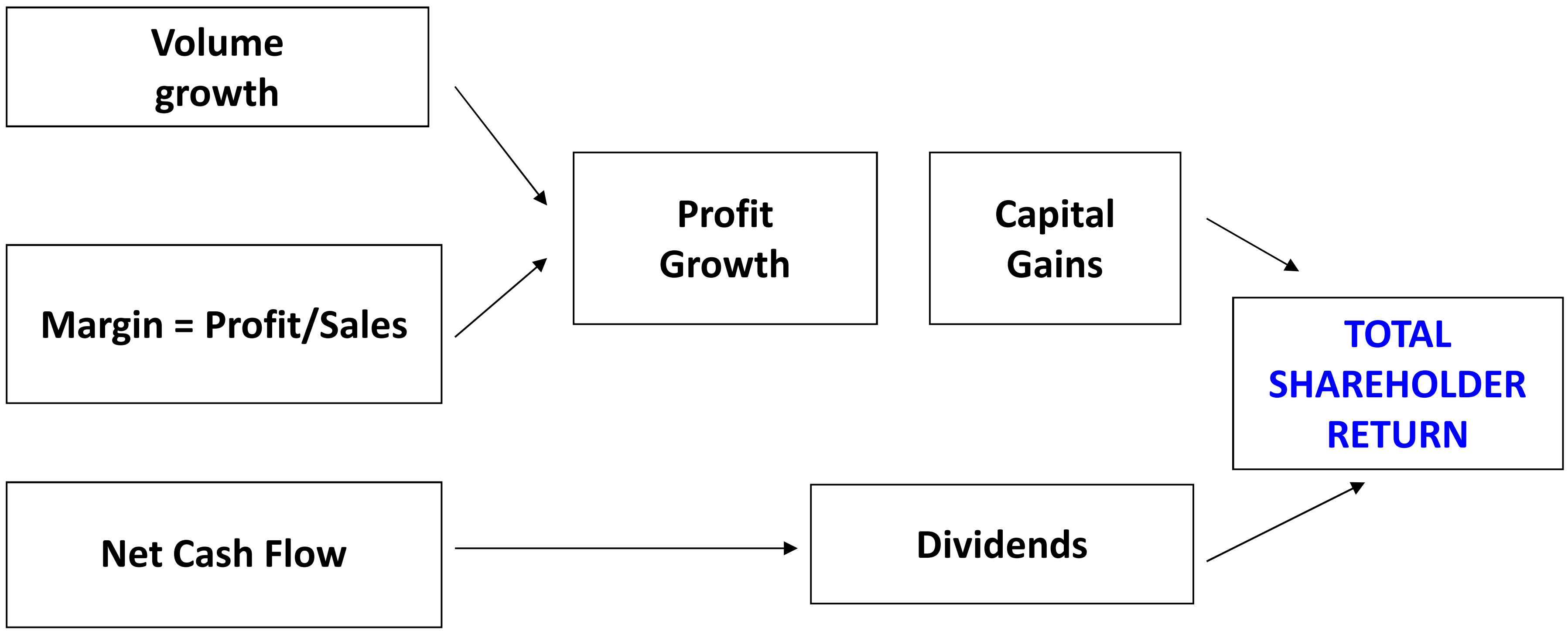
Adapted from M.J.Epstein

OUTCOME: THE ECONOMIC DIMENSION IN SUSTAINABILITY PROJECTS



Adapted from the Porter model

TSR – TOTAL SHAREHOLDER RETURN



Proposed cost model with reduction on variable expenses , same profit:

MANUFACTURING ELEMENTS	current		future	
ENERGY	1		2	
RAW MATLS	11		12	
ANCILLARY MATLS/OH	2		1	
PACKAGING MATERIALS	12		2	
LABOR	8		6	
TRANSPORTATION	3		3	
WAREHOUSE	3		2	
MFG EQUIPMENTS DEPRECIATION	2		2	
PACKAGING EQUIPMENTS DEPRECIATION	4		1	
IT	2		2	
R&D	2		2	
QUALITY ASSURANCE	2		2	
MARKETING (ADVERT.; PROMO PLANS; RESEARCH; CSR)	14		10	
SALES	8		5	
PROCUREMENT	2		2	
HR/PERSONNEL	8		5	
INTERESTS/FIN. CHARGES	2		1	
PROFIT	**14**	**14%**	**10**	**14%**
SALES PRICE	**100**		**70**	

Adapted from - Planet Life Economy Foundation

TSR – TOTAL SHAREHOLDER RETURN

Shareholder VALUE ADDED = NOPAT – WACC X CAPITAL

Increase revenues	Decrease Operating costs	Decrease	Manage assets
GROWTH	**EFFICIENCY**	**RISK MGMT**	**UTILIZATION**
• Product innovation • Licence to operate • New markets	• Lean production • Resource mgmt and conservation	• Social • Political • Brand • Reputation	• Process simplification • Streamline SC • Capital productivity

EVA® = ECONOMIC VALUE ADDED

Economic Profit (EVA) = NOPAT – WACC x Capital

The amount by which earnings exceed or fall short of the required minimum rate of return that shareholders and lenders could get by investing in other securities of comparable risk

(Ex. Coca Cola; GE; AT&T; DHL; DuPont …)

Measures the Company Cost to borrow money – from lenders and Shareholders, who want interests and dividends paid.

Represents the investor's opportunity cost of taking on the risk of putting money into a company (rather than somewhere else).

WACC = (Equity x Cost of Equity) + (Debt x (1-tax) x Cost of Debt)

(EVA® is a registered trademark from Stern Stewart)

BRAND REPUTATION

Shareholder VALUE ADDED = NOPAT – WACC X CAPITAL

- **PATENTS**
- **CUSTOMER LIST**
- **BRAND NAME**

- **Market research**
- **Interviews to executives (ex. Gartner Top 25)**

\+

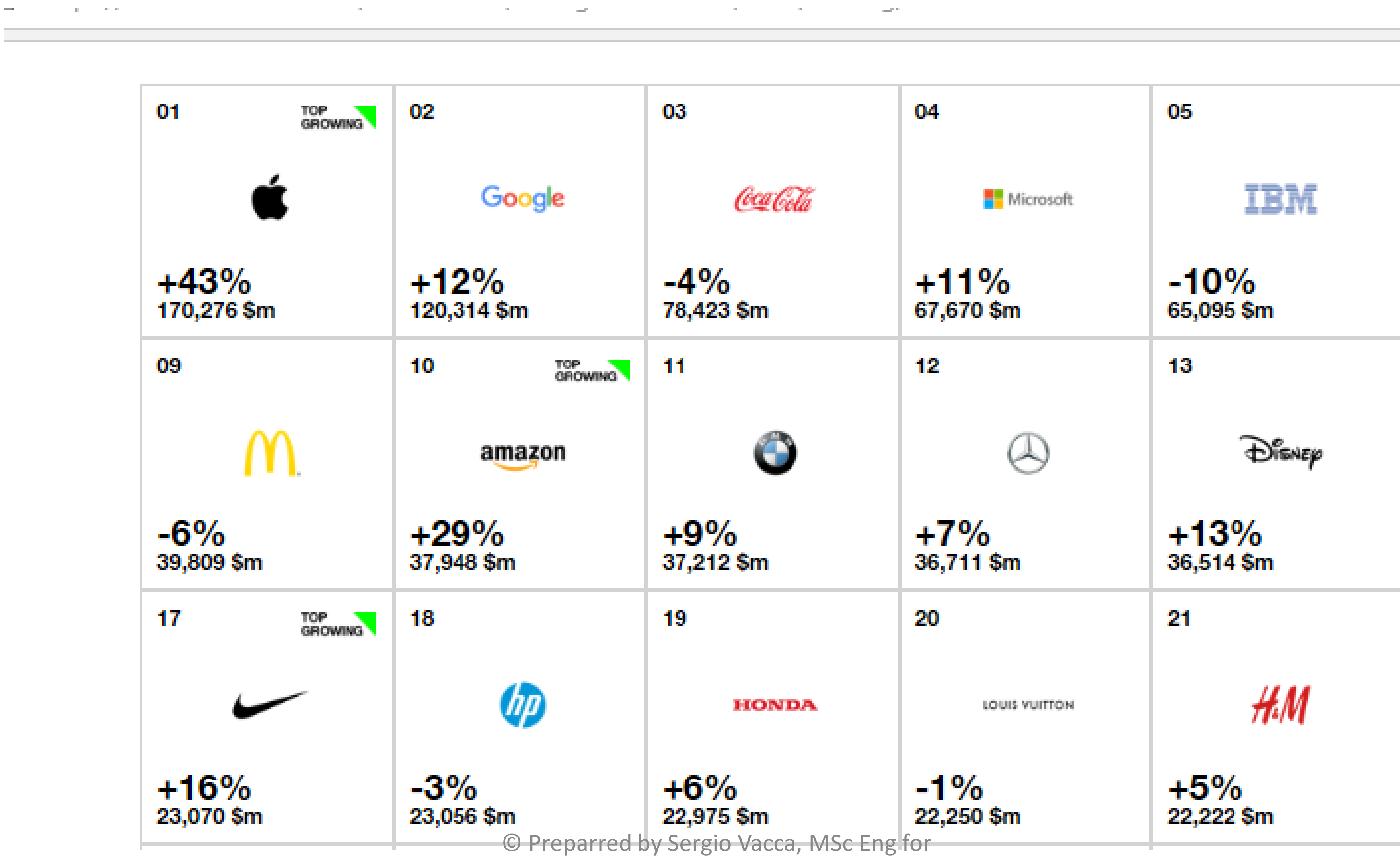
Brand resilience additional factors:

- **Market leadership**
- **Stability**
- **Global reach**

calculate

BRAND NAME DISCOUNT FACTOR

BRAND REPUTATION



SOCIAL AND POLITICAL COSTS
(examples of items to be considered as Risks)

	Cost	Likely hood
SOCIAL RISKS (and Cost impact):		
• Negotiation with protesters		
• Child labor		
• Reputation damage		
• Costs of litigation and remuneration		
• Infringement of local regulations, lands		
• Strike		
POLITICAL RISKS (and Cos impact):		
• Changes in legislation and effects /tax, tariffs, etc)		
• Forced contracts local		
• Insurrection		
• Corruption (endemic, bribery)		
• Criminal activities		
• Terrorism		

SOCIAL AND POLITICAL COSTS
(examples of items to be considered as Risks)

TOTAL OUR VISION OUR CHALLENGES REPORTING INDICATORS

grievances circuit.

TAKING INITIATIVES IN FAVOR OF **THE LOCAL COMMUNITIES AND RESIDENTS**

SOCIAL AND POLITICAL RISKS

RISK DEFINITION, IN BUSINESS:

RISK = **PROBABILITY** OF AN EVENT x **IMPACT** OF THE EVENT (*)

(*) X DETECTION TO PREVENT → RPN (Risk Priority Number)

SOCIAL AND POLITICAL RISKS ARE COST COMPONENTS TO WITHDRAW FROM BENEFITS WHEN CALCULATING THE ROI OF A SUSTAINABILITY PROJECT

$$\text{ROI} = \frac{\text{Total Benefits} - \text{Total Costs}}{\text{Investment}} \times 100$$

SOCIAL AND POLITICAL RISKS

$$\text{ROI} = \frac{\text{Total Benefits} - \text{Total Costs}}{\text{Investment}} \times 100$$

COST ITEMS:

- **TSCMC (Matls; Mfg; Logist; Planning; Return)**
- **Social Risks Cost**
- **Political Risks Cost**

Example of Oil companies evaluating the potential risks with exploration:
- Communities
- Environment
- Brand and reputation

Supply Chain Sustainability in practice
Agenda

1. Sustainability: do we need a trigger to start taking action in depth? examples:
   - Fairtrade in South America; big Corporations as Walmart
   - The EOD - Earth Overshoot Day
2. Cultural and Managerial direction setting to make things happen
3. Sustainability Model structure:
   - convergence of Social, Environmental and Economic factors
   - Kpi's and ROI
4. **The SC Manager focus on Emissions and NPD while monitoring the external social and political factors**
5. LCA – Life Cycle Assessment: a methodology to measure and improve the Sustainable Supply Chain:
   - Sustainable SCOR – an holistic methodology for environmental impact accounting
   - ISO 14000 stds, GRI, Sustainable SCOR framework
6. Case study: work together to get a «feeling» on how to influence results

SUSTAINABILITY MODEL
SC Professional responsibilities and tasks

PROCUREMENT / Materials

- Suppliers are ISO 14000 compliant
- Possibility to recycle/reuse matls
- Opportunities for renewable resources

MANUFACTURING

- Product is Designed for Mfg
- Reduction/elimination of toxic or hazardous matls
- Reduction in energy consumption
- Safety is top priority

WHSE / TRANSPORTATION

- Facilities are environmentally friendly
- Inbound/outbound affecting local environment
- Recyclable matls in the logistics operations/repackaging
- Certified carriers
- Transportation mode with lower emissions selected

REVERSE LOGISTICS

- Process for gathering return for recycle, reuse
- Storing of toxic, dangerous prods
- Is the customer supporting recycling? Actions needed

Adapted from APICS CSCP

HOW THE SC MANAGER IMPROVES THE SUSTAINABILITY

THE SC MGR SHOULD BE FOCUSED ON TWO MAIN AREAS:

BE INFORMED ON:

1 - SOCIAL AND POLITICAL RISKS

labor conditions, effect of sustainability in the local and external communities is a shared responsibility to manage.

BE ACCOUNTABLE FOR IMPROVING:

2 - THE ENVIRONMENT

Collaborative NPD, Suppliers Certification and Process impact are a direct responsibility and a priority.

SCM – FOCUS ON EMISSIONS and NPD

SC Professionals must be highly concerned and practice their leadership with:

1. **<u>NPD</u> collaboration**

   provide valuable inputs to R&D

2. **<u>PROCESS</u> monitoring and Performance measurement**

   GHG emissions, resources (matls, equipments, manpower) efficiency – **<u>Apply the LCA methodology</u>**

SCM – FOCUS ON EMISSIONS and NPD

1. **<u>NPD</u> collaboration**

   provide valuable inputs to R&D

SCM – FOCUS ON EMISSIONS and NPD

The rationale for collaborating to the NPD design is twofold:

a) Consider the feedbacks coming from the Stakeholders and relating them to the <u>Social and Political Risk Mgmt</u>

b) Design Products for better <u>energy and environmental efficiencies</u>

SCM – FOCUS ON EMISSIONS and NPD

methodologies

REDESIGN PRODUCTS

- NIKE: replacing the SF6 (GHG) with N2 with Nike Air prods
- Sani Terre Inc. (cleaning equipm.s) – using electrical power i/o gas: -50% GHG
- P&G: toothpaste w/o carton

RE-ENGINEER PRODUCTS

- GENERAL MILLS (food): wastewater treatment: > 400Kusd savings
- COLGATE: formula changes for cleaning lines (and many more)
- WARNER BROS: efficient lighting: abou 9 Mill kWh/yr

SCM – FOCUS ON
NPD – some model theory

DESIGN FOR ENVIRONMENT

Nike example:

Our vision:

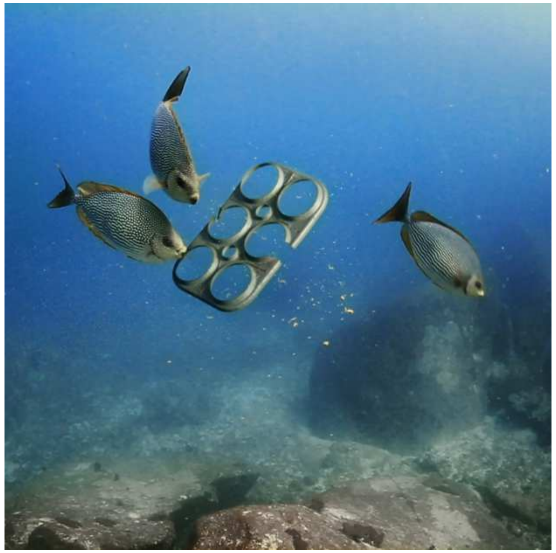
We design for recycling.

Consumers bring their products back to us to be recycled into new products. Waste that cannot be eliminated is recycled.

Product is less reliant on oil and water

We all step lighter, faster into a future low-carbon sustainable economy.

We use healthier chemistry to minimize the impact of product ingredients through lifecycle.



Shoes from ocean plastic

Ikea kitchen with recycles PE bottles

Saltwater Beer eatable rings

BMW cars designed for full recycling

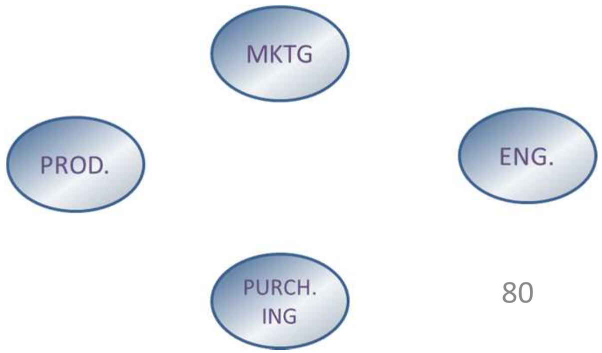
SCM – FOCUS ON
NPD – some model theory

The Design costs are 10-15% of the TSCMC and up to 70% of Logistics cost

TRADITIONAL «OVER THE WALL» PROCESS

- MKTG provides the product «brief» to Engineering
- Engineering develops the Product
- Purchasing origines the RFQ, ITT to vendors and suppliers
- Manufacturing defines the capacity constraints and production leadtimes

The process is not optimized and functions work separately – silos approach



SCM – FOCUS ON
NPD – some model theory

COLLABORATIVE DESIGN

STANDARDIZATION	BROAD BASED METHODS	SIMPLIFICATIONS
Component commonality	Design for SC	Concurrent Engineering
Universality	Design for Logistics	Design for Manufacture and Assemply (DFMA)
	Design for everything	Design for Service
CUSTOMIZATION	**QUALITY**	**SUSTAINABILITY**
Modular design	Design for Quality	Design for environment
Mass customization	Quality Function Deployment (QFD)	Design for Reverse Logistics
Postponement		Design for Remanufacture

PC'S

CPG

NIKE

AUTOMOTIVE

FASHION (ZARA)

APPLE
IKEA
appliances

Source: adapted from APICS CSCP

Traditional Over-the-Wall vs. Collaborative Design

Over-the-wall design

- Marketing sends customer requirements to engineering.
- Engineering: full-featured design.
- Purchasing: unaffordable parts.
- Production: costly changes.
- Rework.
- Logistics finally gets design, but SC/packaging too costly.

Collaborative design

- Design team initially includes engineers, other departments, and possibly SC partners.
- Design team considers issues from raw material to final stage of product life cycle, approximating cost differences.
- Given approval by all functions and partners, purchasing and production start detailed design.

Source: adapted from APICS CSCP

Simplification: Concurrent Engineering

Strategy	Definition	Benefits/Tradeoffs
Concurrent engineering (CE)	**Engineers and other stakeholders contribute.** • Shorten/simplify design.	**Benefits** • **Design collaboration.** • **Parallel rather than sequential.** • **Virtual design meetings.**

Source: adapted from APICS CSCP

Simplification: DFMA

Strategy	Definition	Benefits/Tradeoffs
Design for manufacture and assembly (DFMA) (a further development of concurrent engineering)	Involves manufacturing function in initial stages. • Materials for ease of production and function. • Component tolerances. • Fewer parts. • Less part handling. • Concurrent/parallel steps. • Assembly obvious and easy. • Simplify assembly steps. • Design in easy testing.	**Benefits** • Less confusion, complexity, variability, production delays, setup times, and training. • Enforced by standards/policies. • Uses standardization for parts. • Helps lean, modular design, and mass customization. • Software automates DFMA. **Tradeoffs** • Could be at odds with customer desires if features are omitted.

Source: adapted from APICS CSCP

Sustainability - DFE

Strategy	Definition	Benefits/Tradeoffs
Design for the environment (DFE)	**Consider health, safety, and environment during design and development.** • Provision for reuse or recycling. • Reduced energy consumption. • Avoidance or mitigated danger of hazmat. • Use of lighter components and less material.	**Benefits** • **Fits SC emphasis on total life cycle.** • **Better reputation and goodwill.** • **Less liability and legal costs.** • **Marketable environmental friendliness.** **Tradeoffs** • **Increased manufacturing costs and higher sales price.** • **Reduced safety or longevity from less weight/preservatives.**

Source: adapted from APICS CSCP

Sustainability - DFE

- the importance of moving toward the <u>optimization of production systems,</u> promoting the principle of obtaining the maximum well-being with the least possible consumption of resources
- the need to spread a correct perception of the environmental question among consumers, fundamental to promoting <u>an industrial production directed at limiting the obsolescence of products and at encouraging their recycling</u>

The 30-Year Sweatshirt

methodologies

RE-THINK THE MARKET

Conditions:

1. Customers are willing to pay a premium for sustainability and environment
2. Benefits get communicated to customers and stakeholders
3. NPD is protected against competition

→ The Market Paradox: there is an increased Demand for Sustainable Products/Services, but not always the Companies are ready to fill the need

SCM – FOCUS ON EMISSIONS and NPD

<u>RE-THINK THE MARKET</u> (Case Study):

STAR KIT (HEINZ Group)

<u>Background</u>: tuna fishing was killing dolphins and it became known to stakeholders

<u>Action</u>: the Company publicized to fish in West Pacific only dolphin free tuna fish

<u>Outcome</u>: no match of the previous three conditions.

→ Customers wanted a cheap source of proteins

→ dolphin free was ok, but harming other species

→ no proprietorship over fishing model, so competitors doing the same

Key learning: the market analysis and customer profiling need to be properly done

SCM – FOCUS ON
NPD – Re-think the Market

Sometimes Companies arrive late to satisfying the Customer requirements on Sustainability, simply to prioritize the bottom line Profits. However:

- The consumers are the more and more willing to pay some more money for environmental friendly goods

- The benefits from new technologies (materials), solutions (free up space in trasportation by loose products – ex.P&G) and reduced energy consumption (Walmart)

- Move from products to services (Interface - selling carpets and afterward leasing them and maintaining)

SCM – FOCUS ON EMISSIONS and NPD

2. **<u>PROCESS</u> monitoring and Performance measurement**

   GHG emissions, resources (matls, equipments, manpower) efficiency - **<u>Apply the LCA methodology</u>**

SCM – FOCUS ON EMISSIONS and NPD

Suppliers involvement and certification (ISO 20400) are essential traits to reinforce transparency and achieve the needed reputation. This reduces possible complaints/protests and allows additional benefits in terms of:

- **Cost avoidance** with lower waste mgmt fees and hazardous materials and **Savings** from energy, water and fuel efficiencies
- **Compliance** with regulations
- Reduced **Risk** of accidents, health care and safety costs

Activities:

- ❖ Supplier meetings
- ❖ Training on products and technical assistance
- ❖ Collaborative R&D
- ❖ Buy in from top Mgmt

SCM – FOCUS ON EMISSIONS and NPD

NIKE: selection and approval of new factories:

1. factory profile
2. quality inspections
3. environmental, safety, health, labor inspection
4. 3P labor audit
5. Final approval

L'Oreal: labor conditions; unannounced audits, inspections, interviews

Mattel: compliance of Brazilian suppliers; training

Adidas: commitment to compliance; training and involvement; management systems in place

Walmart: sustainable packaging from suppliers – GHG reduction.; fishing sources

Unilever: sustainable tea sourcing; pollutants reduction on detergents

Supply Chain Sustainability in practice
Agenda

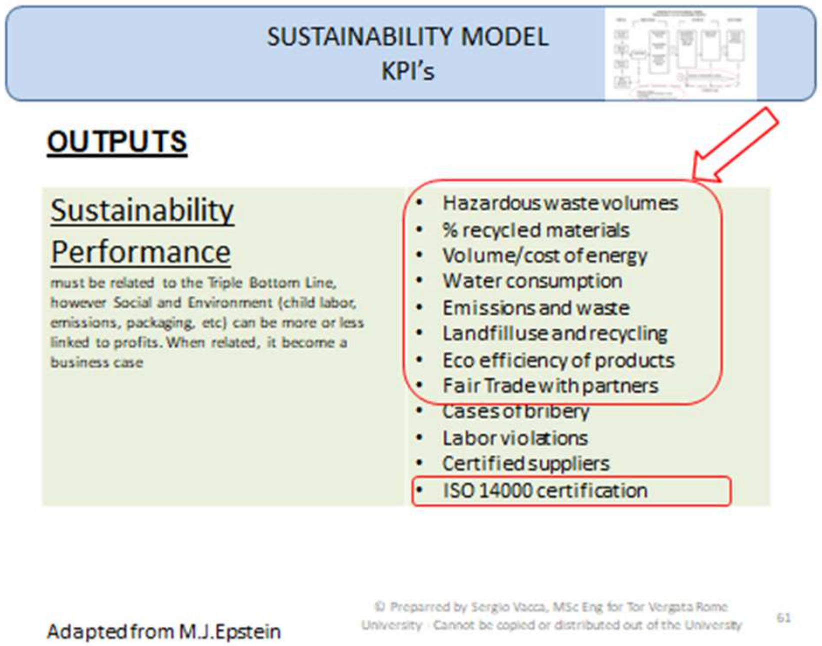
1. Sustainability: do we need a trigger to start taking action in depth? examples:
   - Fairtrade in South America; big Corporations as Walmart
   - The EOD - Earth Overshoot Day
2. Cultural and Managerial direction setting to make things happen
3. Sustainability Model structure:
   - convergence of Social, Environmental and Economic factors
   - Kpi's and ROI
4. The SC Manager focus on Emissions and NPD while monitoring the external social and political factors
5. **LCA – Life Cycle Assessment: a methodology to measure and improve the Sustainable Supply Chain:**
   - Sustainable SCOR – an holistic methodology for environmental impact accounting
   - ISO 14000 stds, GRI, Sustainable SCOR framework
6. Case study: work together to get a «feeling» on how to influence results

MEASURING THE SUSTAINABILITY
IN A SUPPLY CHAIN

HOW TO MEASURE THE ENVIRONMENTAL IMPACT?

Principle:

What gets measured gets done



LCA – LIFE CYCLE ASSESMENT

Do you need to quickly review LCA??

- LCA is a technique to identify, evaluate, measure and improve different potential impacts (materials, energy and wastes) associated to each one of the stages of the life cycle of a product

- LCA focuses on the environmental aspects of a product transformation process

- LCA does not focus on the economic and social aspects of a product transformation process

…WHAT MOVES GLOBAL ATTENTION:

Focus on Crucial Concerns

- Human Health
- Global Climate Change
- Water availability and quality
- Loss of biodiversity
- Depletion of fossil fuel resources
- Stratospheric ozone depletion

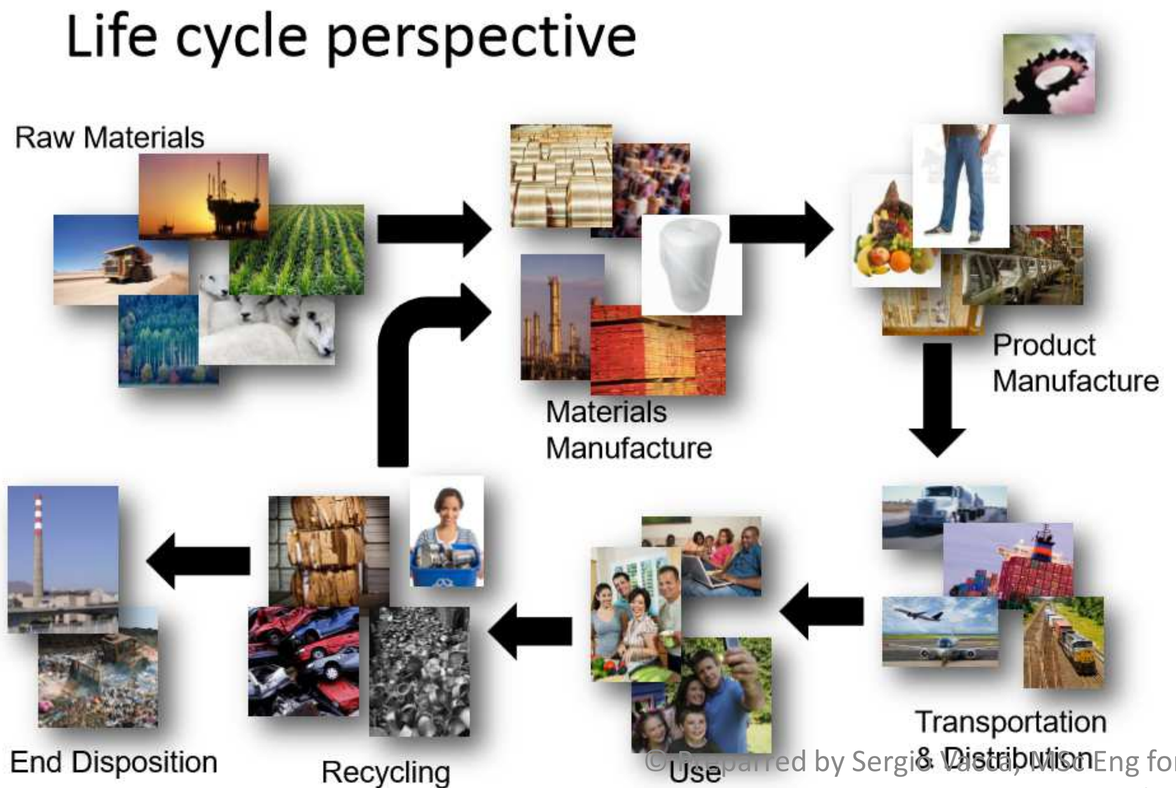
…WHAT CAPTURES GLOBAL ATTENTION:

Global impacts:

- Green House effect
- Ozone depletion
- Persistent toxic chemicals
- Consumption of non-renewable resources
- Acid rain
- Damage to marine ecosystem (e.g. North Sea)
- Constant growing human population and activity
- Increase use of chemicals
- Increasingly use of larger part of the earth

LCA – LIFE CYCLE ASSESMENT

The final objective is to identify the **environmentally critical points** and prevent/remove them by replacing materials and/or systems and methods



LCA – LIFE CYCLE ASSESMENT
Why it is useful ?

1. Explores the whole system, once defined the scope
2. Brings the analysis into action
3. Promotes research and solutions
4. It is visual; creates visibility, alignment and communication,
5. Branding / communication, Eco labeling, Policy making

All departments could benefit from LCA

LCA – LIFE CYCLE ASSESMENT
Different Process Situations:

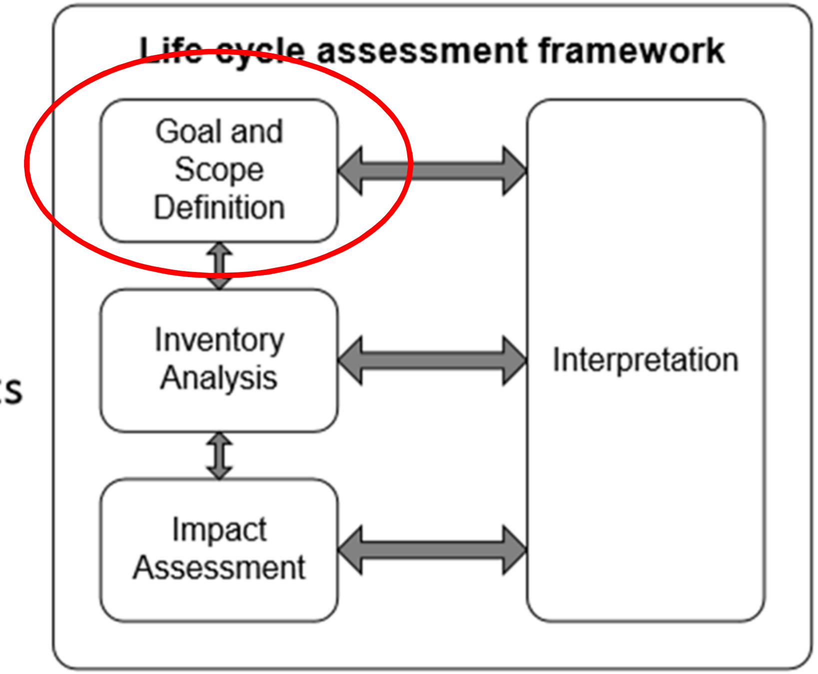
…CAN BE USED FOR DIFFERENT OBJECTIVES:

1. Global exploration of options
2. Company-internal innovation
3. Sector-driven innovation
4. Strategy determination
5. Comparison
6. Comparative assertion (disclosed to the public)

How to do LCA according to ISO

- Goal & Scope Definition:
  - Determination of scope and system boundaries
- Life Cycle Inventory:
  - Data collection, modeling & analysis
- Impact Assessment:
  - Analysis of inputs and outputs using category indicators
- Interpretation:
  - Draw conclusions
  - Checks for: completeness, contribution, sensitivity analysis, consistency w/ goal and scope, analysis, etc.

ISO 14040 and ISO 14044



ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework

ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines

LCA – LIFE CYCLE ASSESMENT
SCOPE AND GOALS

Goal and Scope: it is a key step in the ISO stds which covers the following areas:

- **PRODUCT SYSTEM TO STUDY**
- **THE FUNCTIONAL UNIT**
- **BOUNDARIES (What IN and What OUT)**
- **ASSUMPTIONS**
- **DATA REQUIREMENTS**

LCA – LIFE CYCLE ASSESMENT
Functional Unit Def.

The functional unit is the measure of performance which the system delivers.

- "Unit surface area covered by paint for a defined period of time"
- "packaging used to deliver a given volume of beverage"
- "amount of detergents necessary for a standard household wash"
- "a cup of coffee"

For comparative studies, it is essential that systems are compared on the basis of equivalent function.

Example

- Functional unit is the measure of the performance of each system

Equivalent weight

1 X formula

3 X formula

Equivalent function

1 wash=110 mL

1wash=37mL

LCA – LIFE CYCLE ASSESMENT
ISO 14000 and GRI

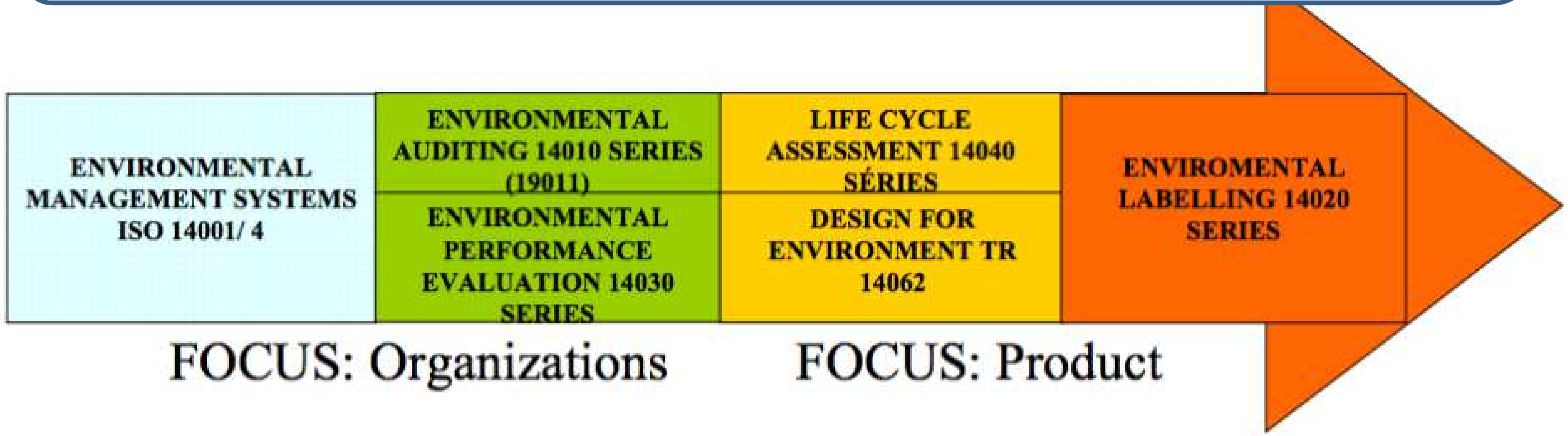
A COMPREHENSIVE LCA IS PERFORMED BASED ON TWO STANDARDS CATEGORIES:

- **ISO – INTERNATIONAL STANDARDS ORGANZATION**
- **GRI – GLOBAL REPORTING INITIATIVES**

ISO 14000

GRI 301 to 308

LCA – LIFE CYCLE ASSESMENT ISO 14000



Life Cycle Assessment (LCA) is a method defined by the international standards ISO 14040 and 14044 to analyse environmental aspects and impacts of product systems.

ISO 14040:2006

- *Environmental management -- Life cycle assessment -- Principles and framework*

ISO 14044:2006

- *Environmental management -- Life cycle assessment -- Requirements and guidelines*

ISO Standards

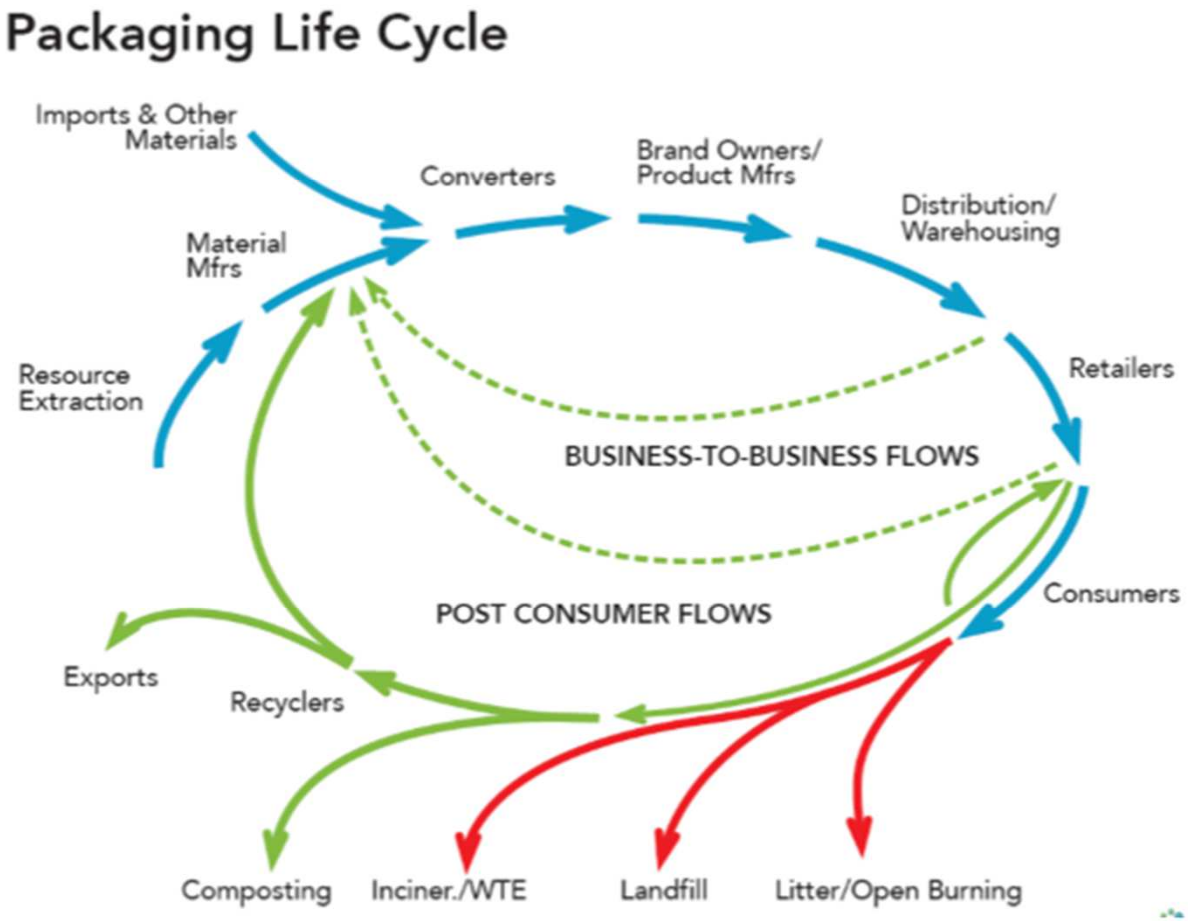
- ISO 14020 (1998) Environmental labels and declarations - General Principles
- ISO 14021 (1999) Environmental labels and declarations - Self-declared environmental claims (Type II environmental Labelling)
- ISO 14024 (1999) Environmental labels and declarations - Type I environmental labelling - Principles and procedures
- ISO 14025 (2006) Environmental labels and declarations - Type III environmental declarations - Principles and procedures
- ISO 14031 (1999) Environmental Management - Environmental Performance Evaluation - Guidelines
- **ISO 14040 (2006) Environmental Management - Life Cycle Assessment - Principles and Framework**
- **ISO 14044 (2006) Environmental Management - Life Cycle Assessment - Requirements and guidelines**
- ISO 14046 () Environmental Management - Water Footprint - Requirements and guidelines
- ISO/TS 14048 (2002) Environmental Management - Life Cycle Assessment - Life Cycle Assessment Data Documentation Format
- ISO/TR 14049 (2000) Environmental Management - Life Cycle Assessment - Examples of Application of ISO 14041 to Goal and Scope Definition and Inventory Analysis
- ISO/WD 14067-1 (2009) Carbon footprint of products -- Part 1: Quantification
- ISO/WD 14067-2 (2009) Carbon footprint of products -- Part 2: Communication
- ISO 14071 () Critical review processes and reviewer competencies -- Additional requirements and guidelines to ISO 14044:2006
- ISO 21930 (2007) Sustainability in building construction - Environmental declaration of building products

LCA – LIFE CYCLE ASSESMENT
SCOPE AND GOALS

Life Cycle Scope

…let's reharse on the LCA concepts…

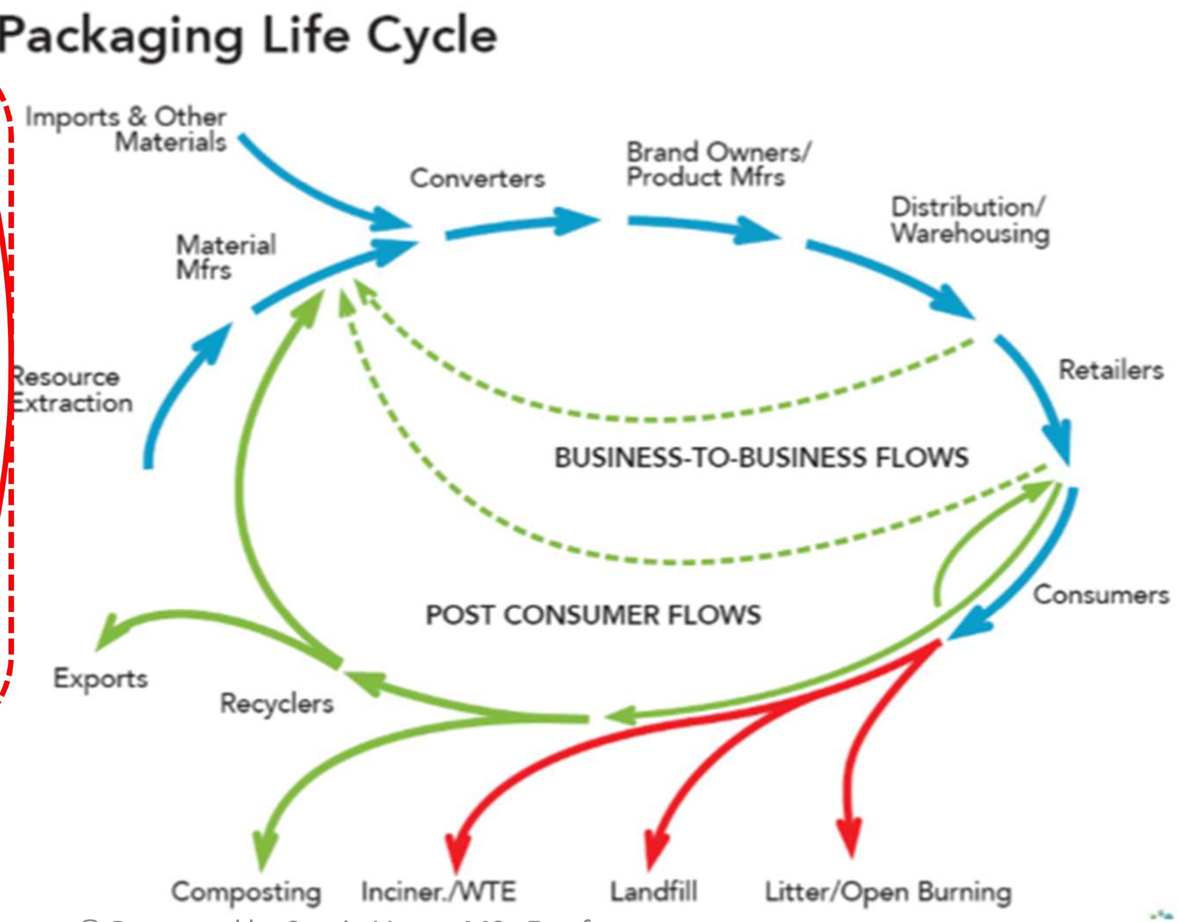
- **Extraction of raw materials**
- **Processing of materials**
- **Production**
- **Transport & Distribution**
- **Use**
- **Reuse or recycle**
- **Disposal**



LCA – LIFE CYCLE ASSESMENT SCOPE
«Cradle to Grave or Cradle (w/ recycling)»

Life Cycle Scope

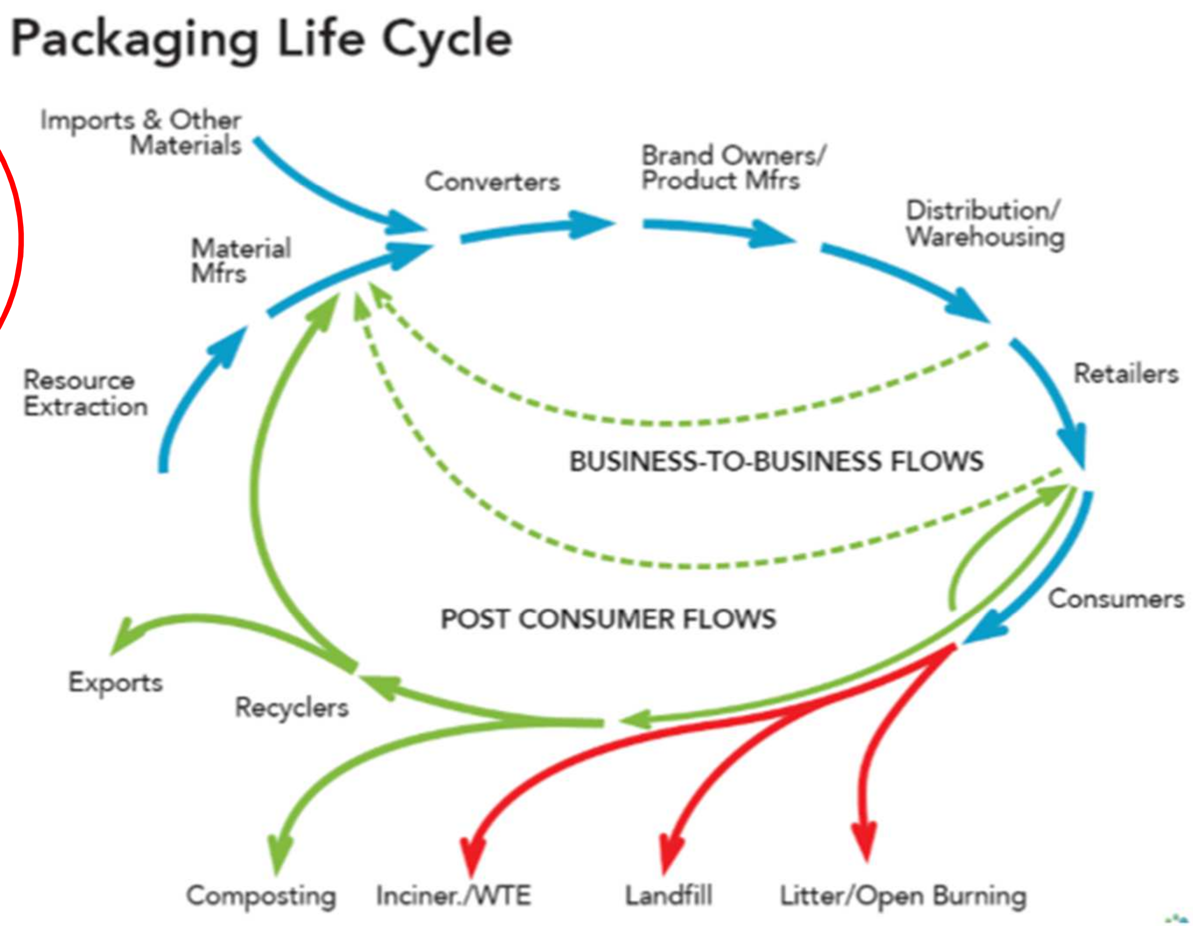
- **Extraction of raw materials**
- **Processing of materials**
- **Production**
- **Transport & Distribution**
- **Use**
- **Reuse or recycle**
- **Disposal**



LCA – LIFE CYCLE ASSESMENT SCOPE
«Cradle to Gate»

Life Cycle Scope

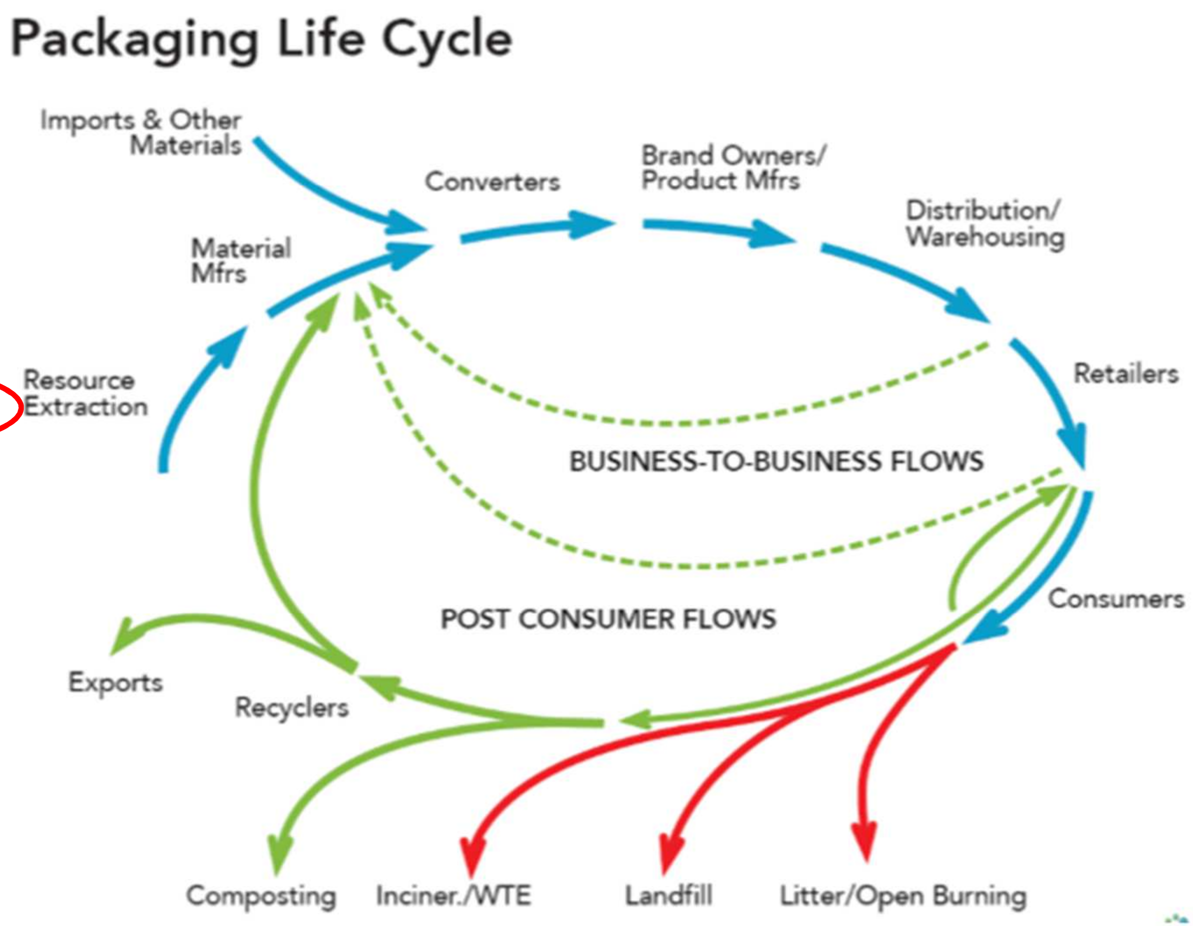
- **Extraction of raw materials**
- **Processing of materials**
- **Production**
- **Transport & Distribution**
- **Use**
- **Reuse or recycle**
- **Disposal**



LCA – LIFE CYCLE ASSESMENT SCOPE
«Gate to Gate»

Life Cycle Scope

- **Extraction of raw materials**
- **Processing of materials**
- **Production**
- **Transport & Distribution**
- **Use**
- **Reuse or recycle**
- **Disposal**



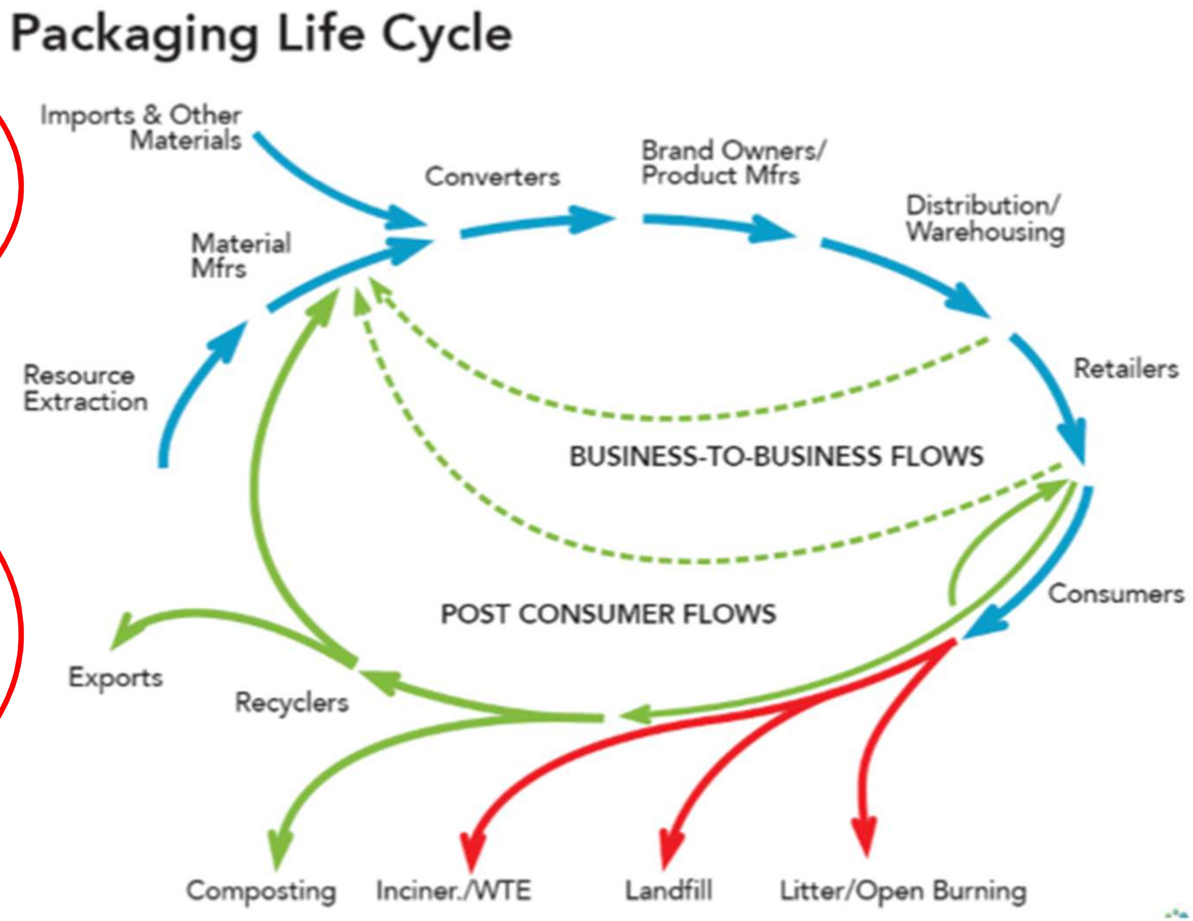
LCA – LIFE CYCLE ASSESMENT SCOPE
«Well to Wheel – Distribution and transportation»

Life Cycle Scope

UPSTREAM

- **Extraction of raw materials**
- **Processing of materials**
- **Production**
- **Transport & Distribution**
- **Use**
- **Reuse or recycle**
- **Disposal**

DOWNSTREAM

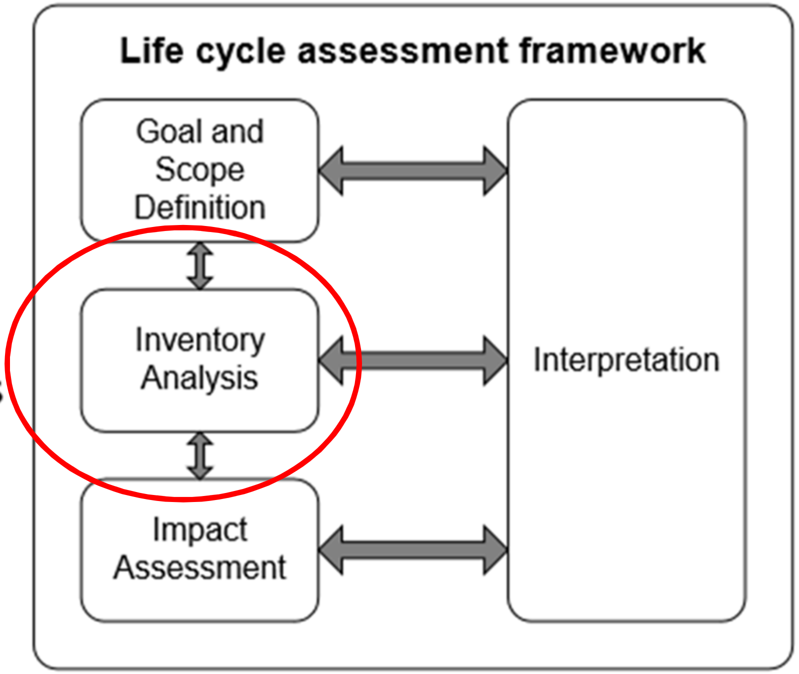


How to do LCA according to ISO

Where SCM (mainly) ?

- Goal & Scope Definition:
  - Determination of scope and system boundaries
- Life Cycle Inventory:
  - Data collection, modeling & analysis
- Impact Assessment:
  - Analysis of inputs and outputs using category indicators
- Interpretation:
  - Draw conclusions
  - Checks for: completeness, contribution, sensitivity analysis, consistency w/ goal and scope, analysis, etc.

ISO 14040 and ISO 14044



ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework

ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines

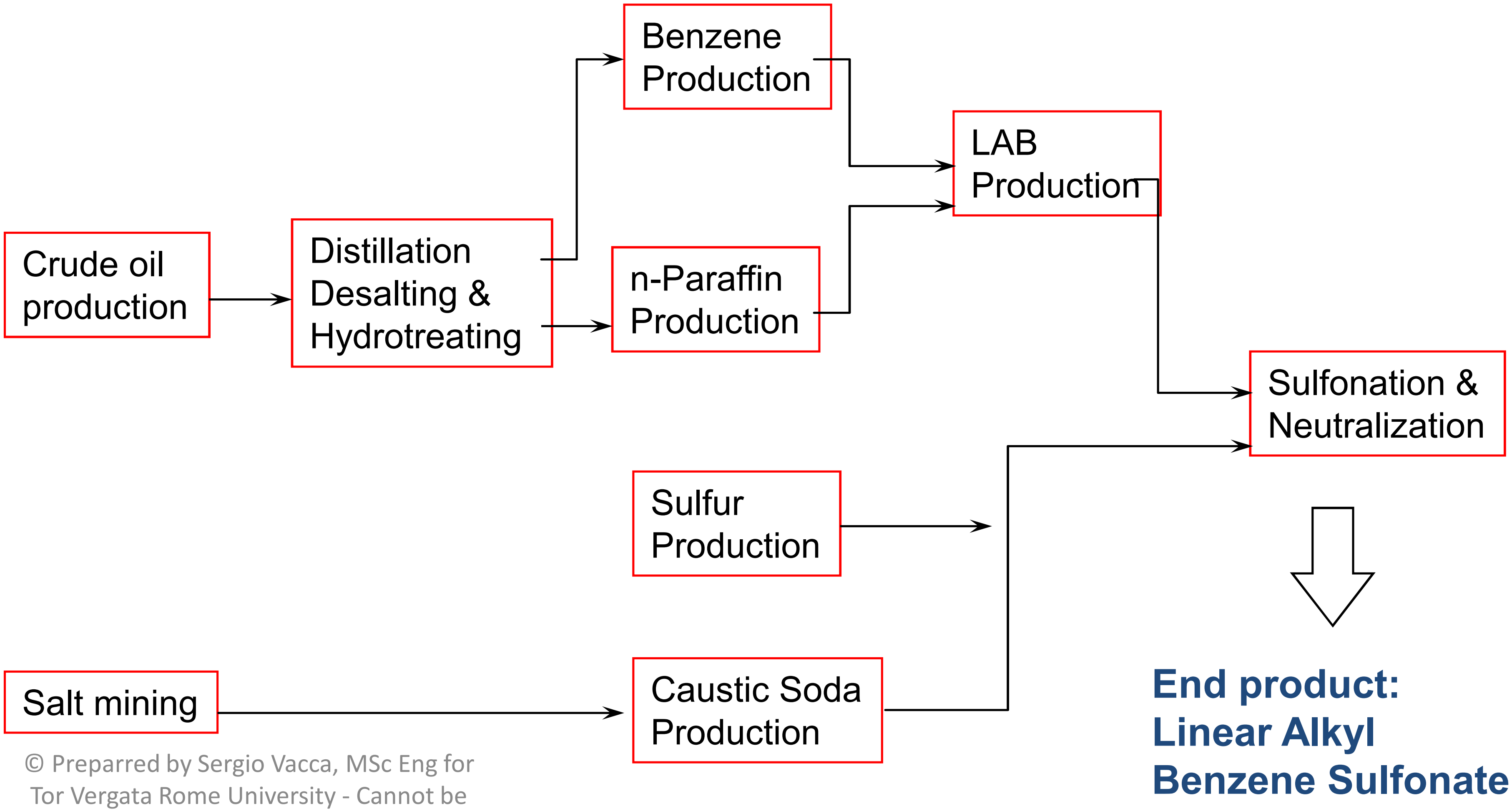
LIFE CYCLE «INVENTORY» – LCI – Literally means «Listing Of Products»

A life cycle inventory is a process of quantifying energy and raw material requirements, atmospheric emissions, waterborne emissions, solid wastes, and other releases for the entire life cycle of a product, process, or activity

In practice is the process Flow Mapping, including components, flows, Inputs and Outputs of mass and energy with relevant values and balance.

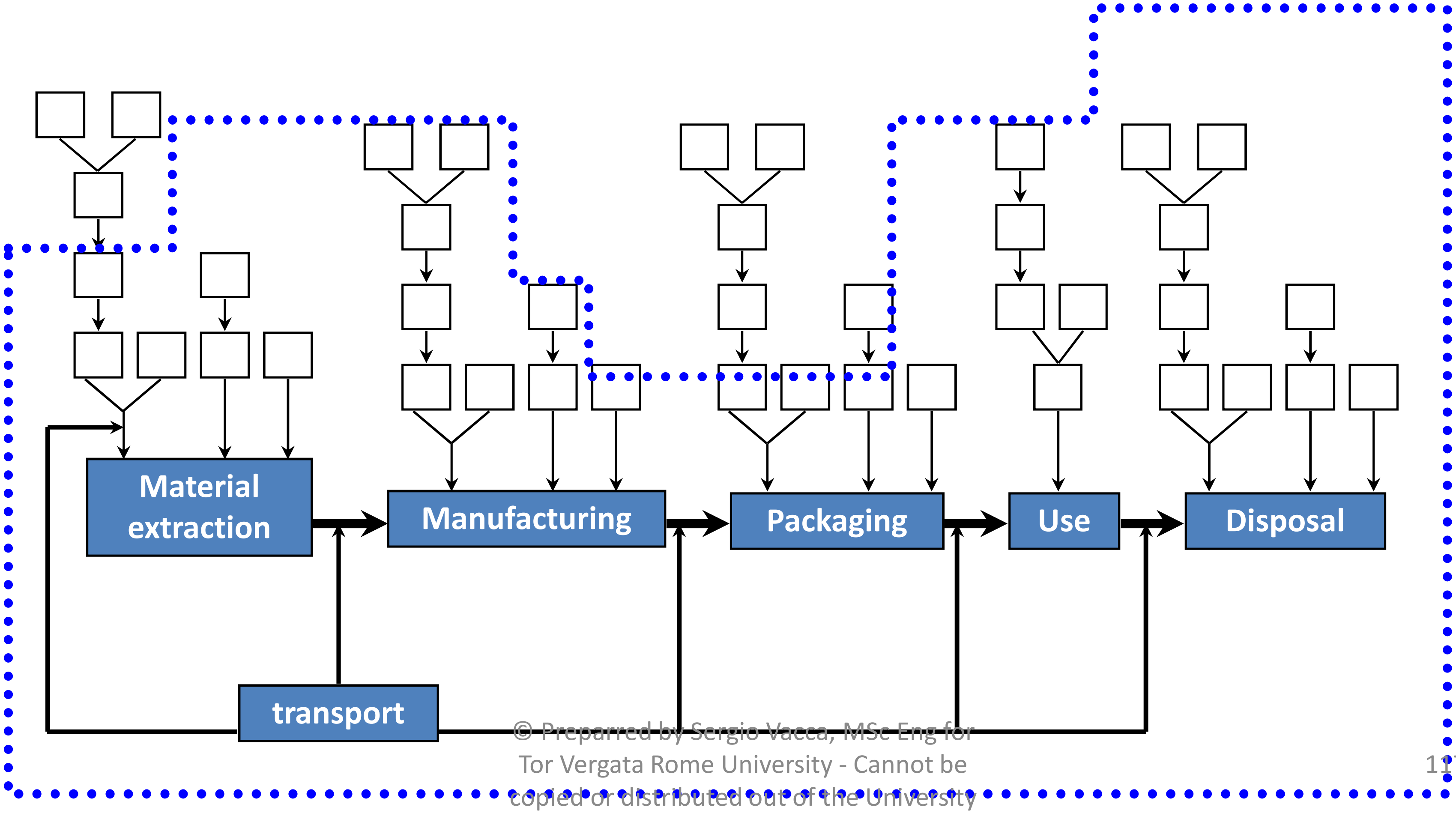
LCA – LIFE CYCLE ASSESMENT
Process Flow Chart

The more complete the flow diagram, the greater the accuracy and utility of the results

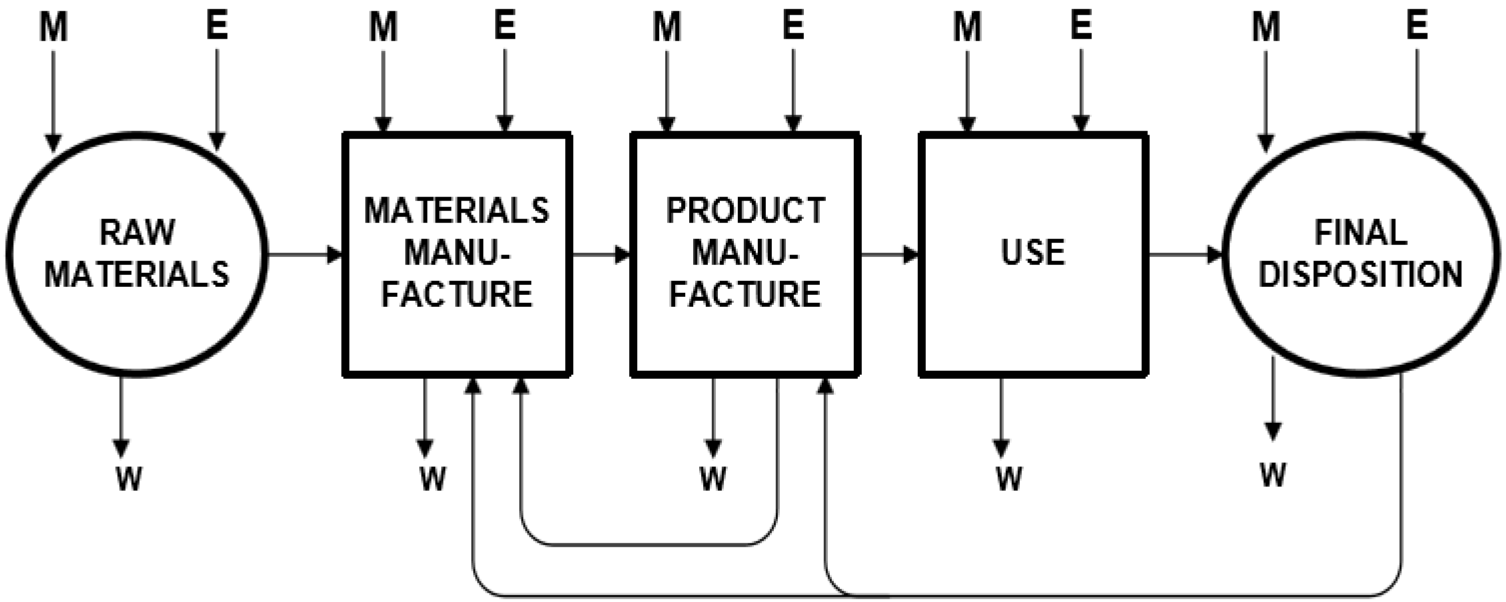


LCA – LIFE CYCLE ASSESMENT
Process Flow Chart

A generic process mapping for a E2E transformation



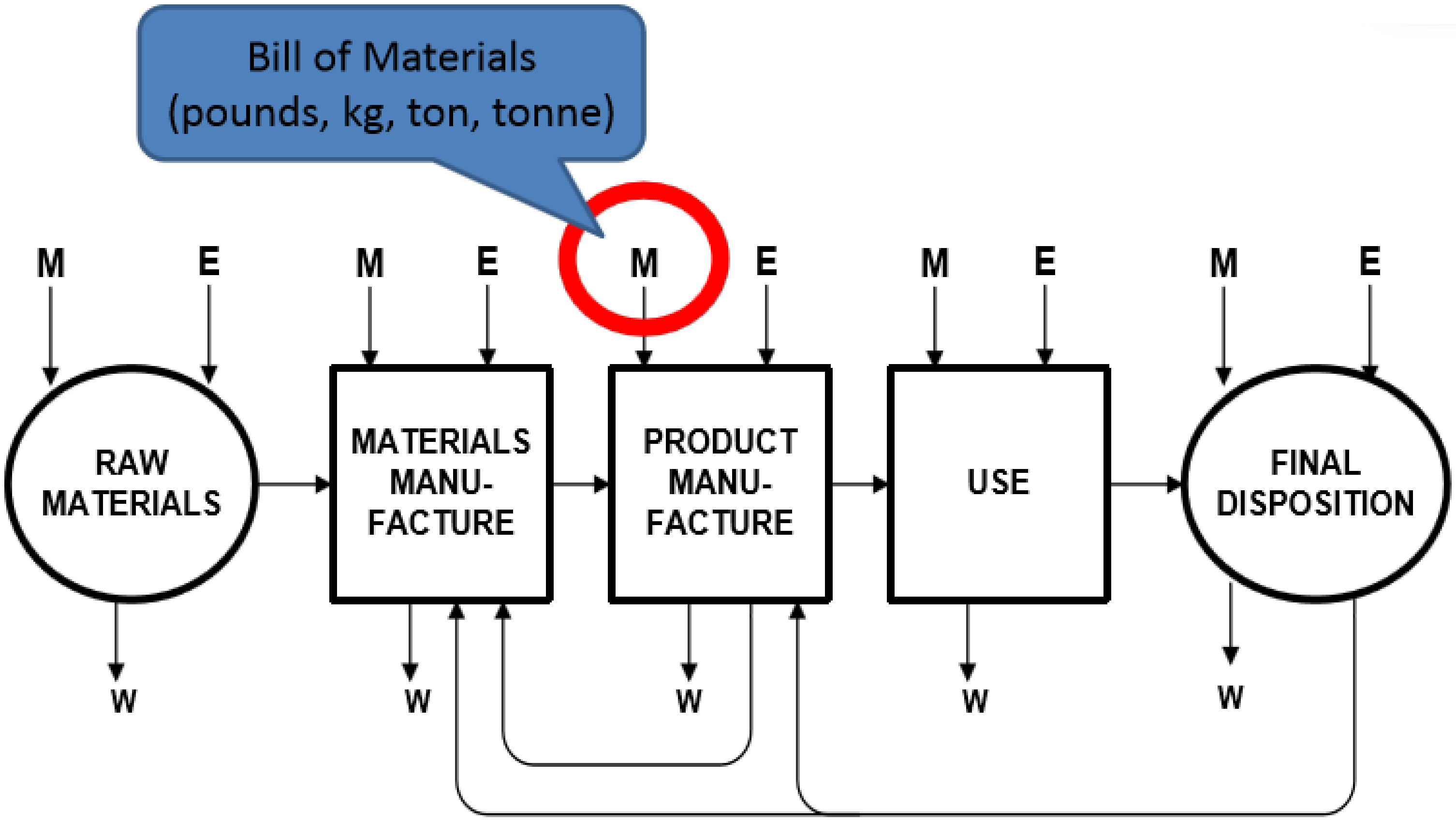
Process Level Inventory



M = Materials
E = Energy
W = Wastes (air, water, & soil)

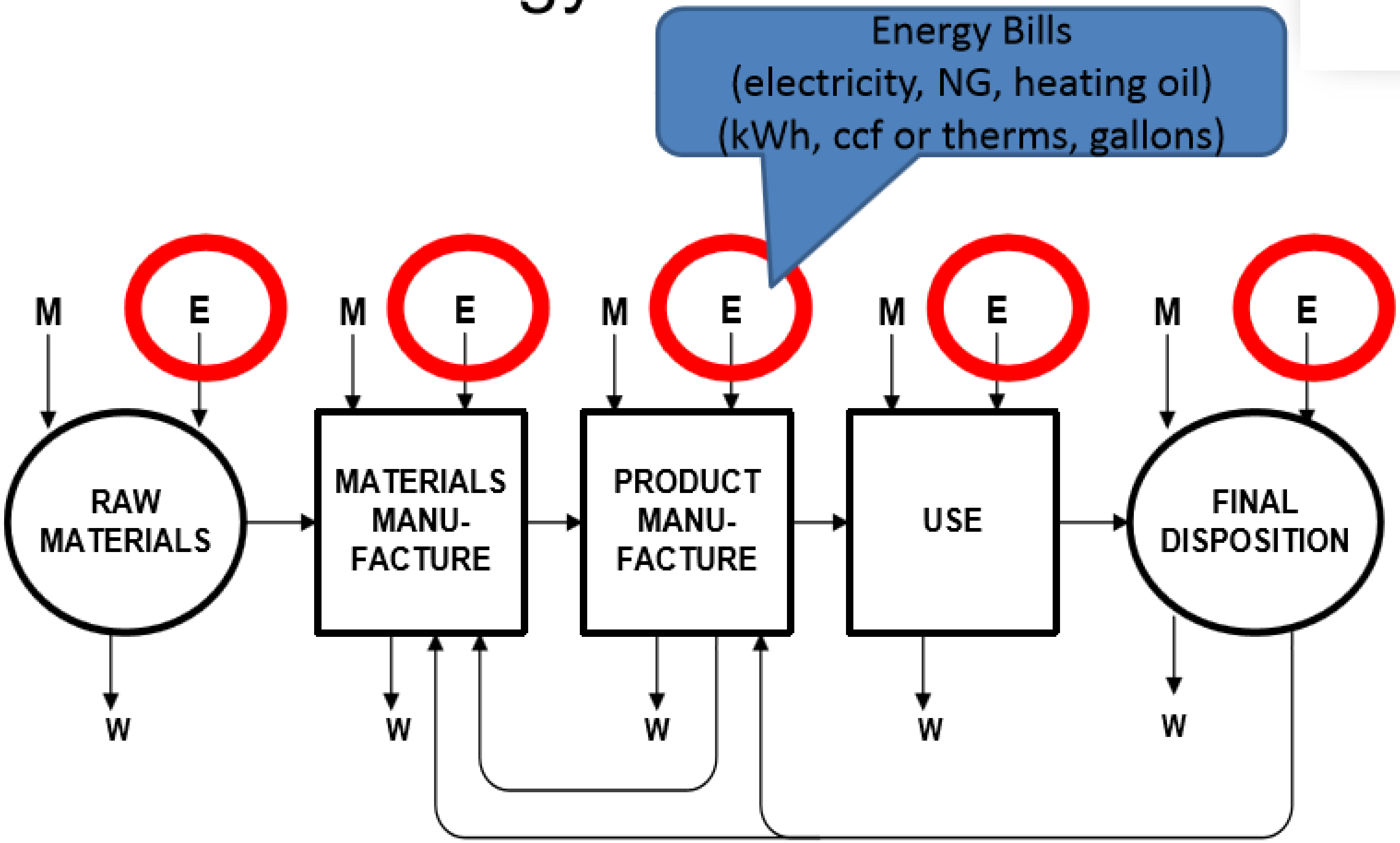
RESOURCE EFFICIENCY INDICATORS

#1. Determine materials in product – by mass



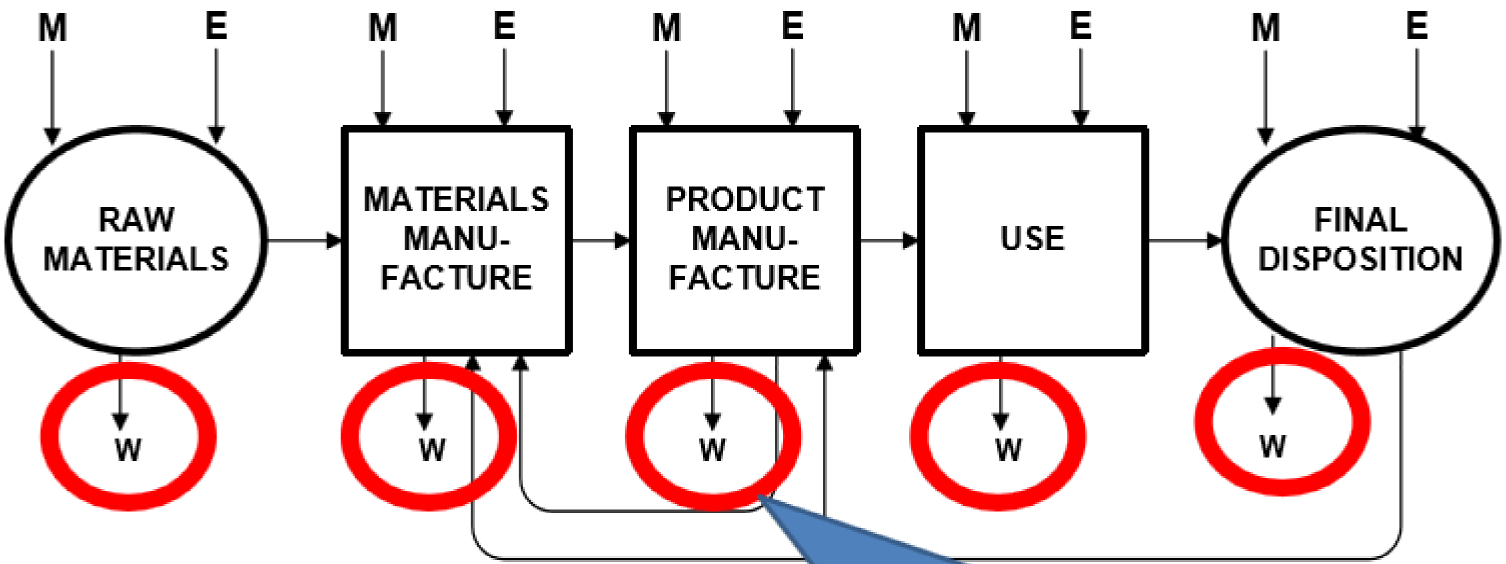
M = Materials
E = Energy
W = Wastes (air, water, & soil)

#2. Determine Energy Use



M = Materials
E = Energy
W = Wastes (air, water, & soil)

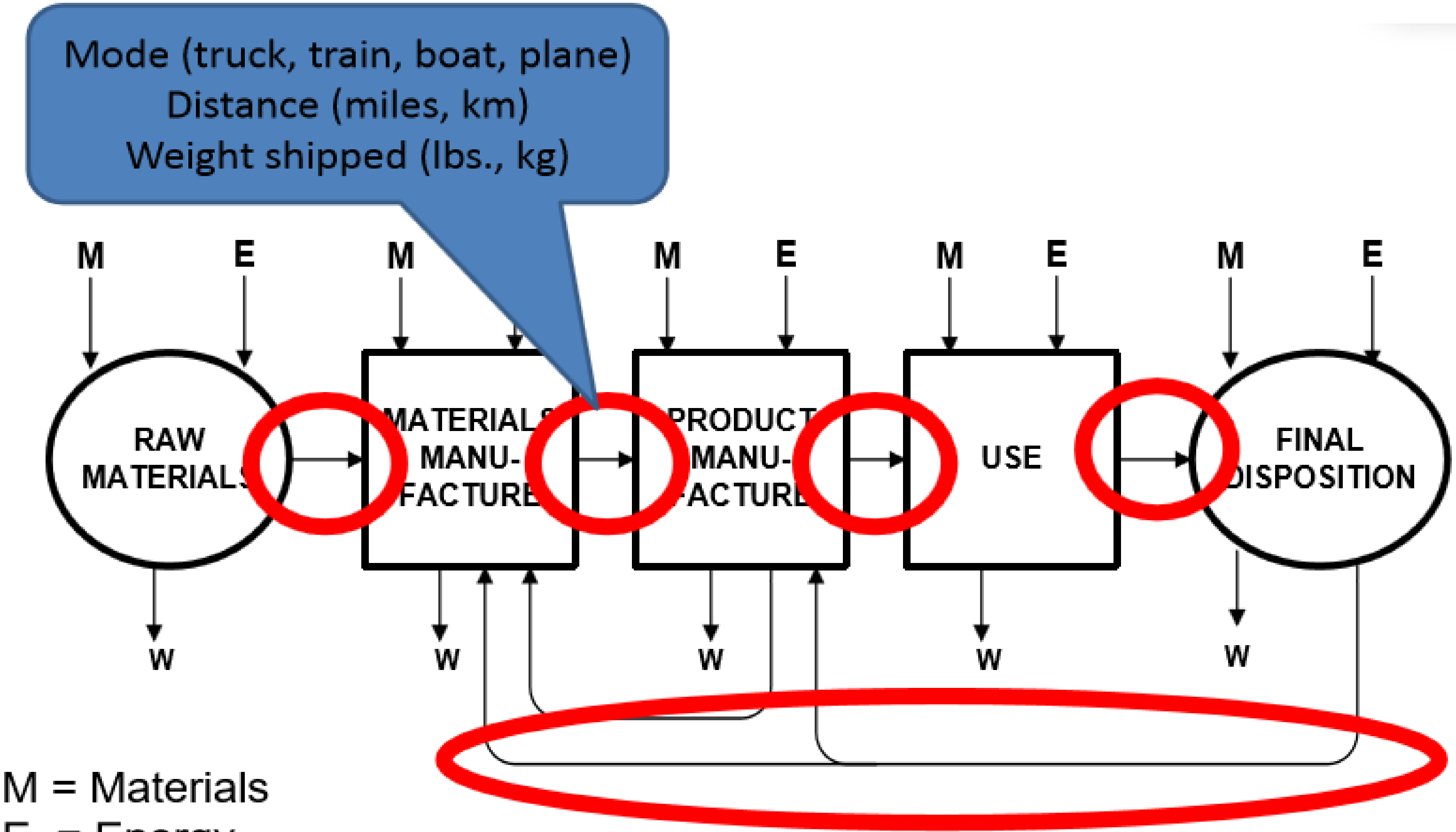
#3. Determine Process Efficiency



M = Materials
E = Energy
W = Wastes (air, water, & soil)

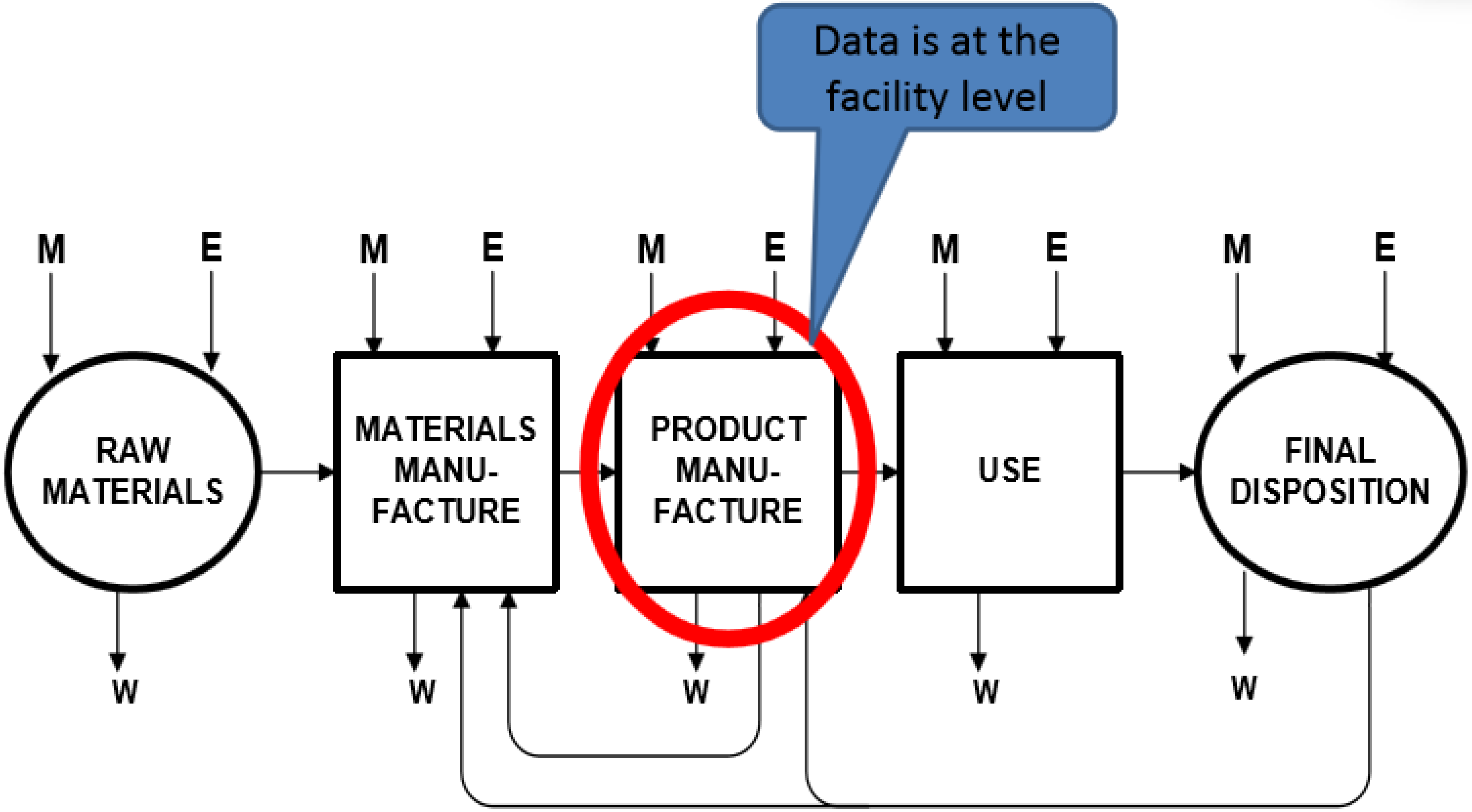
Typically measured as a percent of waste generated – i.e., how much falls on the floor, down a pipe, or up a stack.

#4. Transportation Hops



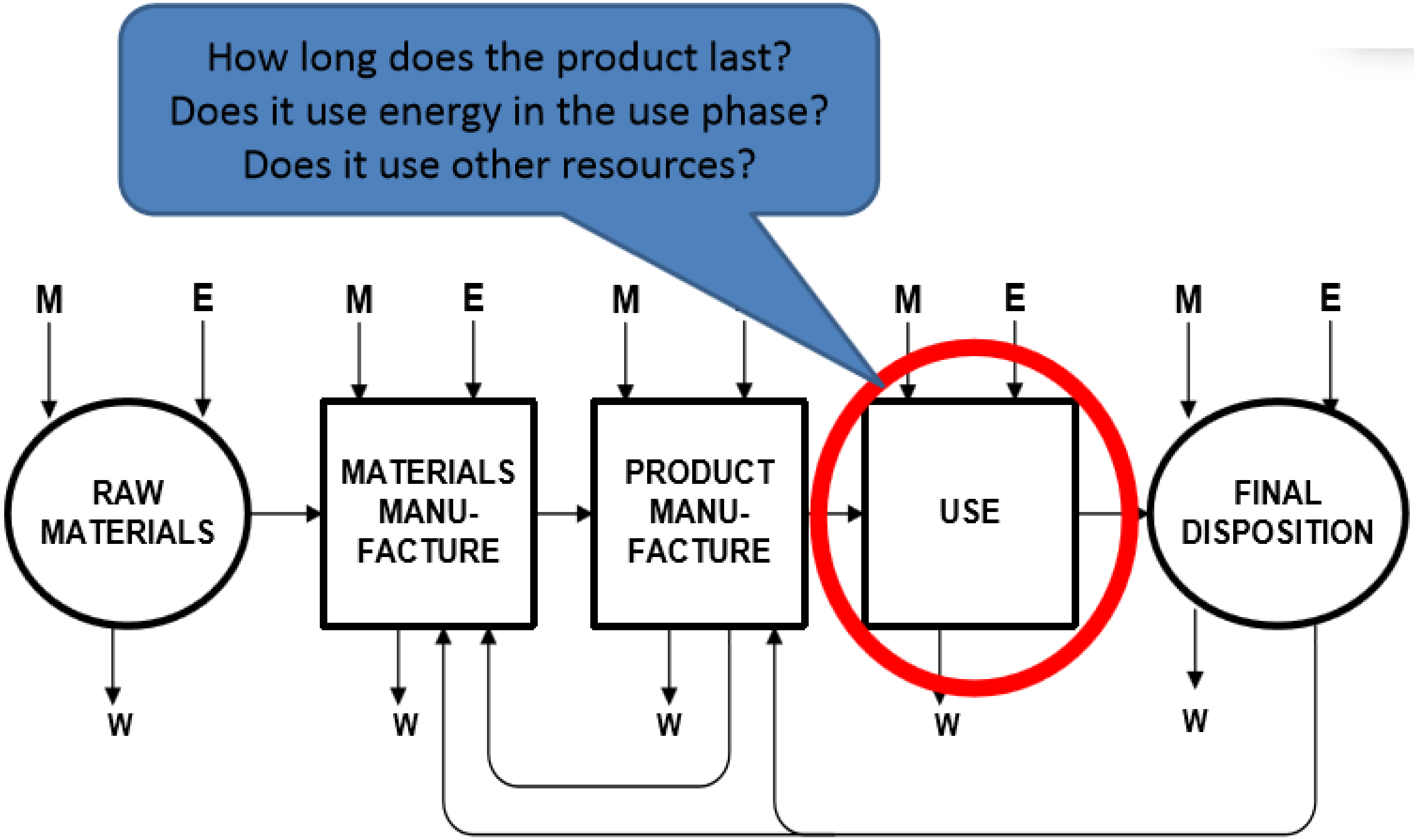
M = Materials
E = Energy
W = Wastes (air, water, & soil)

#5. Allocation of activities



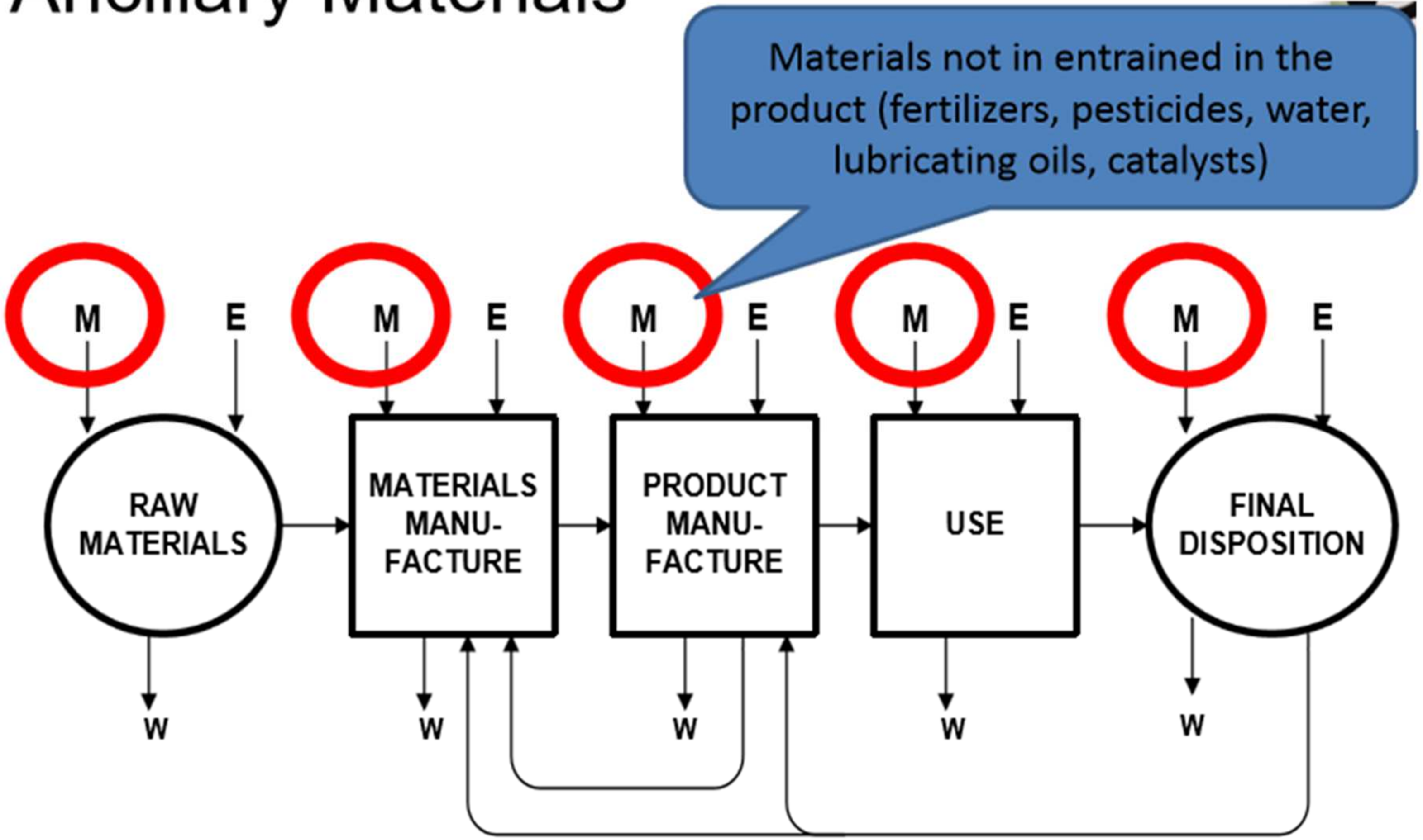
M = Materials
E = Energy
W = Wastes (air, water, & soil)

#6. Use phase assumptions



M = Materials
E = Energy
W = Wastes (air, water, & soil)

#7. Ancillary Materials



M = Materials
E = Energy
W = Wastes (air, water, & soil)

Data collection

- Data collected and used in the LCI should be based on a statistically relevant period that is long enough to integrate normal fluctuation.
- Source, geographic and temporal relevant should be recorded.
- Averaging techniques should be reported.
- Data are collected and expressed based on the defined functional unit.

Inventory tables: example

Process 1

Energy	MJ	Air emissions	g	Waterborne emissions	g
Process	12	CO2	2	BOD	13
Transportation	2	CO	4	COD	18
EMR	23	NO2	.3	Metal	.02
Total	45	Nox	.5	Suspended solids	4
		SO4	2	Phenol	.004
Solid Waste	kg	Sox	1	Sulfide	.5
Sludge	11	VOC	.04	Zinc	.6
Ash	34	Particulates	.006	Ammonia	1
Total	44	CH4	.004	Pesticides	.007
		Insecticides	.1	Sulfate	.143
		Alcohols	3	Oil	1
		….	..	...	..

Inventory tables

		P1	P2	P2	P2	P2	P2	P2	P2	Sum
Energy		MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ
	Process	12	3	3	3	3	3	3	3	345
	Transportation	2	45	45	45	45	45	45	45	456
	EMR	23	5	5	5	5	5	5	5	324
	Total	45	53	53	53	53	53	53	53	123
Solid Waste		kg	kg	kg	kg	kg	kg	kg	kg	kg
	Sludge	11	2	2	2	2	2	2	2	678
	Ash	34	54	54	54	54	54	54	54	34
	Total	44	56	56	56	56	56	56	56	54

The inventory tables represent the sum of energy and raw material consumption and environmental emissions for all processes described in the flow-chart. They represent <u>aggregated</u> data.

Data-Quality Assessment

- This is the degree of confidence in individual input and output data.
- This information is crucial to understand and appreciate the validity of the results.
- The methodology is not always 100% reliable, however it is important to make it consistent

LCA – LIFE CYCLE ASSESMENT
Sustainable SCOR – Link with the GRI metrics

The SustainableSCOR section, within *Special Applications,* of the SCOR reference manual introduces a set of strategic environmental metrics that effectively allow the SCOR model to be used as a framework for environmental accounting.

GRI Standards are free to use and are available at www.globalreporting.org/standards.

LCA – LIFE CYCLE ASSESMENT
Sustainable SCOR – benefits

- ✓ The framework ties the different emissions to the originating processes to identify root cause analysis and action taking
- ✓ Considering the hierarchical structure of SCOR, top down goals can be translated into targets for each activity
- ✓ Metrics are clearly defined and can provide a foundation for effective benchmarking

Sustainable SCOR – expected benefits

- ✓ Improves Agility – Sustainable SCM help mitigate risks and speed innovations
- ✓ Increases Adaptability - Sustainable supply chain analysis often lead to innovative processes and continuous improvements.
- ✓ Promotes Alignment – Sustainable SCM involves negotiating policies with suppliers and customers, which results in better alignment of business processes and principles

Adapted from Oklahoma State University - IEM 5813

LCA – LIFE CYCLE ASSESMENT

Sustainable SCOR – Link with the GRI metrics

Which are the advantages of using SCOR instead of simple Process Mapping ?

The benefits come from the possibility to utilize a:

1. *In depth and detailed proven to work framework with 3 levels of Processes and accurate metrics – exhaustive LCI*
2. *A full linkage among Processes, Metrics, Practices and GRI (and People) in a E2E approach*
3. *A comprehensive output for different purposes: Assessment, Auditing and Process re-engineering*

LCA – LIFE CYCLE ASSESMENT
SCOR – Performance Attributes

RELIABILITY: correct product to the Customer – reduces waste from product discards and emissions from rework. Correct doc.s allow to track hazard matls, proper storage and disposal

RESPONSIVENESS: the speed by which product is transformed, thus mitigating the environmental impact, pollution and regulatory steps

FLEXIBILITY: the degree by which an organisation can meet the environmental demand of its customers

COSTS: including the costs of environmental compliance, energy, clean up, disposal

ASSET MGMT: any investment practice include governance, environmental and social aspects. C2C provides the entity of value circulating, expecially on Inventory.

Sustainable SCOR – Performance Attributes proposition

PLAN Phase

- Plan to minimize energy consumption and hazardous material usage
- Plan the handling and storage of hazardous materials
- Plan for the disposal of ordinary and hazardous waste
- Plan compliance of all supply chain activities

Processes used to aid environmental decision-making in this phase

- Environmental Cost Accounting
- Environmental life cycle analysis
- Design for environment

SOURCE Phase

- Select suppliers with positive environmental records
- Select materials with environmentally friendly content
- Specify packaging requirements
- Specify delivery requirements to minimize transportation and handling requirements

Processes used to aid environmental decision-making in this phase:

- Environmental Auditing
- Environmental Certification

Adapted from Oklahoma State University - IEM 5813

Sustainable SCOR – Performance Attributes proposition – cont.ed

MAKE Phase

- Schedule production to minimize energy consumption
- Manage waste generated during the Make process
- Manage emissions (air and water) from the Make process

Processes used to aid environmental decision-making in this phase:

- Pollution prevention techniques like substitution, product modification, improved maintenance, and recycling.
- Environmental management systems like guidance for employees in environmental health and safety procedures and facilitation of tools for continual improvement of environmental performance.

DELIVER Phase

- Minimize use of packaging materials
- Schedule shipments to minimize fuel consumption

Processes used to aid environmental decision-making in this phase:

- Green Logistics Approach: Considers the impact of procurement, transport, inventory control, and distribution activities to minimized environmental costs.

Adapted from Oklahoma State University - IEM 5813

Sustainable SCOR – Performance Attributes proposition – cont.ed

RETURN Phase

- Schedule transportation and aggregate shipments to minimize fuel consumption; prepare returns to prevent spills of hazardous materials (oils, fuels, etc.) from damaged products

Processes used to aid environmental decision-making in this phase:

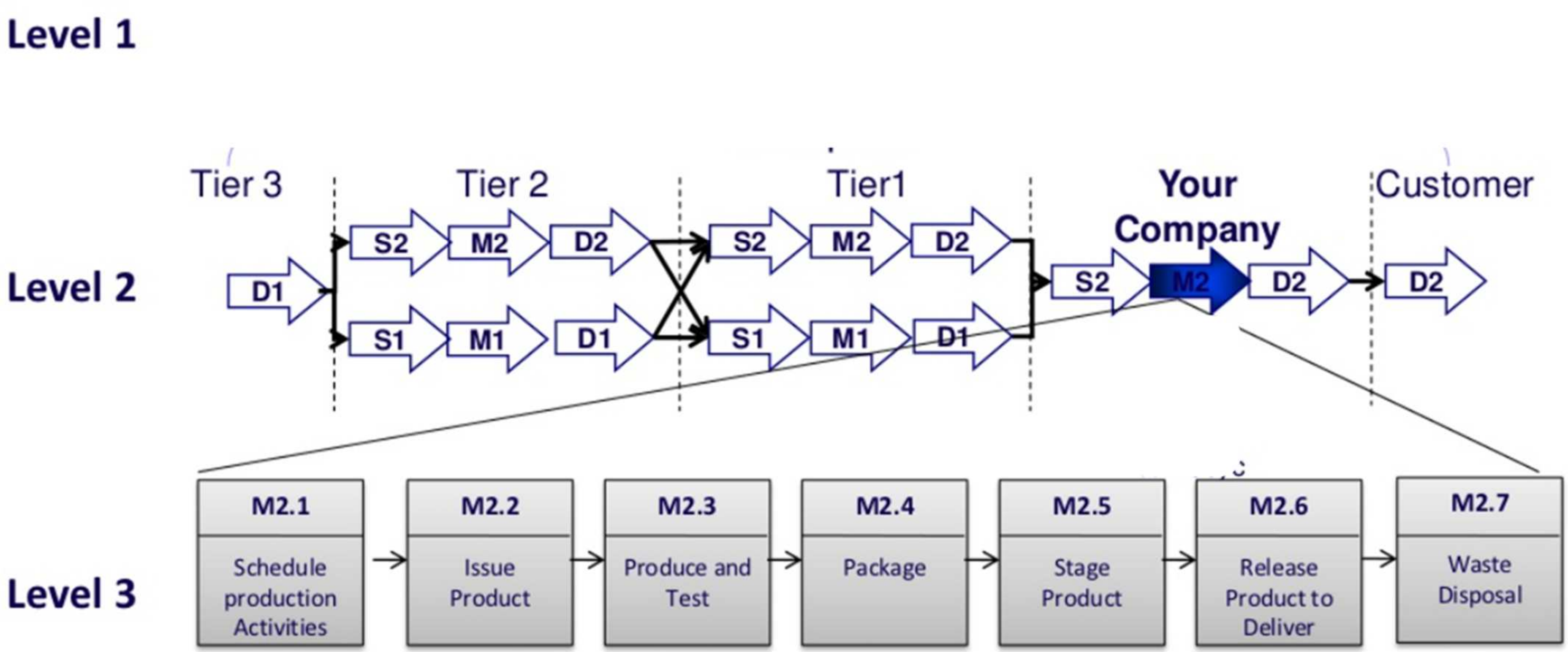
- Reverse Logistics
- Remanufacturing
- Recycling

Benefits

- Improved environmental management performance
- Improved supply chain management performance
- Improved green supply chain initiatives
- Challenges
- Data
- Cultural
- Training

Adapted from Oklahoma State University - IEM 5813

LCA – LIFE CYCLE ASSESMENT
Sustainable SCOR – Link with the GRI metrics

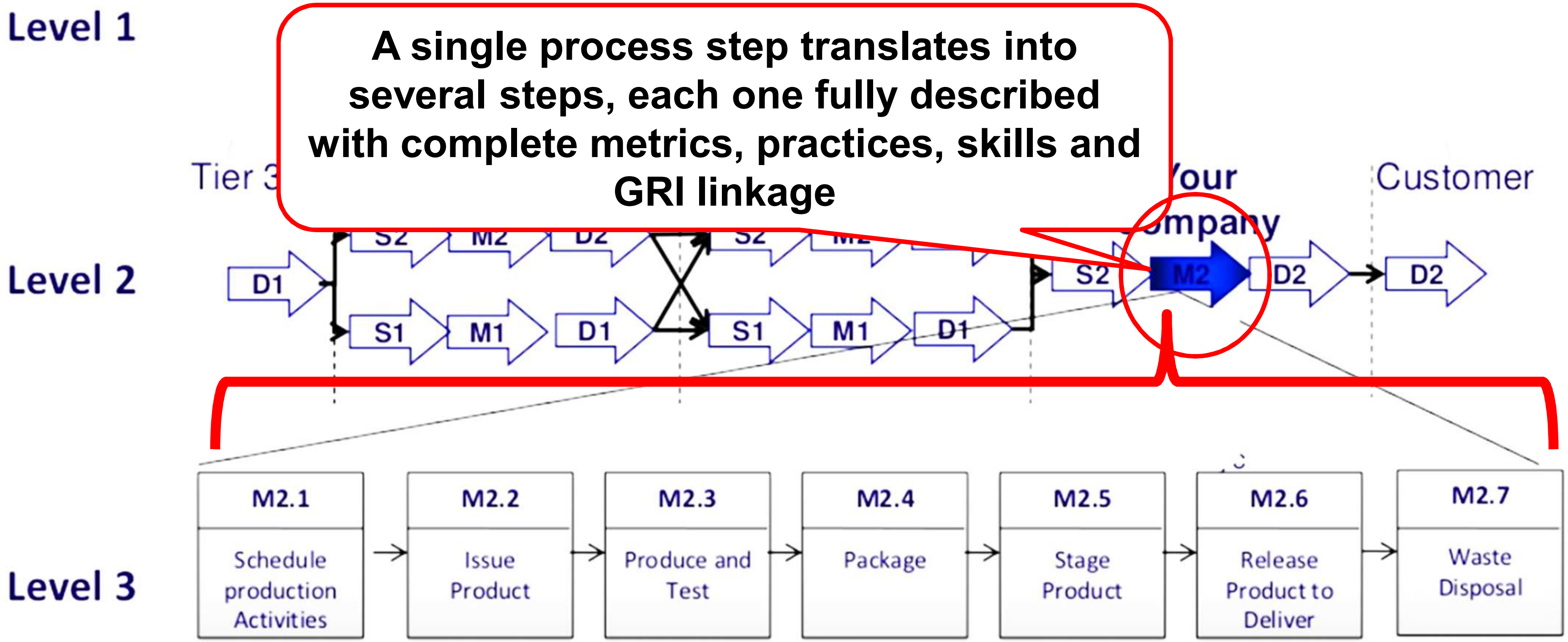


SS.1.015 Total SC GHG Emissions =

Direct (Scope 1) GHG (SS.1.016) + Indirect (Scope 2) GHG (SS.1.017) + Other GHG (Scope 3) (SS.1.018)

Ex. SS.2.045 Make Direct (Scope1) GHG Emissions

LCA – LIFE CYCLE ASSESMENT
Sustainable SCOR – Link with the GRI metrics



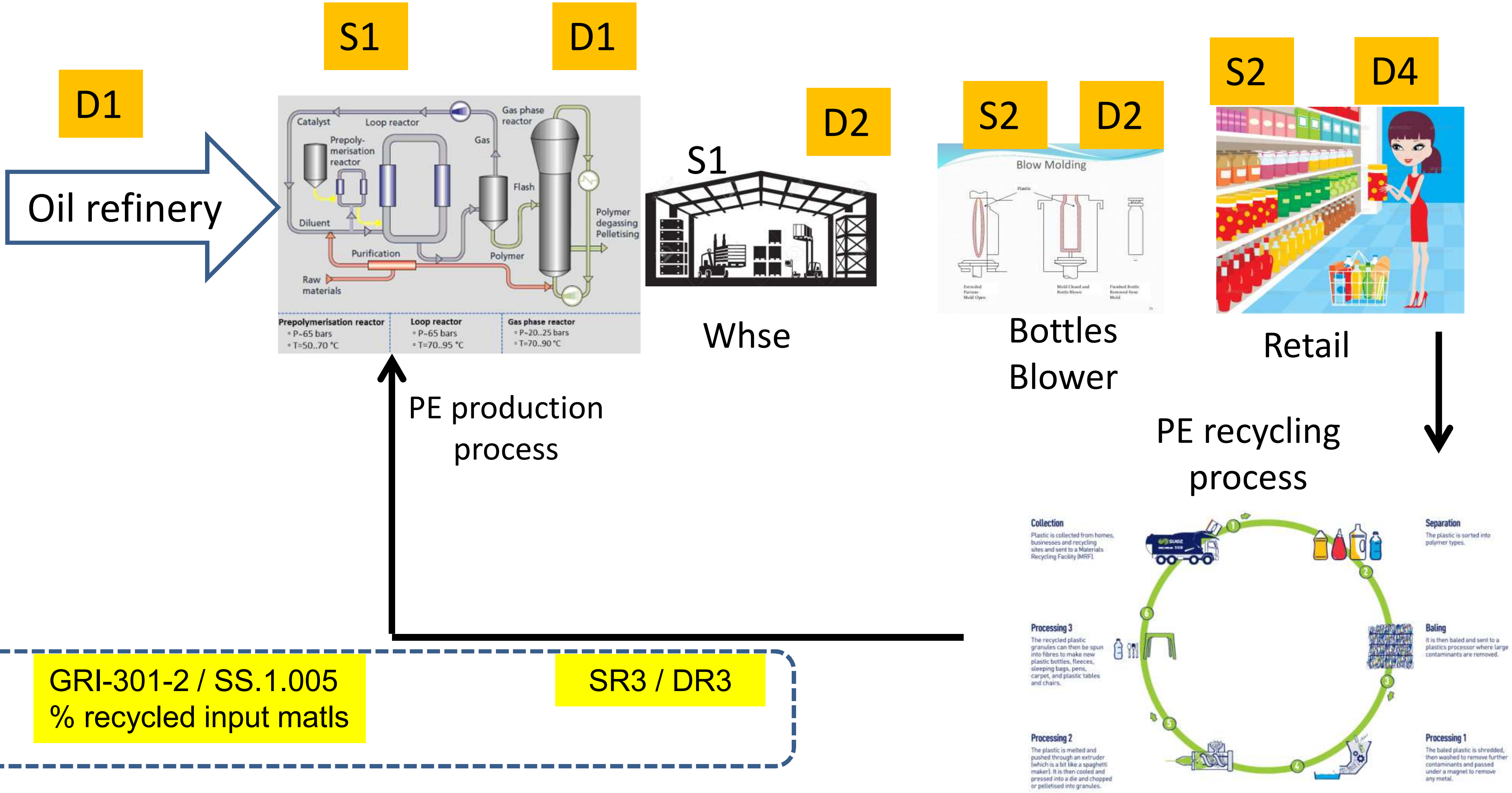
SS.1.015 Total SC GHG Emissions =

Direct (Scope 1) GHG (SS.1.016) + Indirect (Scope 2) GHG (SS.1.017) + Other GHG (Scope 3) (SS.1.018)

Ex. SS.2.045 Make Direct (Scope1) GHG Emissions

Polyethilene Recycling Process

GRI-301-1	materials used
GRI-302	energy consumed SS.1.007; GRI-302-1 and GRI-302-2
GRI-303	water withdrawn / re-used
GRI-305	305-1 GHG emissions (Direct-SCOPE 1 ; 305-2 Indirect (Scope2); 305-3 Other Indirect (Scope 3)



LCA – LIFE CYCLE ASSESMENT
SCOR AND GRI CONVERGENCE

S

METRICS Lev.1 ,26 – Lev.2, 90– Lev.3, 55 Total 171

SustainableSCOR Metrics

GRI Standard	Category	Metric	Units	Basis
SS.1.001-1.004	Materials	Materials used	Weight or volume	Total weight or volume of materials that are used to produce and package the organization's primary products and services.
SS.1.005 301	Recycled inputs	Percent recycled input materials	Percent	The percent of recycled input materials used to manufacture the organization's primary products and services.
SS.1.006	Reclaimed inputs	Percent reclaimed input materials	Percent	The percent of reclaimed input materials used to manufacture the organization's primary products and services.
SS.1.007-1.009 Inside/outside 302 Prods./Services	Energy	Energy consumed	Joules, Watt-hours or multiples	
		Energy intensity ratio	Ratio	The energy required per unit of activity, output or any other organization-specific metric.
		Reduction of energy consumption	Joules, Watt-hours or multiples	The amount of reductions in energy consumption achieved as a direct result of conservation and efficiency initiatives.

LCA – LIFE CYCLE ASSESMENT
SCOR AND GRI CONVERGENCE

SustainableSCOR Metrics (continued)

GRI Standard	Category	Metric	Units	Basis
303	Water	Water volume withdrawn	Gallons, liters or multiples	
		Water intensity ratio	Ratio	The water withdrawal required per unit of activity, output or any other organization-specific metric.
		Water recycled and reused	Gallons, liters or multiples	The rate of water reuse and recycling is a measure of efficiency and demonstrates success in reducing total water withdrawals and discharges.
305	Emissions	Air emissions	Metric tons or equivalents	Emissions into the air, which are the discharge of substances from a source into the atmosphere.
		GHG emissions intensity	Ratio	The amount of GHG emissions per unit of activity, output, or any other organization-specific metric.
		Reduction of GHG emissions	Metric tons or equivalents	The amount of reductions in GHG emissions achieved as a direct result of elements or activities designed to reduce GHG emissions, such as carbon storage.
306	Effluents and Waste	Liquid and solid wastes	Gallons, Liters or Multiples, Weight or Volume	The amount of effluents and waste generated by an organization to produce and package the organization's primary products and services. This includes water discharges, hazardous and non-hazardous waste.

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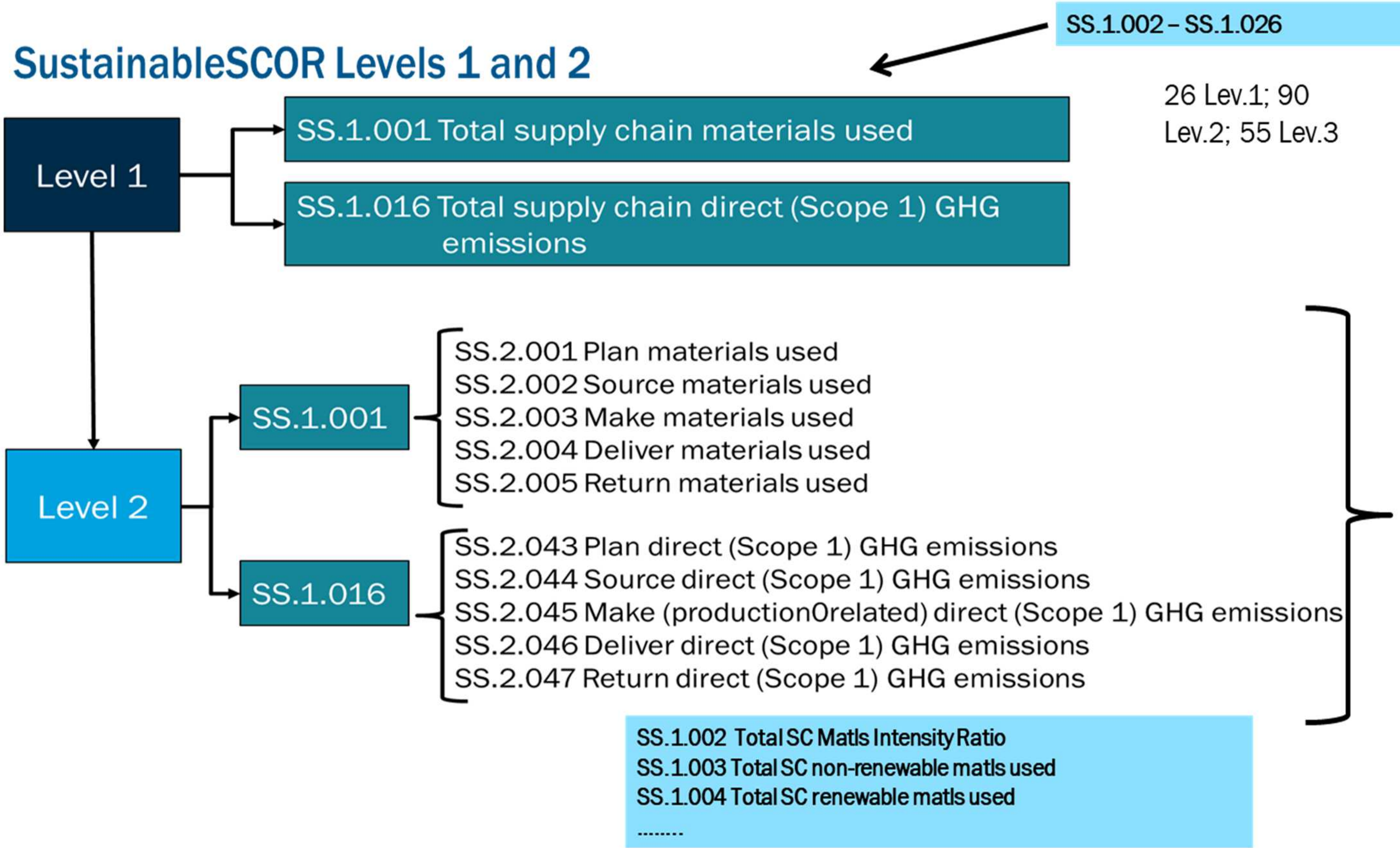
SCOR AND GRI CONVERGENCE



GRI's Vision & Mission

Vision

A sustainable global economy where organizations manage their economic, environmental, social and governance performance and impacts responsibly and report transparently.

Mission

To make sustainability reporting standard practice by providing guidance and support to organizations.

Source: GRI

Global Reporting

LCA – LIFE CYCLE ASSESMENT
GRI – Global Reporting Initiative

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GRI – Global Reporting Initiative

Most of the data are relevant to the Environmental management – **GRI 300** Stds

GRI 301 – Materials

GRI 302 – Energy

GRI 303 – Water / Effluents

GRI 304 – Biodiversity

GRI 305 – Emissions

GRI 306 – Effluents / Waste

GRI 307 – Environmental compliance

GRI 308 - Supplier environmental assessment

SCOR

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GRI – Global Reporting Initiative

Disclosure 305-1
Direct (Scope 1) GHG emissions

Reporting requirements

Disclosure 305-1

The reporting organization shall report the following information:

a. Gross direct (Scope 1) GHG emissions in metric tons of CO_2 equivalent.

b. Gases included in the calculation; whether CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3, or all.

c. Biogenic CO_2 emissions in metric tons of CO_2 equivalent.

d. Base year for the calculation, if applicable, including:

   i. the rationale for choosing it;

   ii. emissions in the base year;

   iii. the context for any significant changes in emissions that triggered recalculations of base year emissions.

e. Source of the emission factors and the global warming potential (GWP) rates used, or a reference to the GWP source.

f. Consolidation approach for emissions; whether equity share, financial control, or operational control.

g. Standards, methodologies, assumptions, and/or calculation tools used.

2.1 When compiling the information specified in Disclosure 305-1, the reporting organization shall:

2.1.1 exclude any GHG trades from the calculation of gross direct (Scope 1) GHG emissions;

2.1.2 report biogenic emissions of CO_2 from the combustion or biodegradation of biomass separately from the gross direct (Scope 1) GHG emissions. Exclude biogenic emissions of other types of GHG (such as CH_4 and N_2O), and biogenic emissions of CO_2 that occur in the life cycle of biomass other than from combustion or biodegradation (such as GHG emissions from processing or transporting biomass).

LCA – LIFE CYCLE ASSESMENT
GRI – Global Reporting Initiative

SAINT GOBAIN EXAMPLE

Indicator

ENVIRONMENT	2016	2015	2014	GRI
Indirect emissions of greenhouse gases (purchases of electricity, steam, hot water) for the entire Group of the concerned sites*	3.2 Mt eq.CO_2	3.3 Mt eq.CO_2	3.5 Mt eq.CO_2	EN16
Indirect emissions of greenhouse gases (purchases of electricity, steam, hot water) for the entire Group at actual scope**	3.6 Mt eq.CO_2	3.5 Mt eq.CO_2	4.2 Mt eq.CO_2	EN16
Annual variation of indirect emissions of greenhouse gases (purchases of electricity, steam, hot water) for the entire Group at actual scope**	0.1 Mt eq.CO_2 (+3%)	(0.7) Mt eq.CO_2 (-17%)	(0.6) Mt eq.CO_2 (-13%)	EN19
CO_2 impact on Group annual turnover (value in 2010: 0.47 kg CO_2/€)	0,34 kgCO_2/€	0,33 kgCO_2/€	0,40 kgCO_2/€	EN18
OTHER AIR EMISSIONS				
SO_2 emissions from the concerned sites in the Pipe and Glass Activities*	11,187 t	13,150 t	15,230 t	EN21
NO_x emissions from the concerned sites in the Pipe and Glass Activities*	17,824 t	18,679 t	19,972 t	EN21
Dust emissions from the concerned sites of the Pipe and Glass Activities*	3,140 t	5,201 t	7,810 t	EN21
WATER				
Water withdrawal from the concerned sites*	50.9 M of m^3	64.0 M of m^3	63.9 M of m^3	EN8
Total water withdrawal for the entire Group at actual scope**	53.6 M of m^3	66.9 M of m^3	69.7 M of m^3	EN8
Rainwater withdrawal for the entire Group at actual scope**	0.7 M of m^3	0.7 M of m^3	0.7 M of m^3	EN8
Municipal water withdrawal for the entire Group at actual scope**	15.4 M of m^3	14.3 M of m^3	15.9 M of m^3	EN8
Surface water withdrawals for the entire Group at actual scope**	15.6 M of m^3	29.6 M of m^3	28 .9 M of m^3	EN8
Ground water withdrawal for the entire Group at actual scope**	20.3 M of m^3	19.8 M of m^3	22.7 M of m^3	EN8
Total water discharge from concerned sites*	28.0 M of m^3	37.9 M of m^3	39.2 M of m^3	EN22
Total water discharge for the entire Group at actual scope**	29.4 M of m^3	39.1 M of m^3	42.8 M of m^3	EN22
Water discharges into the surrounding environment for the entire Group at actual scope**	19.3 M of m^3	29.5 M of m^3	32.1 M of m^3	EN22
Water discharges into the municipal waste water collection system for the entire Group at actual scope**	9.5 M of m^3	8.8 M of m^3	10.2 M of m^3	EN22

(From Saint Gobain Environmental Report 2016).

LCA – LIFE CYCLE ASSESMENT
Environmental Mgmt

NIKON Sustainability Report 2017 example

Contents / Editorial Policy | Message from the President | Nikon Group Profile | Nikon CSR | Product Responsibility | Environmental Management | Respect for Human Rights | Labor Practices | Supply Chain Management | Community Contribution Activities | Foundations of Management | Data Index etc.

> Data Index | Independent Practitioner's Assurance | GRI Content Index

Data Index Environmental Management

The Nikon Group's Main Environmental Impacts

INPUT		Nikon '16/3	Nikon '17/3	Group companies in Japan '16/3	Group companies in Japan '17/3	Group companies outside Japan '16/3	Group companies outside Japan '17/3*	Unit
Energy etc.	Electricity	164,936	161,254	88,972	87,109	101,936	111,572	MWh
	City gas	5,533	5,128	1,026	1,045	0	0	thousand Nm^3
	Liquefied petroleum gas (LPG)	480	493	2,000	2,023	113	178	t
	Other fuels	9	9	630	868	0	16	kL
	Hot/Cold water	11,013	8,165	0	0	0	0	thousand MJ
Water	Water	1,878	1,846	891	900	1,098*	1,075	thousand m^3
PRTR substances*	Volume handled	21	21	76	45	—	—	t

OUTPUT		Nikon '16/3	Nikon '17/3	Group companies in Japan '16/3	Group companies in Japan '17/3	Group companies outside Japan '16/3	Group companies outside Japan '17/3*	Unit
CO_2 emissions	Electricity	83,293	80,627	47,064	45,026	61,047	63,166	t-CO_2
	City gas	12,418	11,509	2,303	2,346	0	0	t-CO_2
	Liquefied petroleum gas (LPG)	1,439	1,479	5,999	6,066	338	535	t-CO_2
	Other fuels	24	22	1,690	2,332	0	41	t-CO_2
	Hot/Cold water	462	465	0	0	0	0	t-CO_2
Water	Water	—	1,456	—	728	—	847	thousand m^3
PRTR substances released into the air*		22	18	41	29	—	—	t
Wastes etc.	Amount generated	3,404	3,271	3,261*	3,095	2,239*	2,627	t
	Amount of landfill disposal	3	2	1*	2	—	—	t

Note: Boundaries have been expanded since the year ended March 2017.
* Data includes only Group manufacturing companies outside Japan.

LCA – LIFE CYCLE ASSESMENT
Environmental Mgmt

NIKON Sustainability Report 2017 example

Contents / Editorial Policy | Message from the President | Nikon Group Profile | Nikon CSR | Product Responsibility | Environmental Management | Respect for Human Rights | Labor Practices | Supply Chain Management | Communi Contribution Ac

> Data Index Independent Practitioner's Assurance GRI Content Index

CO_2 Emissions List Breakdown by Scope and Category

(Unit: t-CO_2)

Scope/Category	Boundary	CO_2 Emissions	
		'16/3	'17/3
Scope 1	Nikon Group companies in Japan Group manufacturing companies outside Japan	24,210	24,329
Scope 2	Nikon Group companies in Japan Group manufacturing companies outside Japan	191,865	189,284
Scope 3 (individual categories within Scope 3 listed below)			
1. Purchased goods and services	Imaging Products Business and Precision Equipment Business	806,989	1,329,197
2. Capital goods	The entire Nikon Group	100,276	92,055
3. Fuel- and energy-related activities not included in Scope 1 and 2	Nikon Group companies in Japan Group manufacturing companies outside Japan	17,344	17,468
4. Upstream transportation and distribution	The entire Nikon Group	93,220	82,003
5. Waste generated in operations	Nikon (excluding Head Office) Group manufacturing companies in Japan Group manufacturing companies outside Japan	3,182	2,905
6. Business travel	Nikon	6,115	6,067
7. Employee commuting	Nikon	5,171	3,206
8. Upstream leased assets (included in Scope 2)	Calculation included in Scope 2	—	—
9. Downstream transportation and distribution	Excluded (because the amount is very small)	—	—
10. Processing of sold products (excluded)	Excluded (because the amount is very small)	—	—
11. Use of sold products	Imaging Products Business and Precision Equipment Business	110,761	302,484
12. End-of-life treatment of sold products	Imaging Products Business and Precision Equipment Business	6,797	5,129
13. Leased assets (downstream) (excluded)	Excluded (because the amount is very small)	—	—
14. Franchises (out of scope)	Out of scope	—	—
15. Investments (out of scope)	Out of scope	—	—

LCA – LIFE CYCLE ASSESMENT
SCM & CSR

NIKON Sustainability Report 2017 example

Nikon Sustainability Report 2017

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> Data Index | Independent Practitioner's Assurance | GRI Content Index

Data Index Supply Chain Management

Procurement Partner Survey on CSR

	'16/3	'17/3	Unit
Participation in briefings	897	690	Companies
CSR survey implementation	207	214	Companies
Response rate	100	73.4	%
CSR audit implementation	3	3	Companies
Improvement plan requests	13	13	Companies

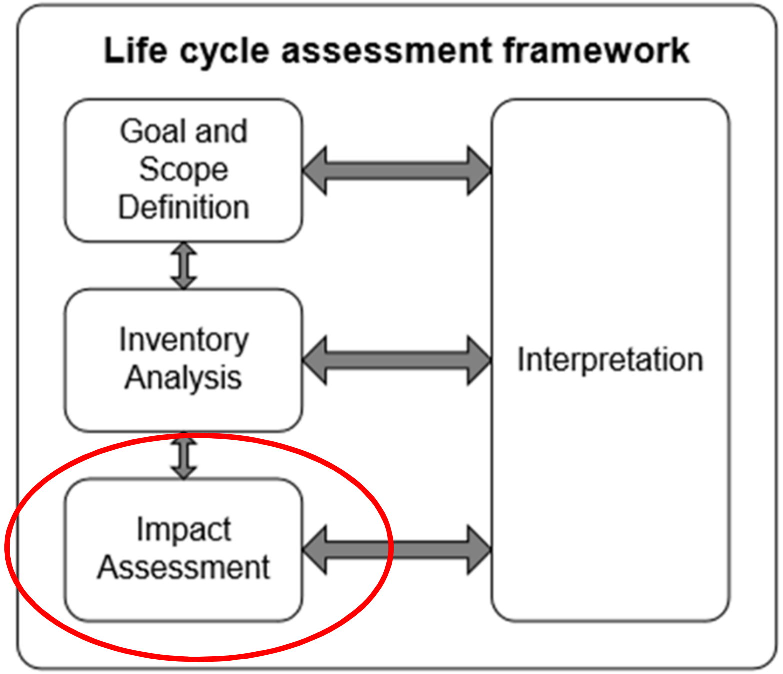
Conflict Minerals' Country of Origin Survey (as of May 31, 2017)

	2013	2014	2015	2016	Unit
Target	348	1,015	1,027	740	Companies
Response rate	90.5	99.9	100	99	%
CFSP-compliant smelter	58	129	227	257	
CFSI-acknowledged smelter	132	92	89	103	

How to do LCA according to ISO

- Goal & Scope Definition:
  - Determination of scope and system boundaries
- Life Cycle Inventory:
  - Data collection, modeling & analysis
- Impact Assessment:
  - Analysis of inputs and outputs using category indicators
- Interpretation:
  - Draw conclusions
  - Checks for: completeness, contribution, sensitivity analysis, consistency w/ goal and scope, analysis, etc.

ISO 14040 and ISO 14044



ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework

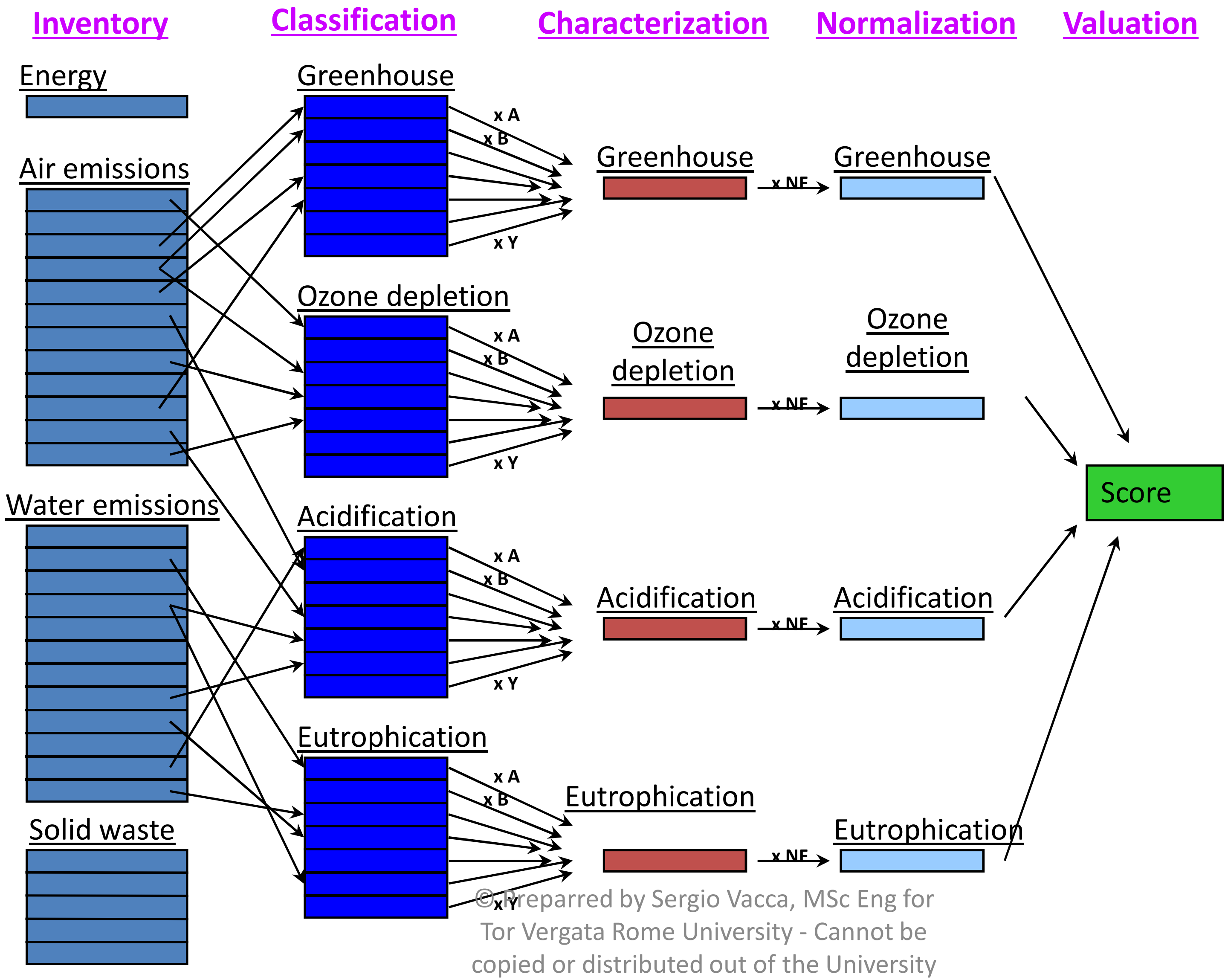
ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines

LIFE CYCLE IMPACT ASSESSMENT- LCIA

- LCIA – is the evaluation of potential human health and environmental impacts of the environmental resources and releases identified during the LCI.

- A life cycle impact assessment attempts to establish a linkage between the product or process and its potential environmental impacts.
  - For example, what are the impacts of 9,000 tons of carbon dioxide or 5,000 tons of methane emissions released into the atmosphere? Which is worse? What are their potential impacts on smog? On global warming?

LCA – LIFE CYCLE ASSESMENT
LIFE CYCLE IMPACT ASSESSMENT- LCIA

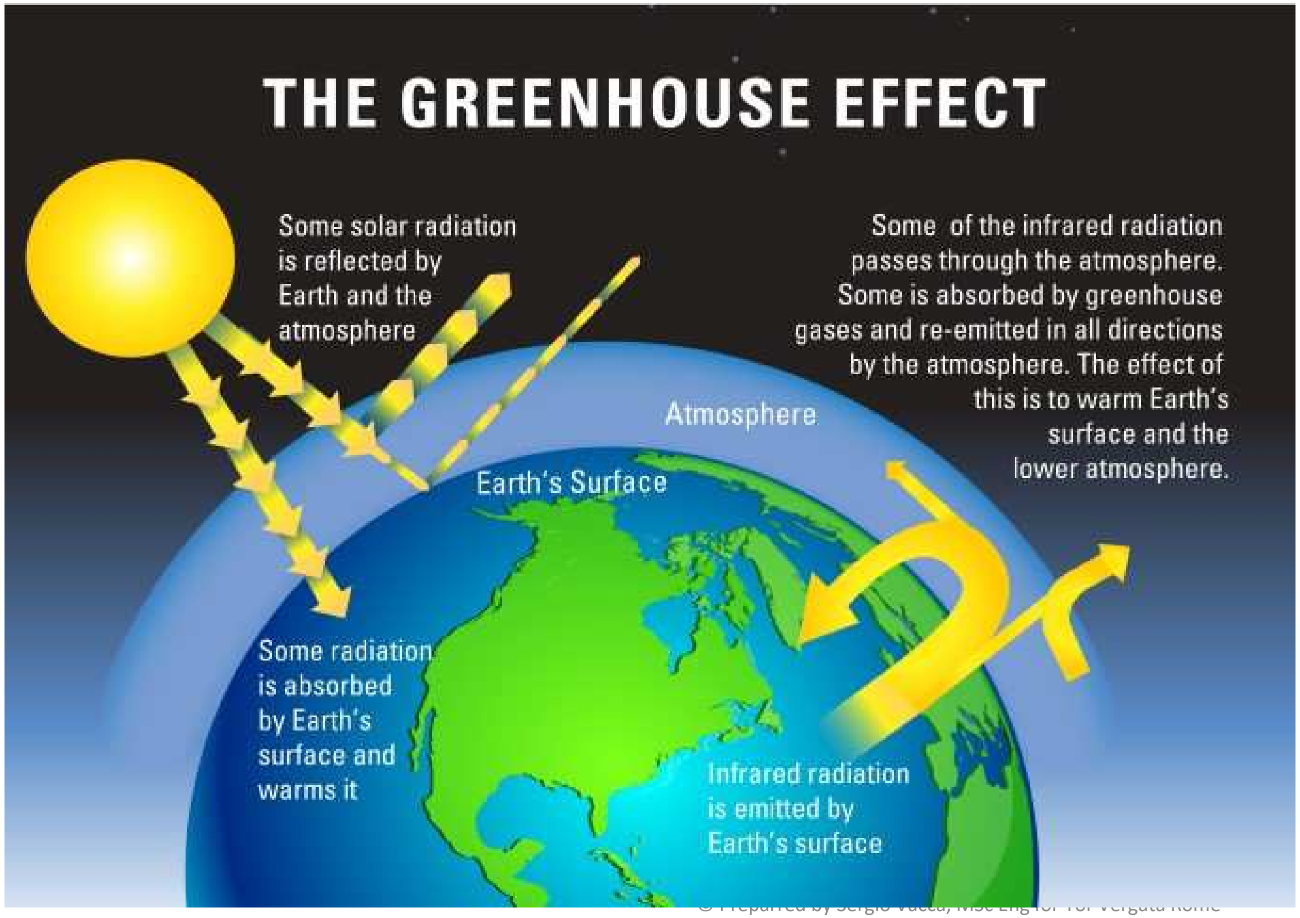


LCA – LIFE CYCLE IMPACT CATEGORIES

Commonly Used Life Cycle Impact Categories

Impact Category	Scale	Examples of LCI Data (i.e. classification)	Common Possible Characterization Factor	Description of Characterization Factor
Global Warming	Global	Carbon Dioxide (CO_2) Nitrogen Dioxide (NO_2) Methane (CH_4) Chlorofluorocarbons (CFCs) Hydrochlorofluorocarbons (HCFCs) Methyl Bromide (CH_3Br)	Global Warming Potential **GRI – 305/1/2/3** **SS.1.016-1.20**	Converts LCI data to carbon dioxide (CO_2) equivalents Note: global warming potentials can be 50, 100, or 500 year potentials.
Stratospheric Ozone Depletion	Global	Chlorofluorocarbons (CFCs) Hydrochlorofluorocarbons (HCFCs) Halons Methyl Bromide (CH_3Br)	Ozone Depleting Potential **GRI – 305/6** **SS.1.021**	Converts LCI data to trichlorofluoromethane (CFC-11) equivalents.
Acidification	Regional Local	Sulfur Oxides (SOx) Nitrogen Oxides (NOx) Hydrochloric Acid (HCL) Hydroflouric Acid (HF) Ammonia (NH_4)	Acidification Potential **GRI – 305/7** **SS.1.022**	Converts LCI data to hydrogen (H+) ion equivalents.
Eutrophication	Local	Phosphate (PO_4) Nitrogen Oxide (NO) Nitrogen Dioxide (NO_2) Nitrates Ammonia (NH_4)	Eutrophication Potential **GRI – 305/7** **SS.1.022**	Converts LCI data to phosphate (PO_4) equivalents.

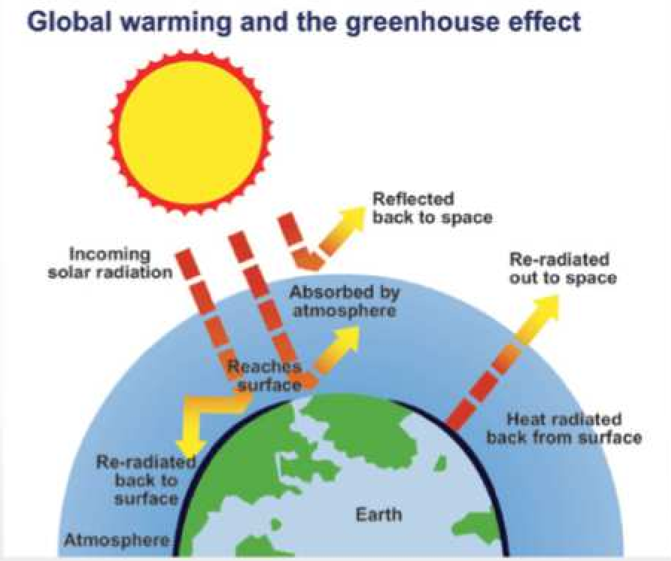
The greenhouse effect is the process by which absorption and emission of infrared radiation by gases in a planet's atmosphere warm its lower atmosphere and surface.



- Water vapor (H_2O)
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Ozone (O_3)
- Chlorofluorocarbons (CFCs)
- Hydrofluorocarbons (HFCs)

LCA – LIFE CYCLE IMPACT CATEGORIES

Global Warming Potential (GWP)



100 years scale

Table 3
Global warming potential equivalent factors [31].

Emission	CO_2 equivalent factor
1 kg CO_2	1 kg eq CO_2
1 kg CH_4	25 kg eq CO_2
1 kg N_2O	298 kg eq CO_2
1 kg SF_6	22,800 kg eq CO_2
1 kg CF_4	5,700 kg eq CO_2
1 kg C_2F_6	11,900 kg eq CO_2

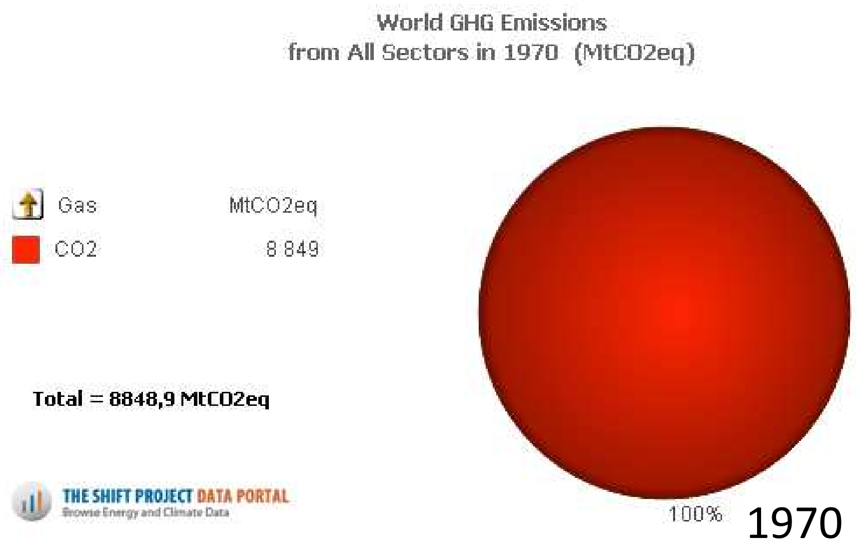
Source: Asdrubali et al. (2015)

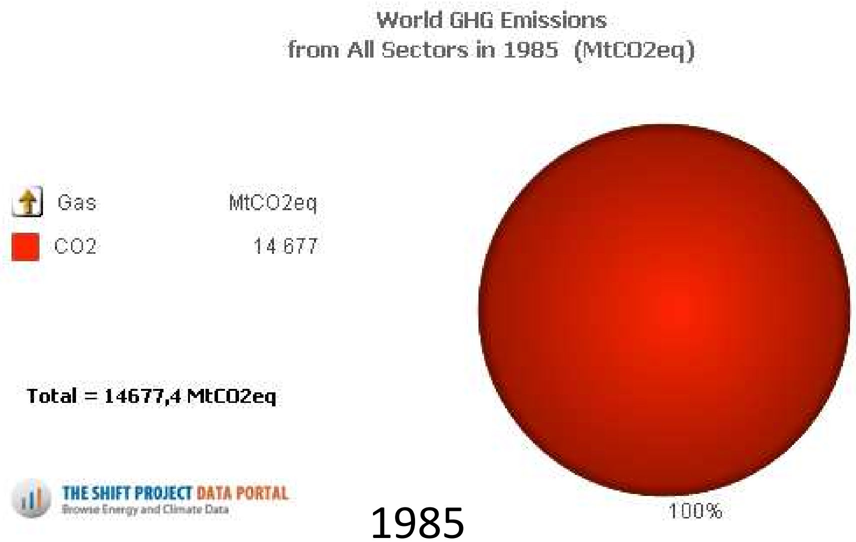
What is it?
- **Increased CO_2 in atmosphere increases the amount of solar energy re-radiated back to earth's surface.**

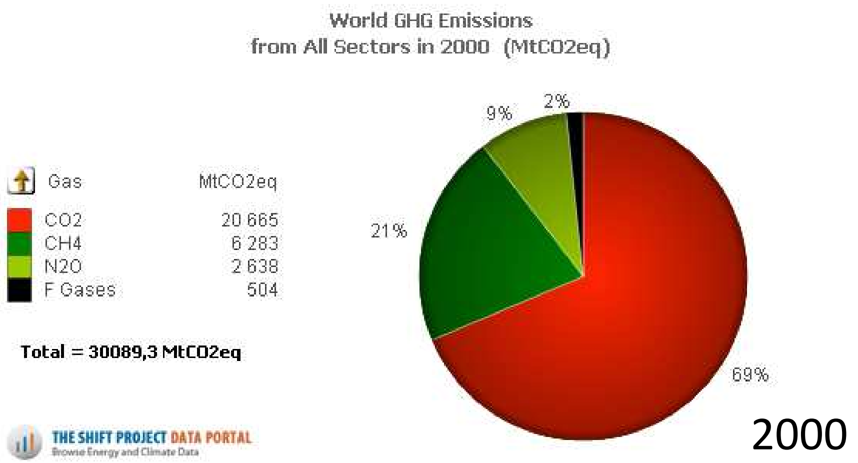
Negative Effects
- **Climate Change**

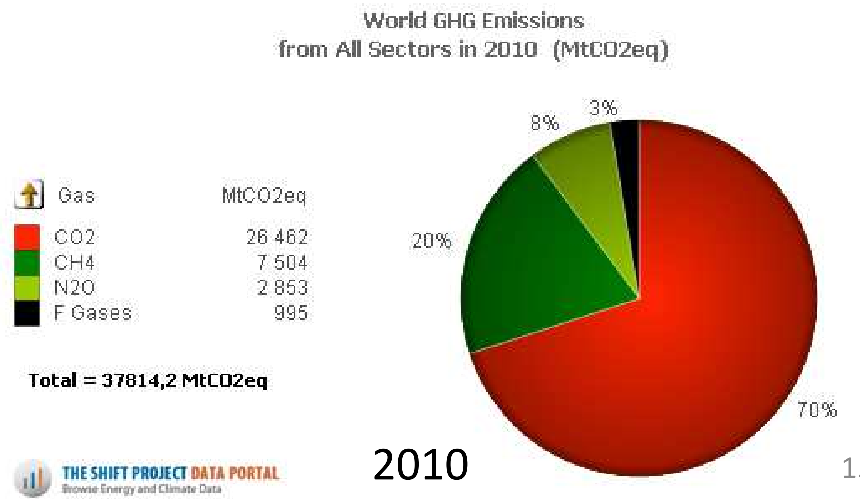
It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. A GWP is calculated over a specific time interval, commonly 20, 100, or 500 years. GWP is expressed as a factor of carbon dioxide (whose GWP is standardized to 1). *Source: Wikipedia*

LCA – LIFE CYCLE IMPACT CATEGORIES
GHG – GWP evolution









By
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BY
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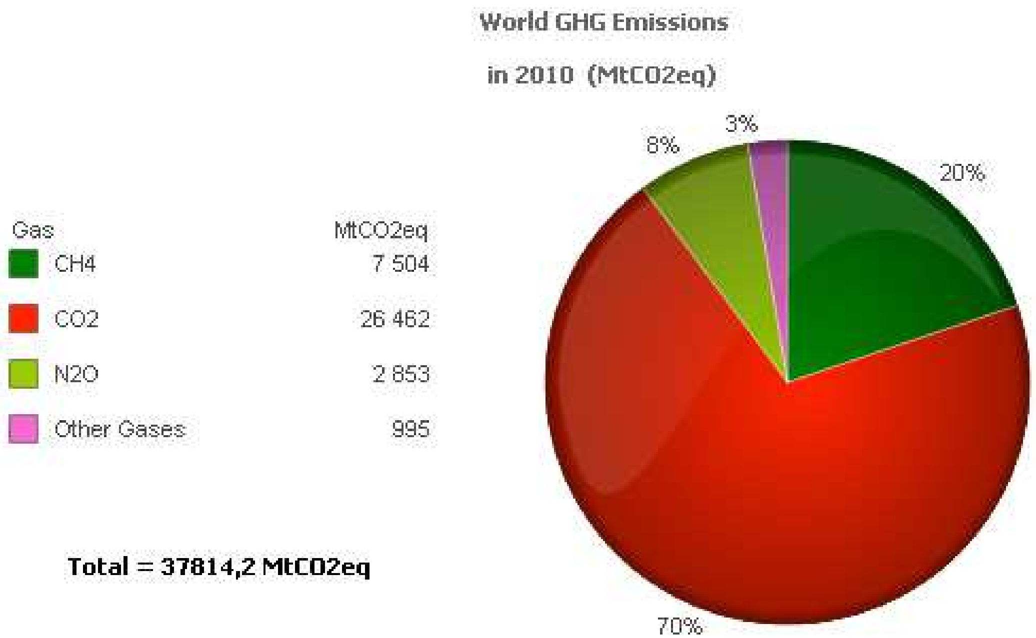
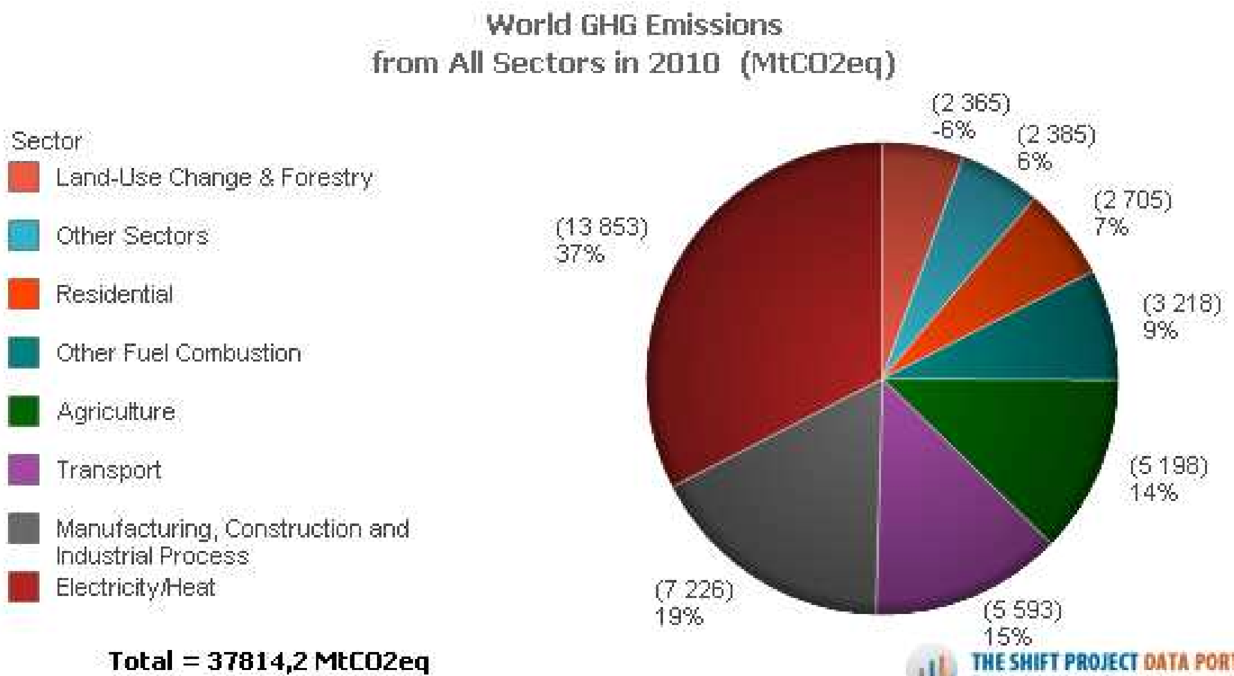
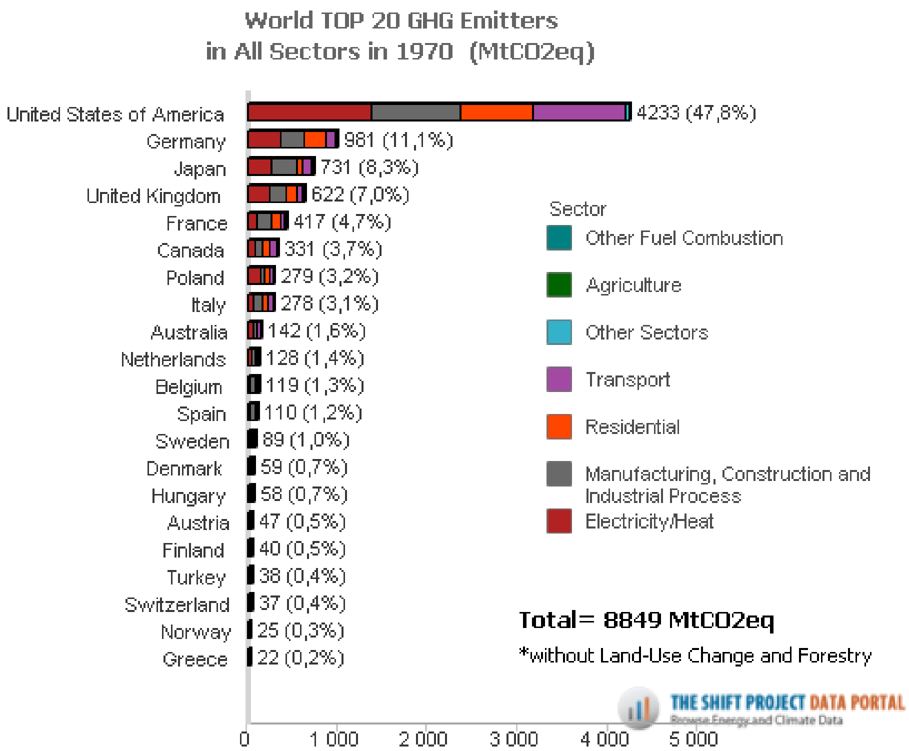




THE SHIFT PROJECT DATA PORTAL
Browse Energy and Climate Data

LCA – LIFE CYCLE IMPACT CATEGORIES
GHG – GWP by Country



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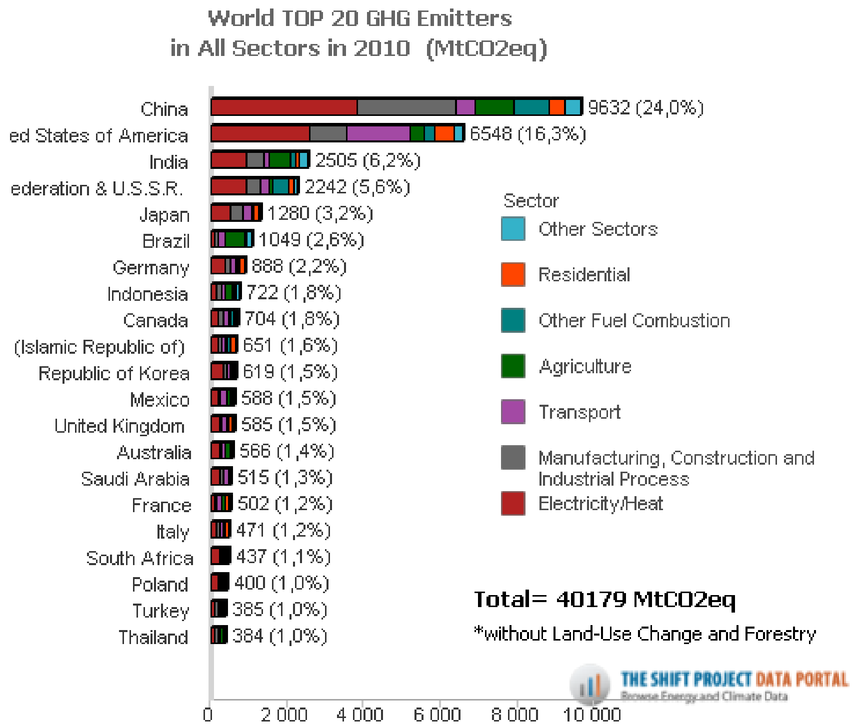
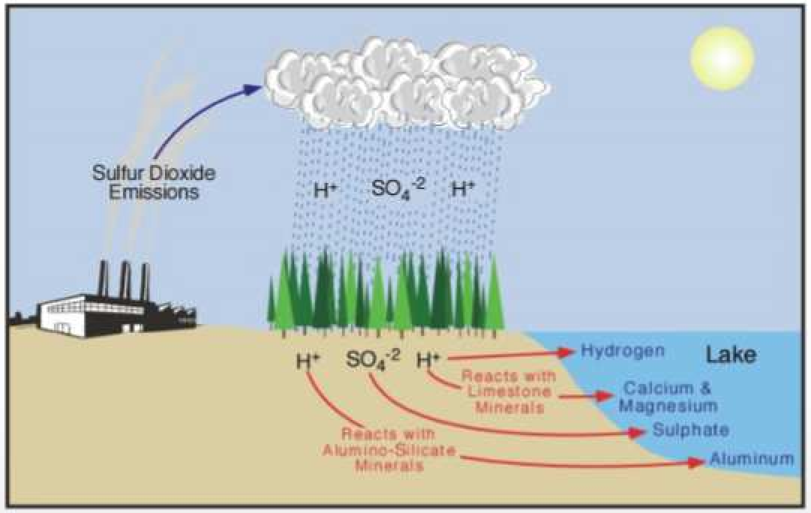


2010

Acidification Potential (AP)



Source: PhysicalGeography.net

Table 1
Acidification potential equivalent factors [29].

Emission	SO_2 equivalent factor
1 kg SO_x as SO_2	1 kg eq SO_2
1 kg NO_x as NO_2	0.7 kg eq SO_2
1 kg NH_3	1.88 kg eq SO_2
1 kg H_2S	1.88 kg eq SO_2
1 kg HF	1.6 kg eq SO_2
1 kg HCl	0.88 kg eq SO_2
1 kg SO_3	0.8 kg eq SO_2
1 kg NO	1.07 kg eq SO_2
1 kg H_2SO_4	0.65 kg eq SO_2
1 kg HNO_3	0.51 kg eq SO_2
1 kg H_3PO_4	0.98 kg eq SO_2

Source: Asdrubali et al. (2015)

What is it?:

- **Reaction of SO_2 with H_2O in atmosphere creates H^+ ions (low pH).**

Negative Effects

- **Destroys forests through soil degradation**
- **Kills fish and fish eggs**
- **Damages civil infrastructure**

Eutrophication Potential (EP)

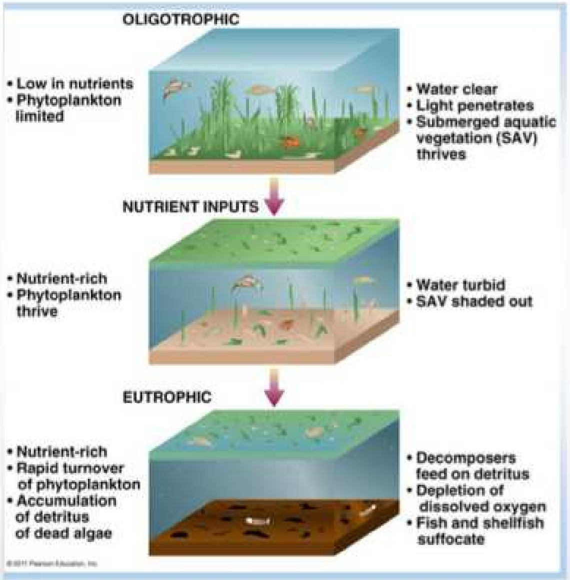


Table 2
Eutrophication potential equivalent factors [30].

Emission	PO_4^{3-} equivalent factor
1 kg PO_4^{3-}	1 kg eq PO_4^{3-}
1 kg COD (Chemical O_2 Demand)	0.022 kg eq PO_4^{3-}
1 kg NO_x as NO_2	0.13 kg eq PO_4^{3-}
1 kg NH_3	0.35 kg eq PO_4^{3-}
1 kg NO_3^-	0.1 kg eq PO_4^{3-}
1 kg NH_4^+	0.33 kg eq PO_4^{3-}
1 kg N	0.42 kg eq PO_4^{3-}
1 kg P	3.06 kg eq PO_4^{3-}

Source: Asdrubali et al. (2015)

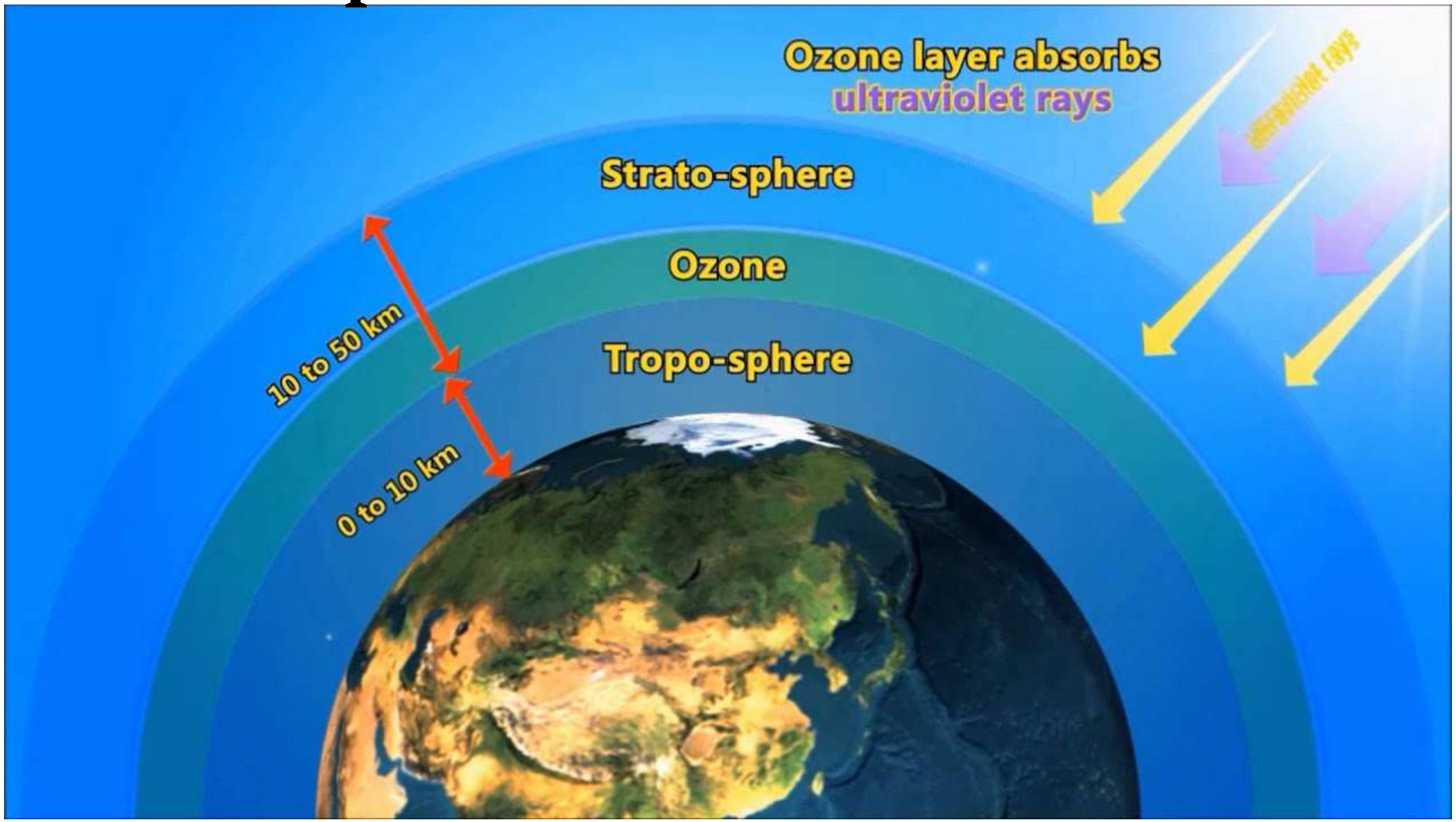
What is it?

- **Rapid and excessive growth of plants such as algae and phytoplankton due to nutrient enrichment by phosphates and equivalents.**

Negative Effects:

- **Turbid water, oxygen depletion and eventually death of fish.**

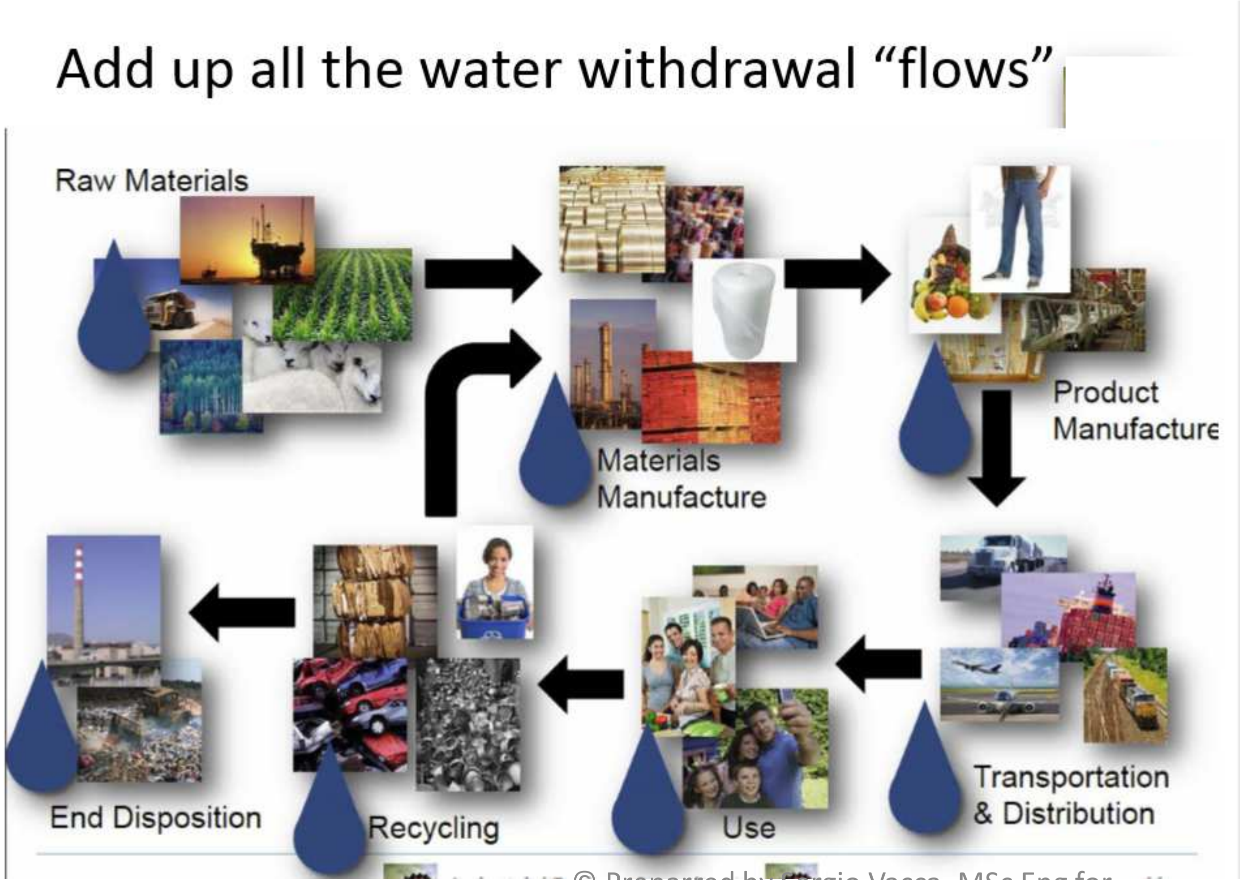
Ozone Depletion



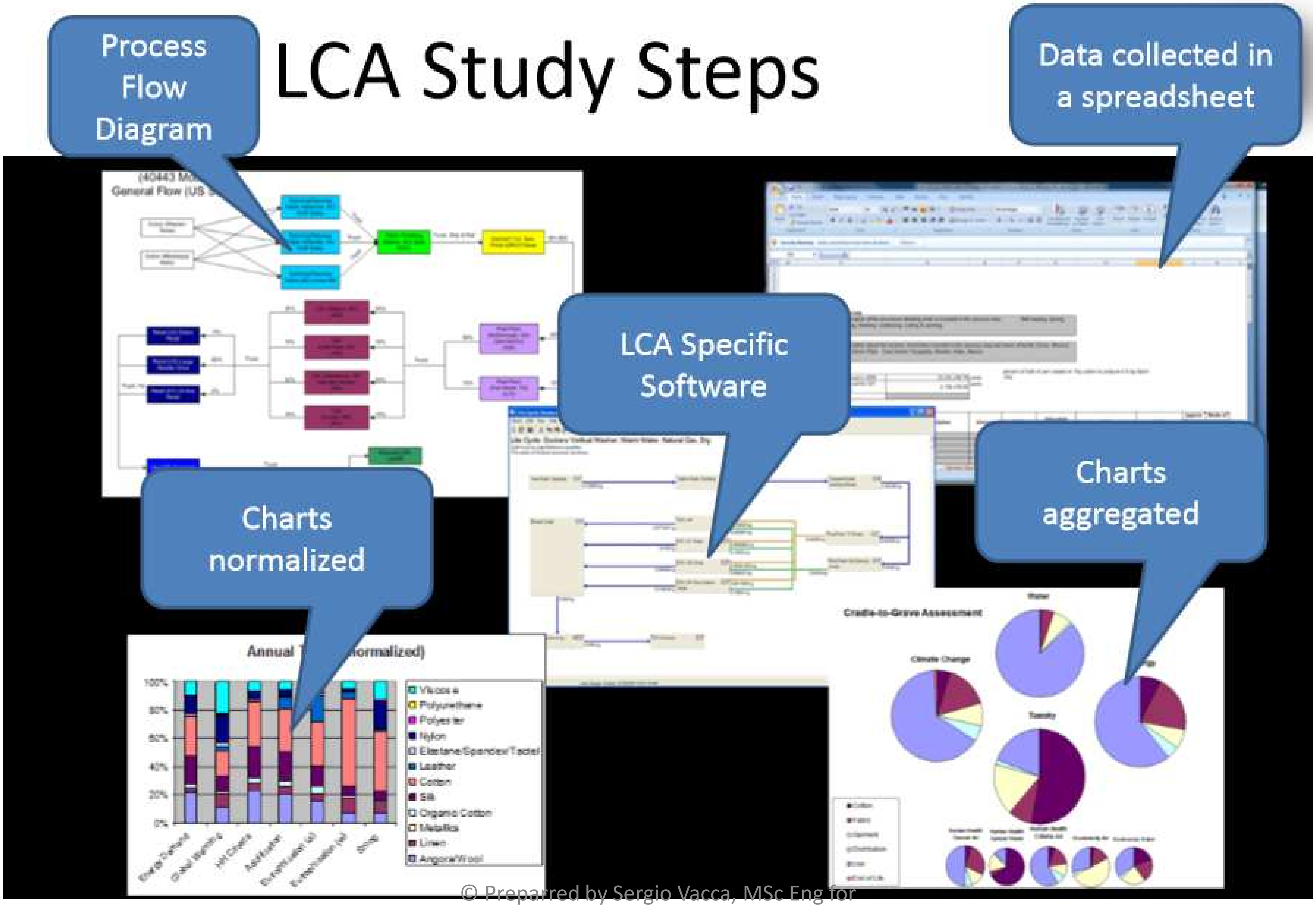
O3 protects against UV

LCA – LIFE CYCLE IMPACT CATEGORIES

Water withdrawal represents the quantity of leakages and is covered by the GRI 303-3



LCA Study Steps

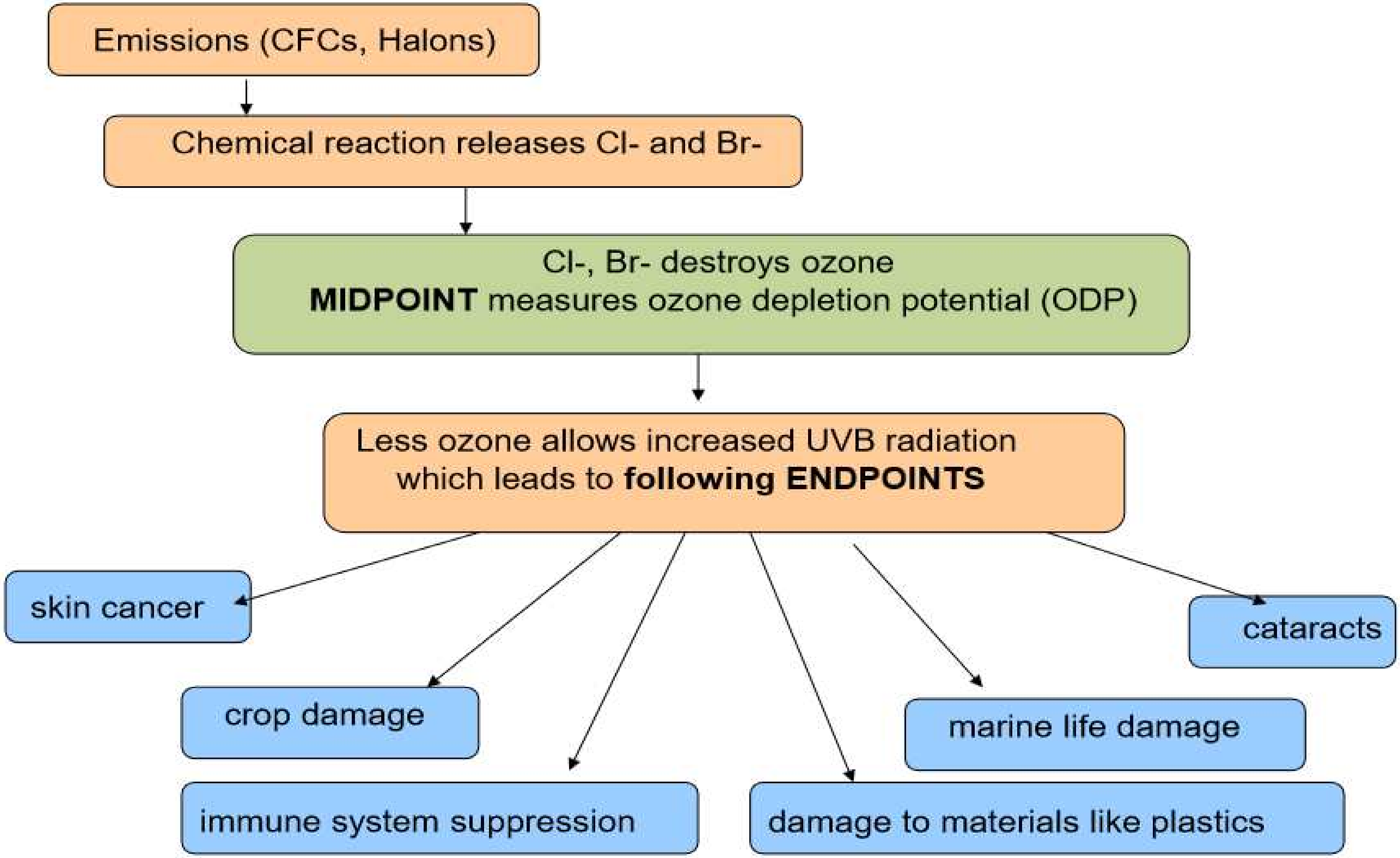


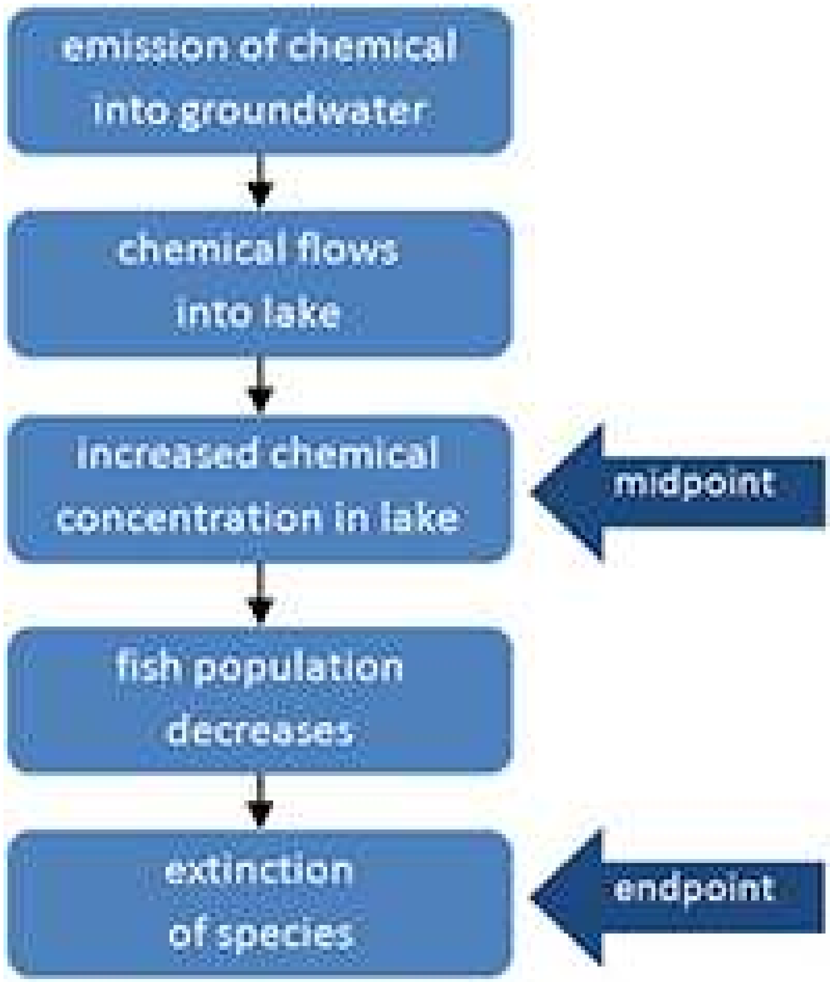
European Commission
Portfolio of LCIA Methodologies (Product and Organization)

Impact Category	Methodology
Climate Change	Intergovernmental Panel on Climate Change 2007 (revised 2011)
Ozone Depletion	Environmental Design of Industrial Products (EDIP) (based on World Meteorological Organization (WMO))
Ecotoxicity	USEtox model
Human Health Toxicity (cancer and non-cancer)	USEtox model
Particulate Matter	RiskPoll model in IMPACT 2002+ (Humbert)
Ionizing Radiation (human health)	Human health effects model (Dreicer et al.)
Photochemical Ozone Formation	ReCiPe (Radboud University, CML, RIVM, PRe Consultants) (Dutch Method)
Acidification	Accumulated Exceedance (Seppällä et al.)
Eutrophication (terrestrial)	Accumulated Exceedance (Seppällä et al.)
Eutrophication (aquatic)	ReCiPe (Radboud University, CML, RIVM, PRe Consultants) (Dutch Method)
Resource Depletion (water)	Swiss Ecoscarcity (Frischknecht et al.)
Resource Depletion (mineral, fossil)	Leiden University (CML 2002) (van Oers et al.)
Land Transformation	Soil Organic Matter (SOM) model (Milà i Canals et al.)

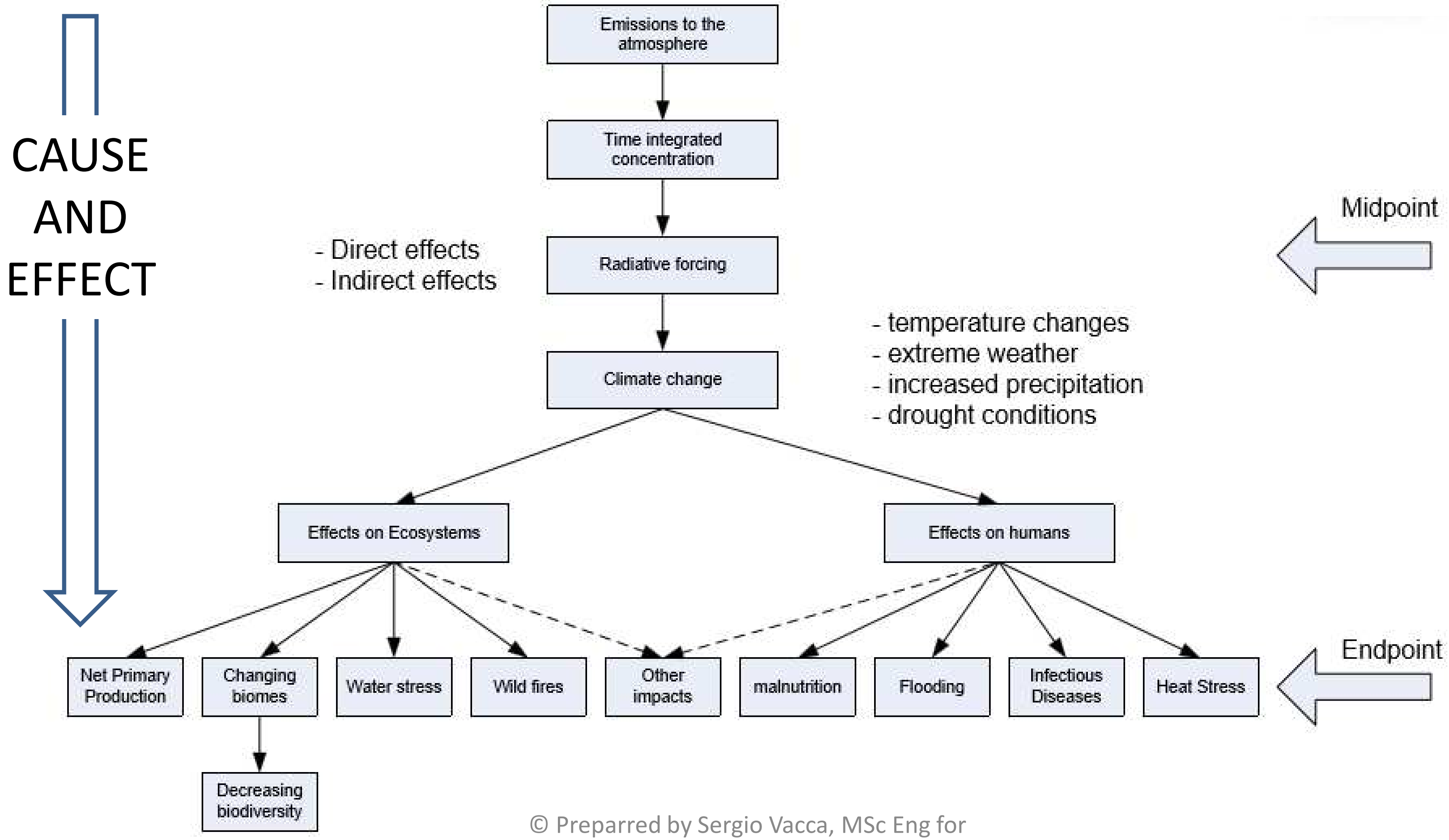
The list is not exhaustive

Midpoints vs. Endpoints




emission of chemical into groundwater
chemical flows into lake
increased chemical concentration in lake
midpoint
fish population decreases
extinction of species
endpoint

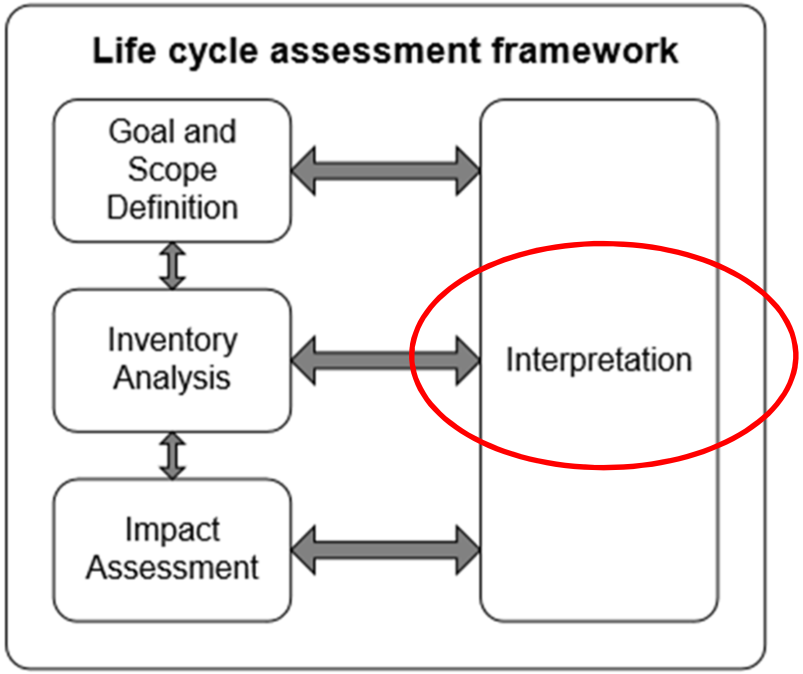
Climate Change Environmental Mechanism



How to do LCA according to ISO

- Goal & Scope Definition:
  - Determination of scope and system boundaries
- Life Cycle Inventory:
  - Data collection, modeling & analysis
- Impact Assessment:
  - Analysis of inputs and outputs using category indicators
- Interpretation:
  - Draw conclusions
  - Checks for: completeness, contribution, sensitivity analysis, consistency w/ goal and scope, analysis, etc.

ISO 14040 and ISO 14044



ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework

ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines

LCA – LIFE CYCLE ASSESMENT
INTERPRETATION

Life Cycle Interpretation is a systematic technique to identify, quantify, check and evaluate information from the results of the LCI and/or LCIA, resulting in a set of conclusions and recommendations for the study.

According to ISO 14040:2006, the interpretation should include:

- Identification of the strong and the weak points based on the results of the LCI and LCIA phases
- Meeting the goals set during the first stage
- Evaluation of the study considering completeness, sensitivity and consistency checks
- Conclusions, limitations and recommendation

LCA – Applications and considerations

- Exhaustive environmental analysis of product/process to support the Design for Environment. It is:

- Scientifically based
- Brings structure and experts to investigation
- Highlights trade offs
- Challenge vs preconceptions
- Captures the knowledge base

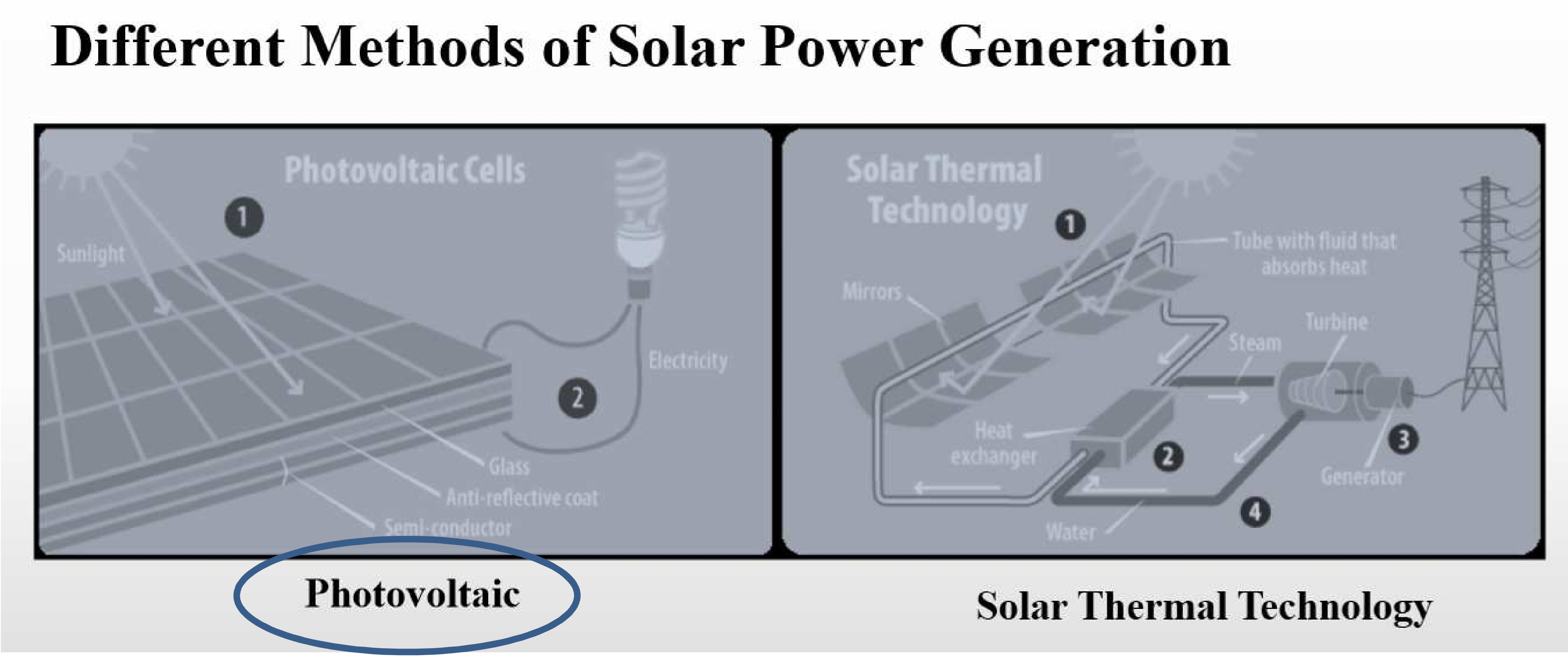
- Allows to capture elements of differentiation where processes look the same/similar

- Hot spot identification

- Helps quick action taking, alignment, emergence
- Facilitates the development of ground rules in the marketplace, associations, lobbing

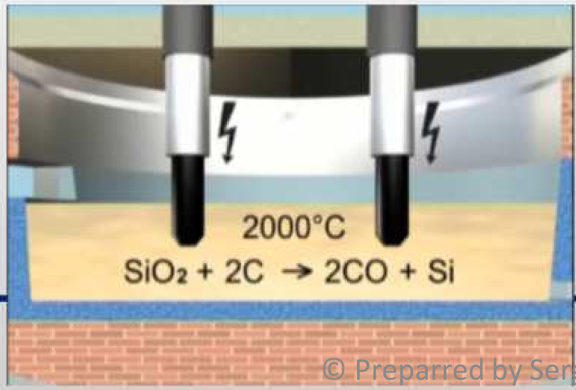
- Allow to support or refuse new policies, based on knowledge

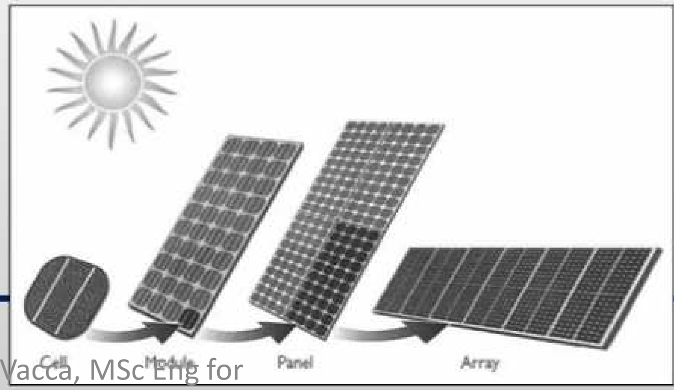
LCA – CASE STUDY example
A comparative analysis of the environmental impact of
PV panels vs Hydroelectric Power generation



LCA – Comparison

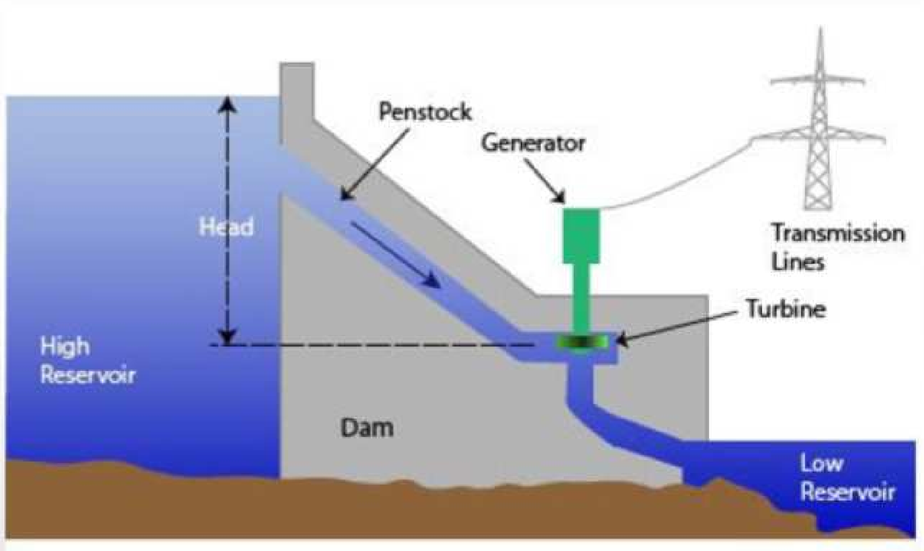
PV System Life Cycle



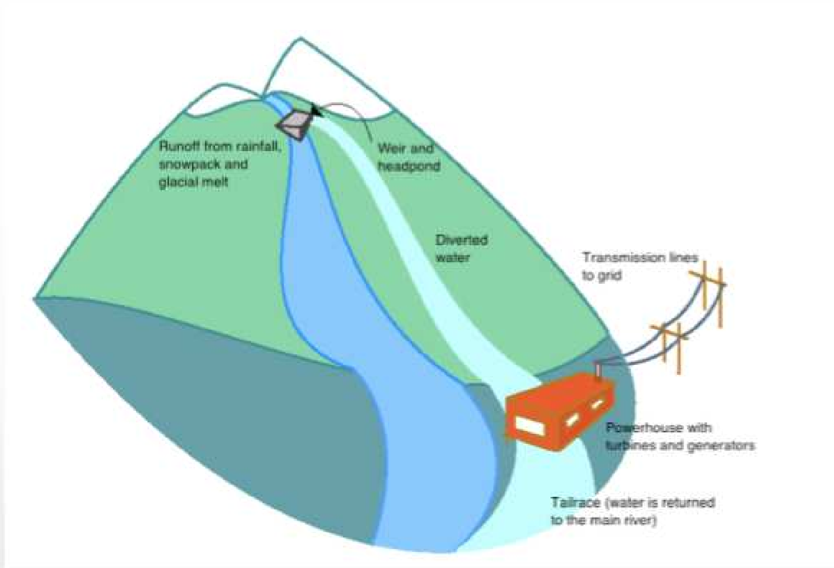


LCA – Comparison

Hydroelectric - Types of Dams



Source: Green Rhino Energy



Source: Energy BC

Conventional Dam

- Can store water
- Large reservoir = High Land Use

Run of River

- Cannot store water
- Small headpond = Low Land Use

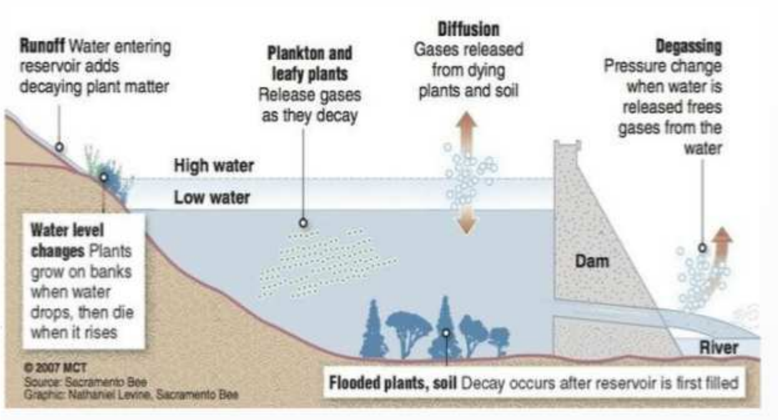
LCA – Comparison

construction

Steel 80 MM Kg

GWP, Ecotoxicity, Ozone depletion

use

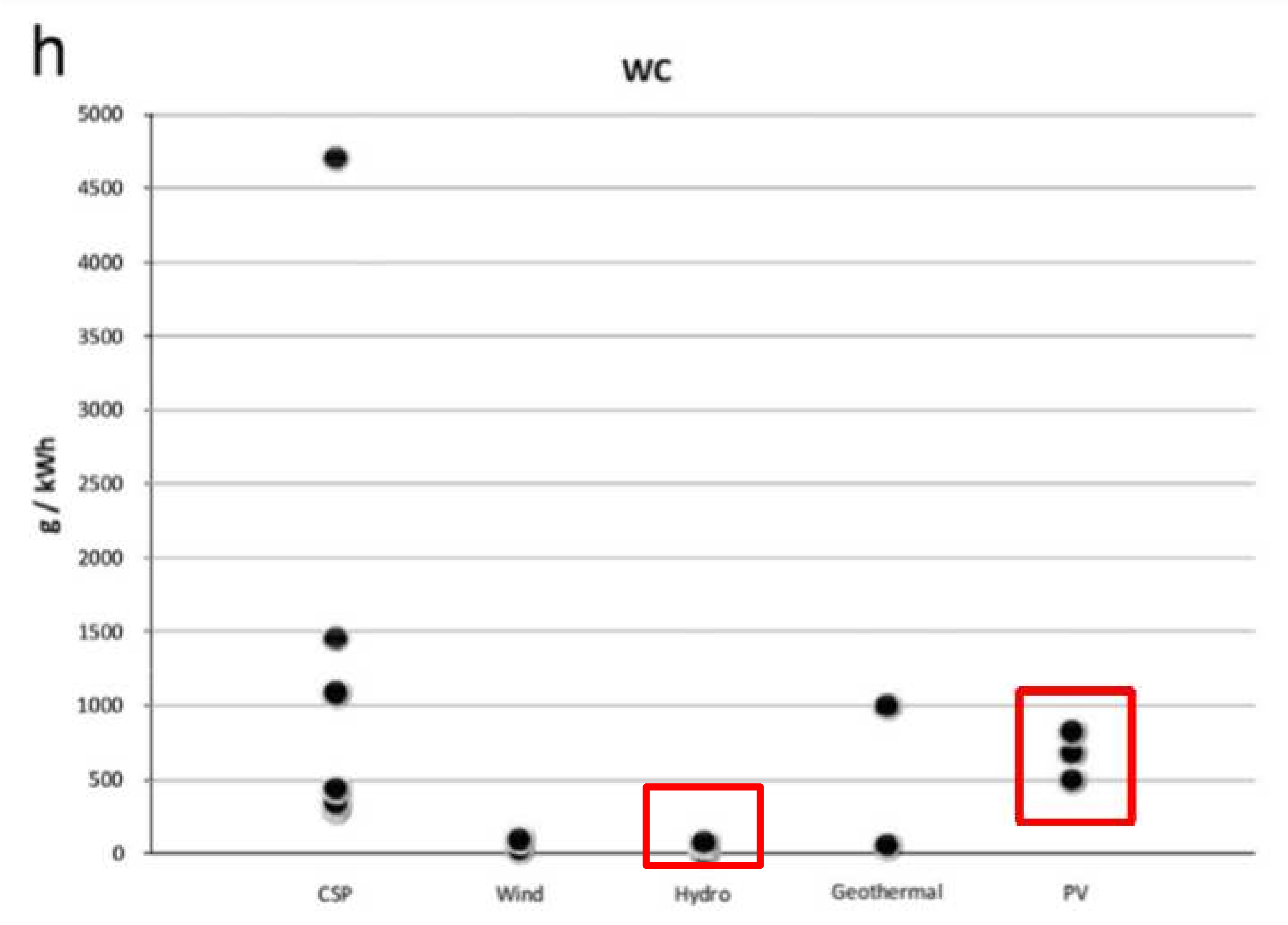


Methane production from organic decomposing - GWP

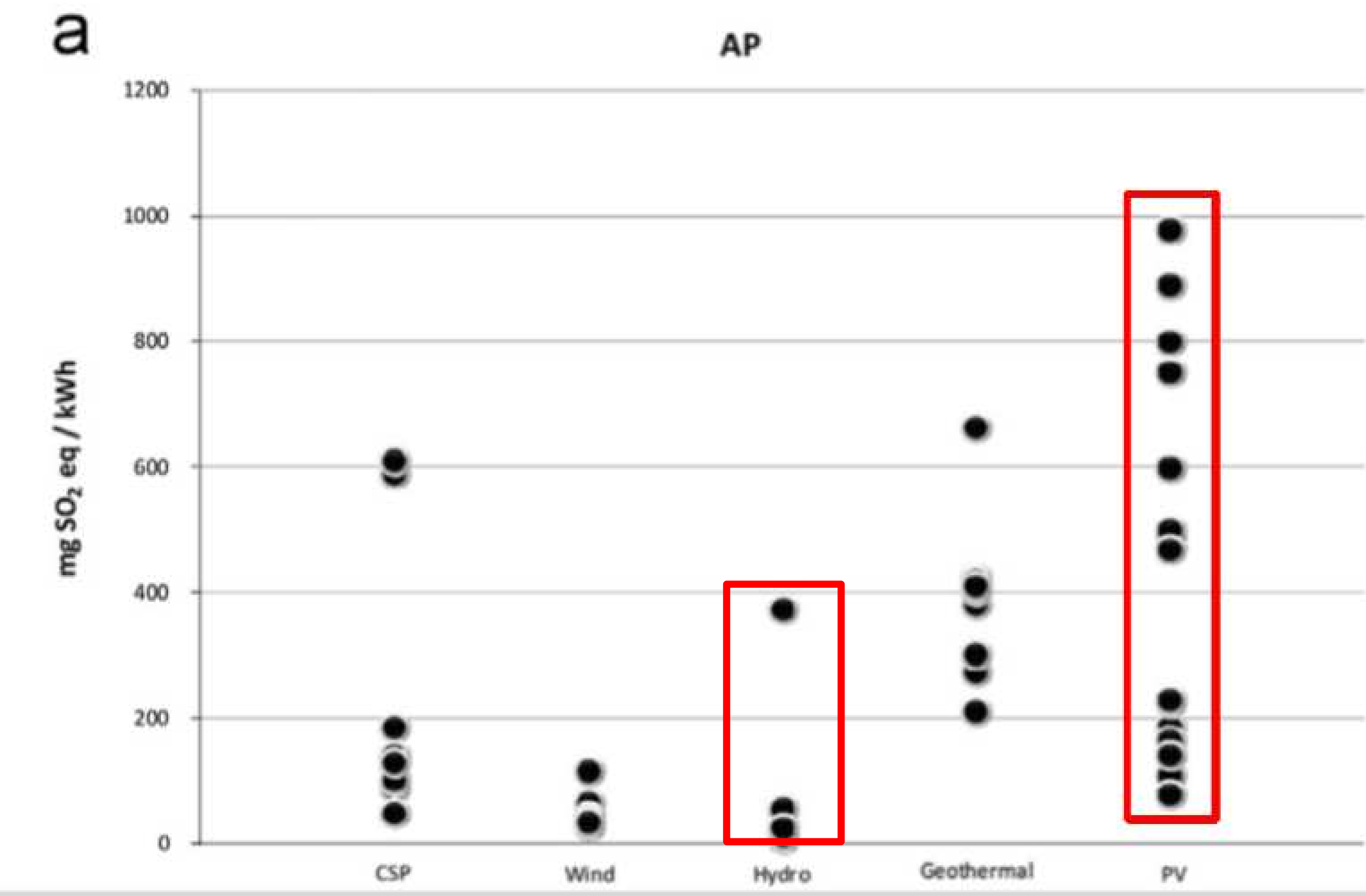
Dismantle/recycle

GWP and AP

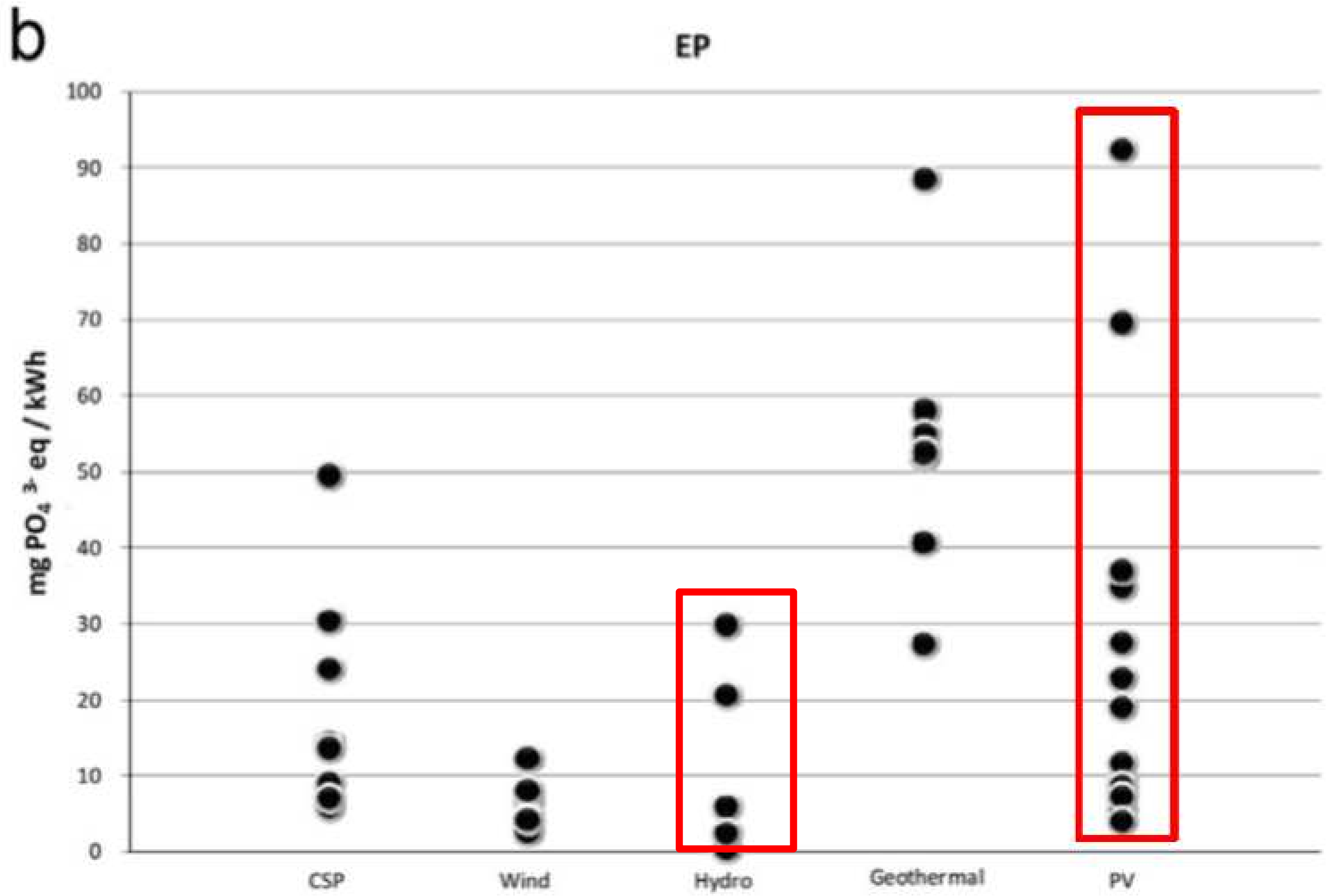
LCIA – Water Consumption



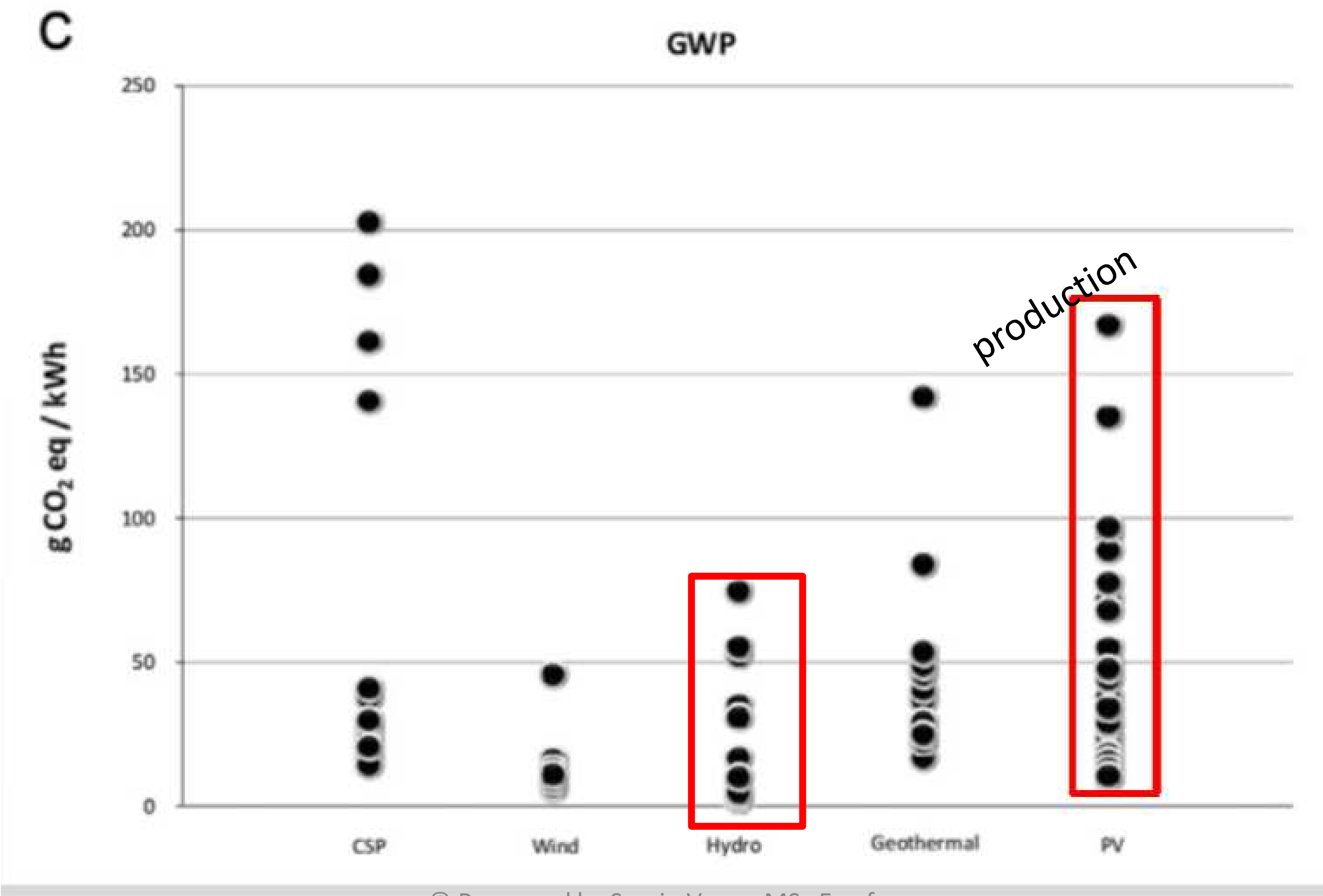
LCIA – Acidification Potential



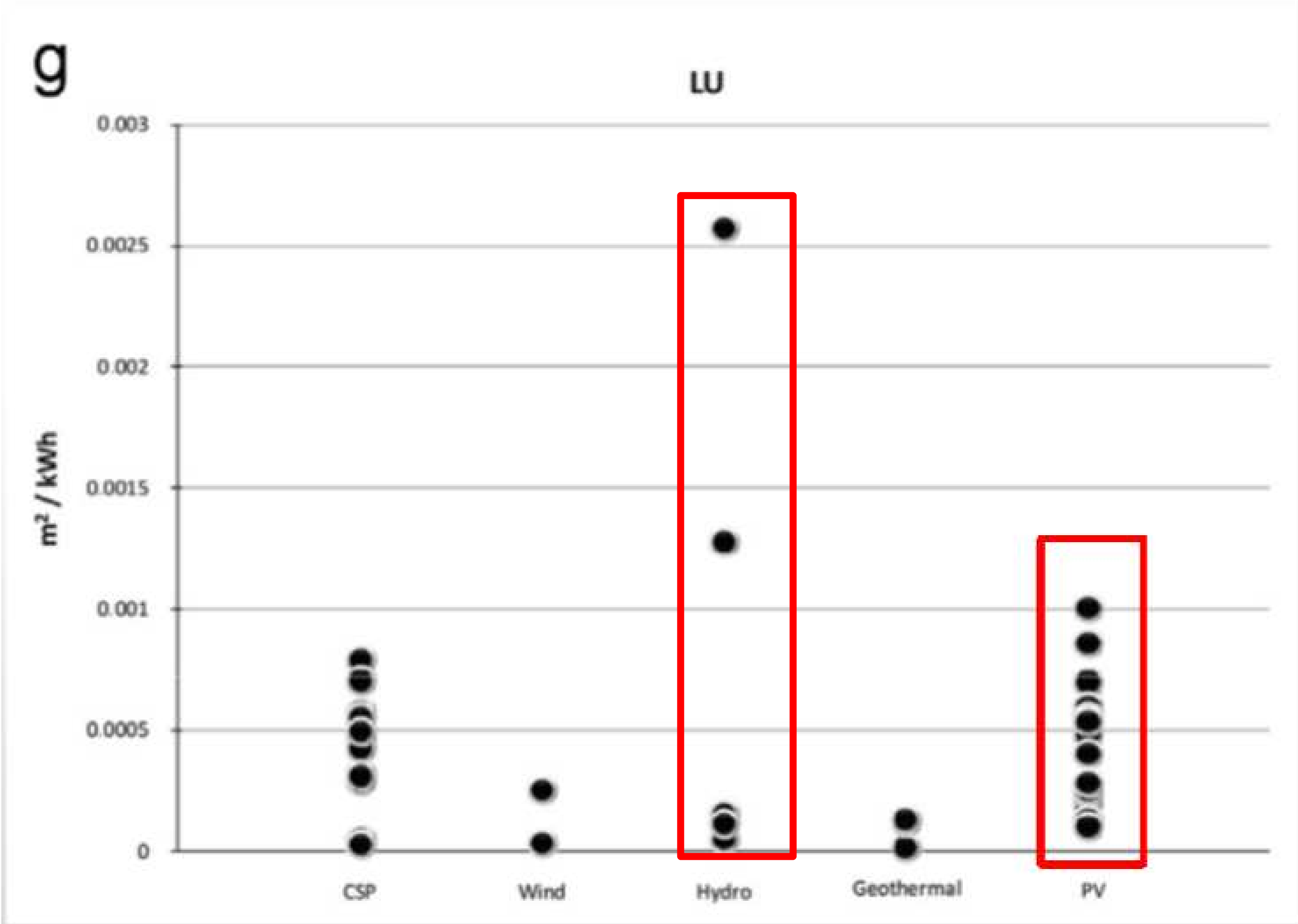
LCIA – Eutrophication Potential



LCIA – Global Warming Potential



LCIA – Land Use



LCA – CASE STUDY example
A comparative analysis of the environmental impact of two different packagings: an Al CAN (ALC) vs a glass BOTTLE (GLB)

Goal:
«Cradle to Gate» LCA comparison between 500 ml Aluminium Cans and Glass Bottles.

	PRO'S	**CON'S**
Aluminium Cans	- Light weight / low transportation costs	- Energy intensive – Bauxite extraction
Glass Bottles	- Recyclable at low cost	- Weight / high transportation costs

LCA – SCOPE

- **FOCUS on**: GHG Emissions, Fuel (Oil, Diesel, Electricity) and Water consumption
- **FUNCTION**: both solutions for drink filling
- **FUNCTIONAL UNIT** i.e REFERENCE UNIT (ISO 14040): 1000 LITERS Bulk into 500 ml bottle equivalent to 2000 units.

LCA – SCOPE

Result of performance measurement

Flow	Category	Flow type	Reference flow	Unit
Empty beer bottle	Case study – beer bottle	Product	2000 bottles	Item

According to record specific gravity of beer is 1.046

The weight of 500 ml beer = 1.046*500 = 523 g

Weight of empty glass bottle + cap weight (5 gm assumed) + 500 ml beer = 916 g

Weight of empty glass bottle = (916-5-523) = **388 g**

Weight of empty alminium can + 500 ml beer = 541 g

Weight of empty alminium can = (541-523) = **18 g**

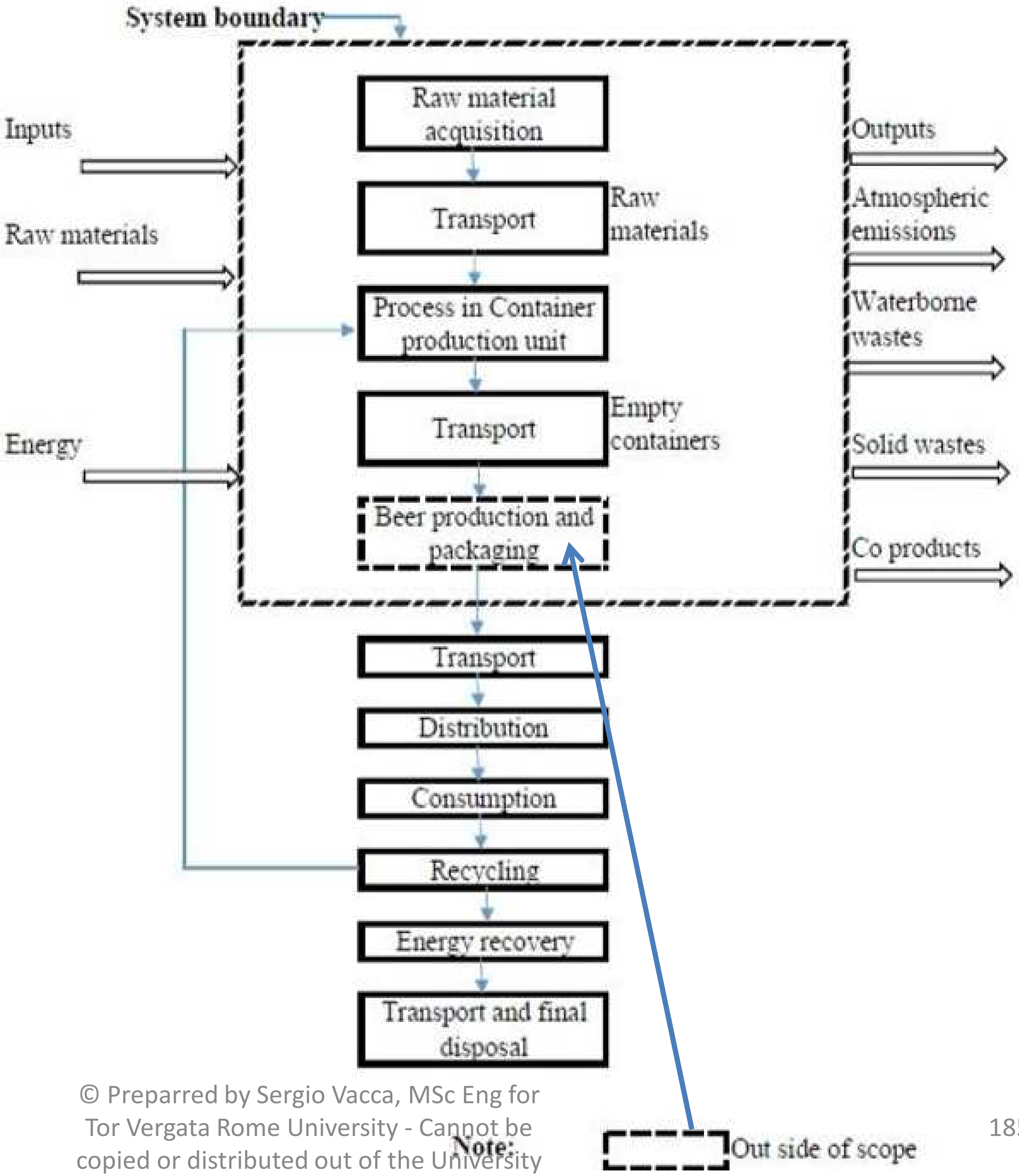
Weight of glass bottle to be considered	(388/1000) * 2000 bottle = 776 kg
Weight of alminium can to be considered	(18/1000) * 2000 bottle = 36 kg

CO_2 Equivalent:

1 kWh = 3.6 MJ

MJ (Mega Joule)

LCA – System Boundary

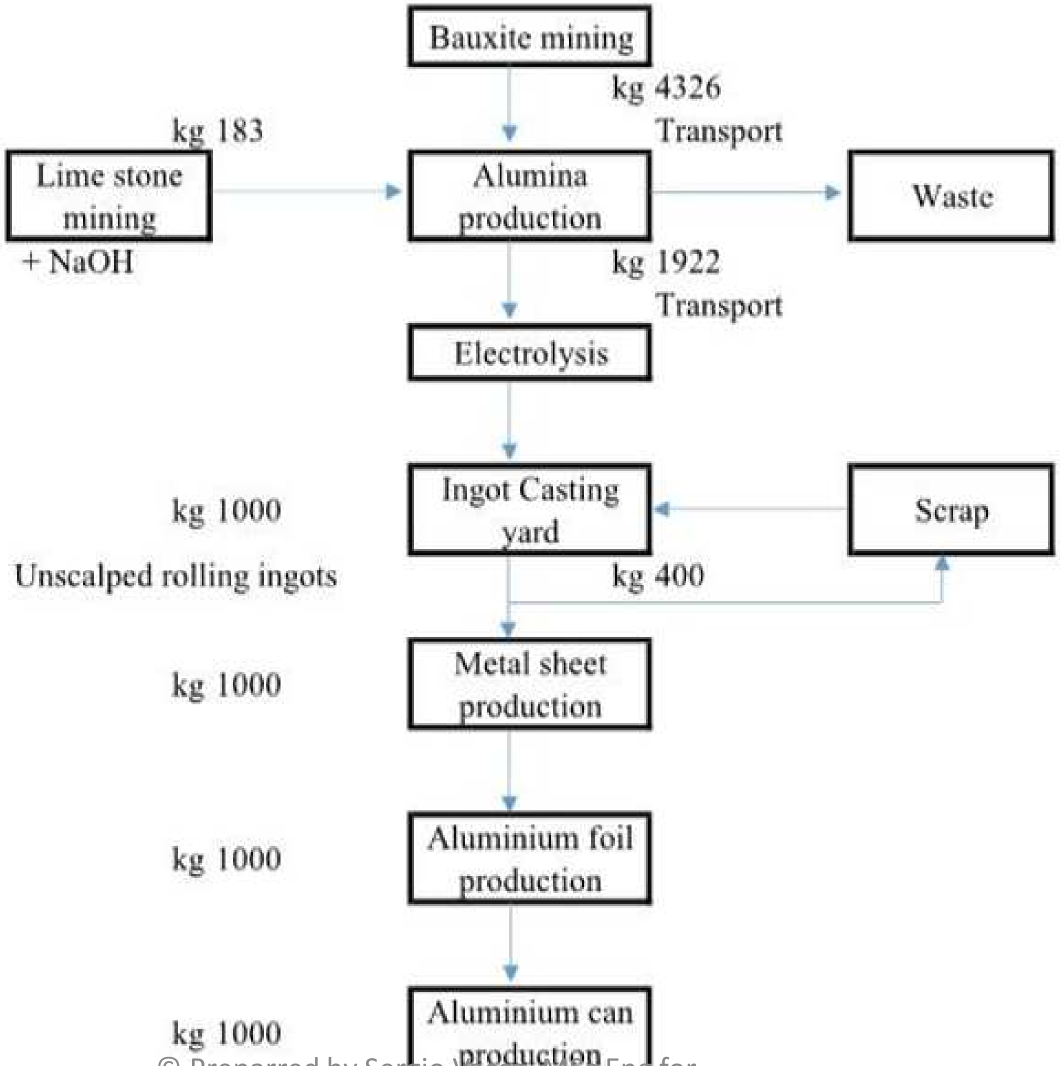


LCA – LCI Life Cycle Inventory analysis
Aluminium Cans Production (Cradle to Gate)

Objectives:

- Data collection
- RM requirements
- Energy requir.s
- Emissions
- Wastes

Material balance



Data: European Aluminium Association

LCA – LCI Life Cycle Inventory analysis
Aluminium Cans Production - Details

Inventory data for Aluminium can production					
Bauxite mining	Bauxite		Allocated mass (kg)	**1000**	
Resource use					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Fresh water	5.00E-01	m3	1	5.00E-01	m3
Sea water	7.00E-01	m3	1	7.00E-01	m3
Energy use (process exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Electricity	9.00E-01	kWh	3.6	3.24E+00	MJ
Oil	2.00E-01	kg	41.86	8.37E+00	MJ
Natural gas	0.00E+00				
Diesel	3.00E-01	kg	43.14	1.29E+01	MJ
Direct atmospheric Emissions during process (exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
CO_2	2.00E+00	kg	1	2.00E+00	kg of CO_2 eqv.
CH_4	0.00E+00	kg	23	0.00E+00	kg of CO_2 eqv.
NO_x	0.00E+00	kg	310	0.00E+00	kg of CO_2 eqv.

LCA – LCI Life Cycle Inv. analysis - Aluminium Cans Production - Details

Alumina production	Alumina		Allocated mass (kg)	1000	
Resource use					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Bauxite	2251	kg	1	2.25E+03	kg
Fresh water	3.60E+00	m3	1	3.60E+00	m3
Sea water	0.00E+00	m3	1	0.00E+00	m3
Energy use (process exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Electricity	1.81E+02	kWh	3.6	6.52E+02	MJ
Oil	5.82E+03	MJ	1	5.82E+03	MJ
Natural gas	4.30E+03	MJ	1	4.30E+03	MJ
Diesel	1.00E+00	MJ	1	1.00E+00	MJ
Direct atmospheric Emissions during process (exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
CO_2	8.34E+02	kg	1	8.34E+02	kg of CO_2 eqv.
CH_4	0.00E+00	kg	23	0.00E+00	kg of CO_2 eqv.
NO_x	1.11E+00	kg	310	3.44E+02	kg of CO_2 eqv.

Electrolysis	Ingot		Allocated mass (kg)	1000	
Resource use					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Alumina	4805	kg	1	4.81E+03	kg
Fresh water	1.69E+02	m3	1	1.69E+02	m3
Sea water	4.85E+02	m3	1	4.85E+02	m3
Energy use (process exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Electricity	1.49E+01	MWh	3600	5.36E+04	MJ
Oil	0.00E+00	MJ	1	0.00E+00	MJ
Natural gas	0.00E+00	MJ	1	0.00E+00	MJ
Diesel	0.00E+00	MJ	1	0.00E+00	MJ
Direct atmospheric Emissions during process (exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
CO_2	1.57E+03	kg	1	1.57E+03	kg of CO_2 eqv.
CH_4	0.00E+00	kg	23	0.00E+00	kg of CO_2 eqv.
NO_x	4.40E-01	kg	310	1.36E+02	kg of CO_2 eqv.

LCA – LCI Life Cycle Inventory analysis
Aluminium Cans Production - Details

Metal sheet production	Sheet		Allocated mass (kg)	**1000**	
Resource use					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Unscalped rolling ingots	1004	kg	1	1.00E+03	kg
Fresh water	0.00E+00	m3	1	0.00E+00	m3
Sea water	0.00E+00	m3	1	0.00E+00	m3
Energy use (process exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Electricity	5.69E+02	kWh	3.6	2.05E+03	MJ
Oil	3.10E+01	MJ	1	3.10E+01	MJ
Natural gas	3.30E+03	MJ	1	3.30E+03	MJ
Diesel	2.80E+01	MJ	1	2.80E+01	MJ
Direct atmospheric Emissions during process (exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
CO_2	2.36E+02	kg	1	2.36E+02	kg of CO_2 eqv.
CH_4	0.00E+00	kg	23	0.00E+00	kg of CO_2 eqv.
NO_x	4.20E+01	kg	310	1.30E+04	kg of CO_2 eqv.

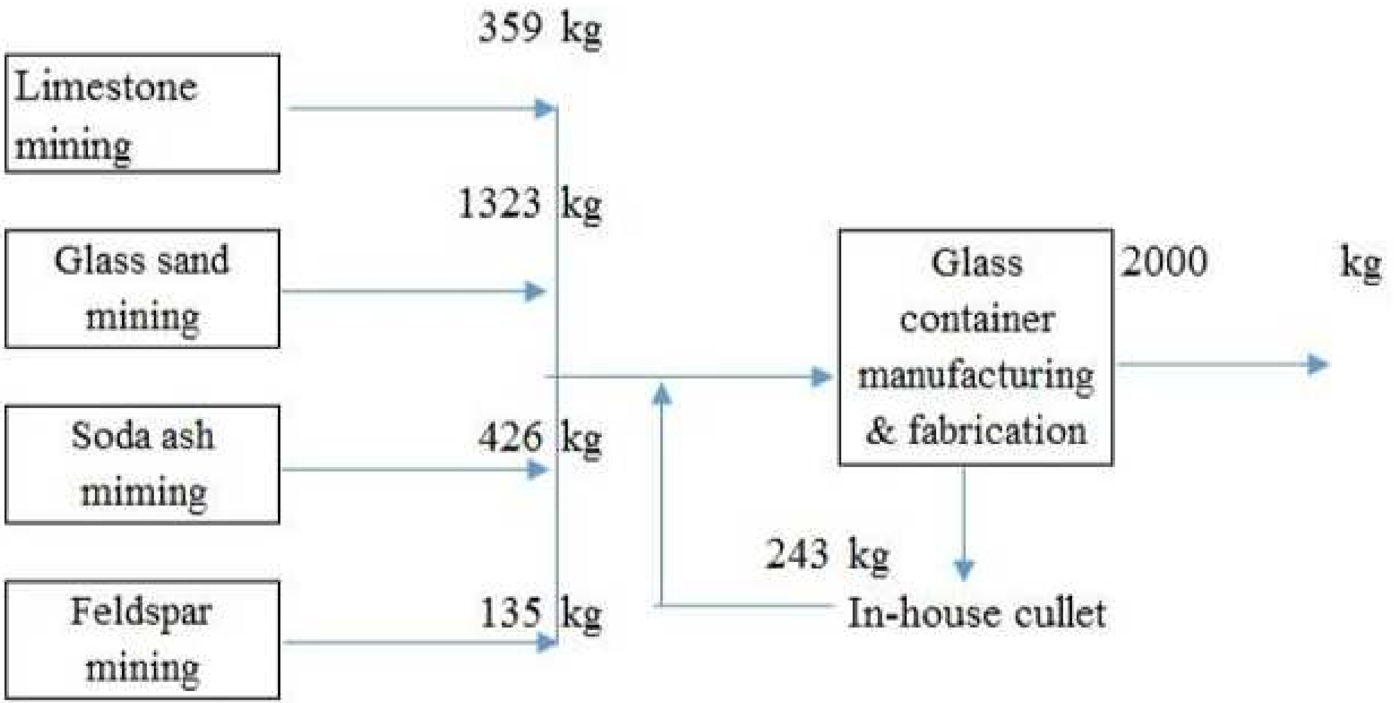
LCA – LCI Life Cycle Inventory analysis
Aluminium Cans Production - Details

Aluminium foil production	foil		Allocated mass (kg)		1000
Resource use					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Metal sheet production	1010	kg	1	1.01E+03	kg
Fresh water	0.00E+00	m3	1	0.00E+00	m3
Sea water	0.00E+00	m3	1	0.00E+00	m3
Energy use (process exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Electricity	8.29E+03	MJ	0	0.00E+00	MJ
Oil	1.78E+03	MJ	1	1.78E+03	MJ
Natural gas	2.93E+03	MJ	1	2.93E+03	MJ
Diesel	2.60E+01	MJ	1	2.60E+01	MJ
Direct atmospheric Emissions during process (exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
CO_2	3.61E+02	kg	1	3.61E+02	kg of CO_2 eqv.
CH_4	0.00E+00	kg	23	0.00E+00	kg of CO_2 eqv.
NO_x	9.70E+01	kg	310	3.01E+04	kg of CO_2 eqv.

LCA – LCI Life Cycle Inventory analysis
Aluminium Cans Production - Details

Aluminium can production	can		Allocated mass (kg)		**1000**
Resource use					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Extrusion ingot	1000	kg	1	1.00E+03	kg
Fresh water	0.00E+00	m3	1	0.00E+00	m3
Sea water	0.00E+00	m3	1	0.00E+00	m3
Energy use (process exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
Electricity	9.59E+02	MJ	0	0.00E+00	MJ
Oil	1.60E+01	MJ	1	1.60E+01	MJ
Natural gas	3.33E+03	MJ	1	3.33E+03	MJ
Diesel	7.70E+01	MJ	1	7.70E+01	MJ
Direct atmospheric Emissions during process (exclusing transportation)					
Particulars	Raw data		Conversion factor	Converted data	
	Amount	Units		Amount	Unit
CO_2	2.34E+02	kg	1	2.34E+02	kg of CO_2 eqv.
CH_4	0.00E+00	kg	23	0.00E+00	kg of CO_2 eqv.
NO_x	1.30E+01	kg	310	4.03E+03	kg of CO_2 eqv.

LCA – LCI Life Cycle Inventory analysis
Glass Bottles Production (Cradle to Gate)



Note: However data provided, are including the energy and emission data of recycling with system expansion

LCA – LCIA Life Cycle Impact Assessment

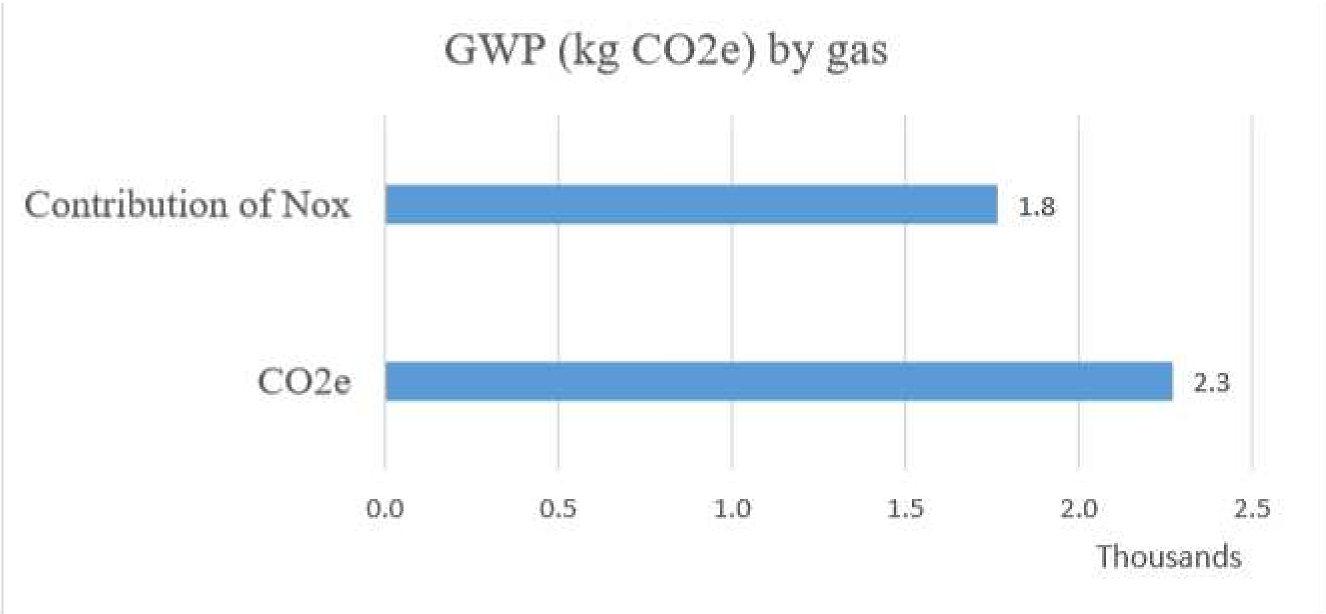


Diagram 3: Contribution of NOx to the global warming effect due to aluminium can production

LCA – LCIA Life Cycle Impact Assessment and LCI summary (Glass Bottle)

Table 2: Sample result showing relationship to the results of LCIA and LCI.

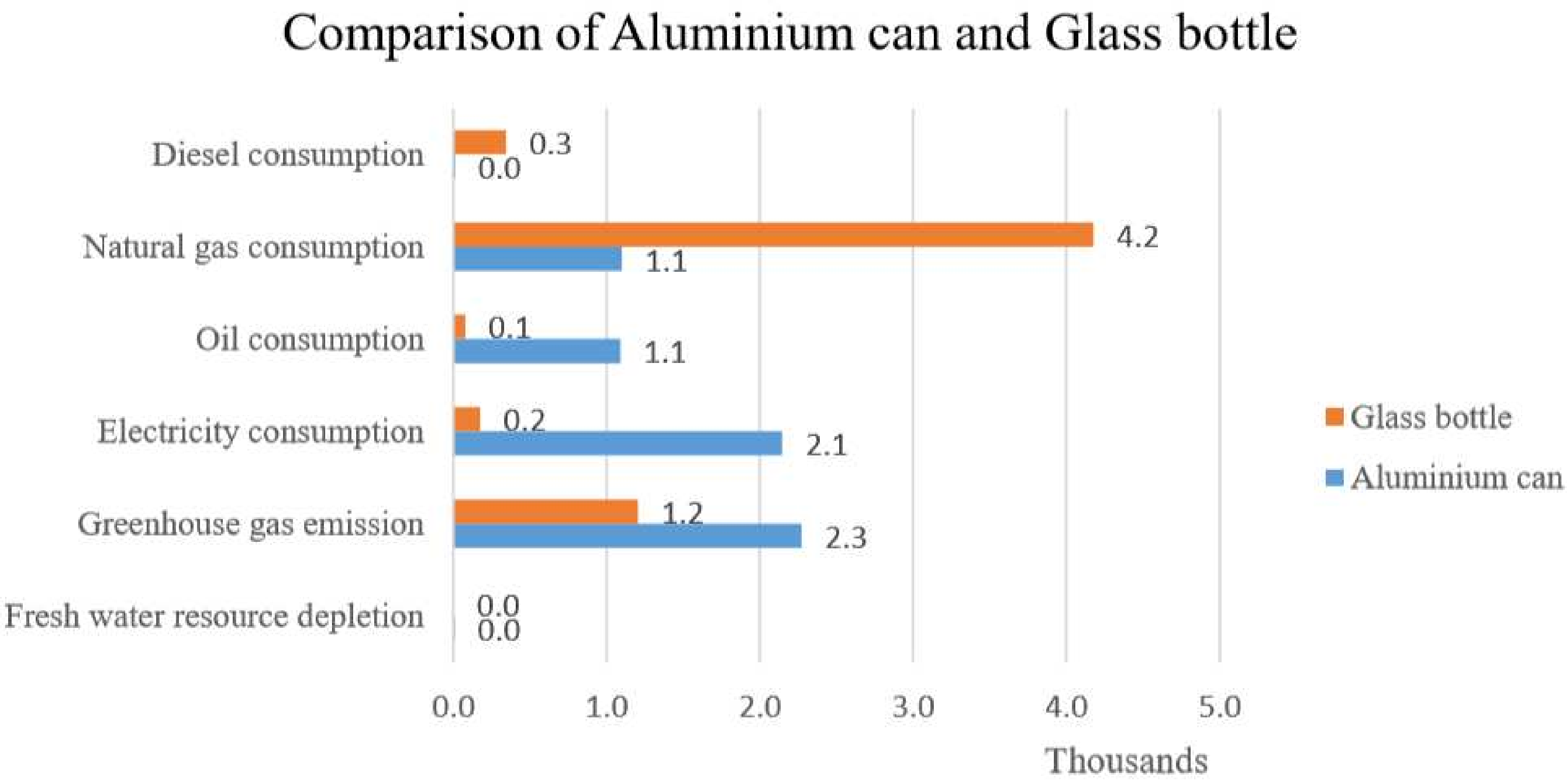
Energy required (MJ)				Emissions (kg CO2 equivalent)			Life cycle impact assessment
Energy (MJ) Electricity	Energy (MJ) Oil	Energy (MJ) Natural gas	Energy (MJ) Diesel	CO_2 non fossil	CH_4	NO_x	kg CO2 equivalent
175.2	77.3	4176.1	344.510	0.0	148.931	766.145	1205.0

LCA – Comparison

Table 4: Result of comparative analysis

Factors	**Aluminium can**	**Glass bottle**	**Unit/ 2000 bottles**
Fresh water resource depletion	7.0	1.5	m3
GREENHOUSE GAS EMISSION	**2271.8**	**1205.0**	**kg CO2 equivalent**
Electricity consumption	2145.6	175.2	MJ
Oil consumption	1090.2	77.3	MJ
Natural gas consumption	1099.5	4176.1	MJ
Diesel consumption	10.0	344.5	MJ

LCA – Comparison



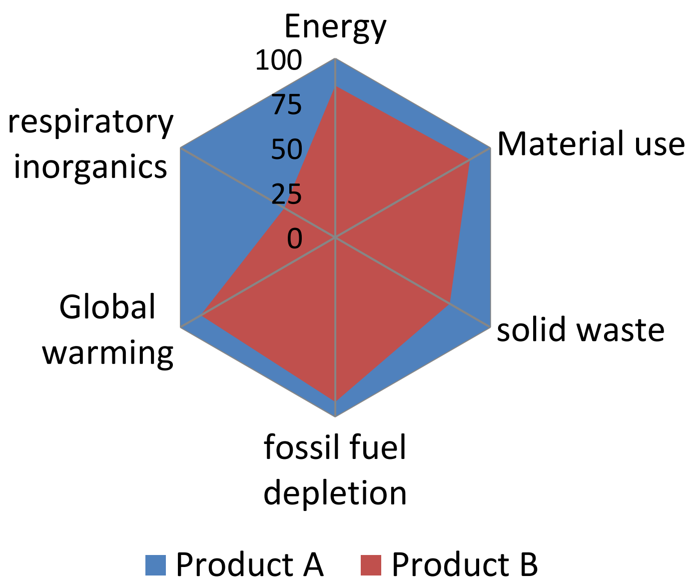
LCA – Comparison
Conclusions and INTERPRETATION

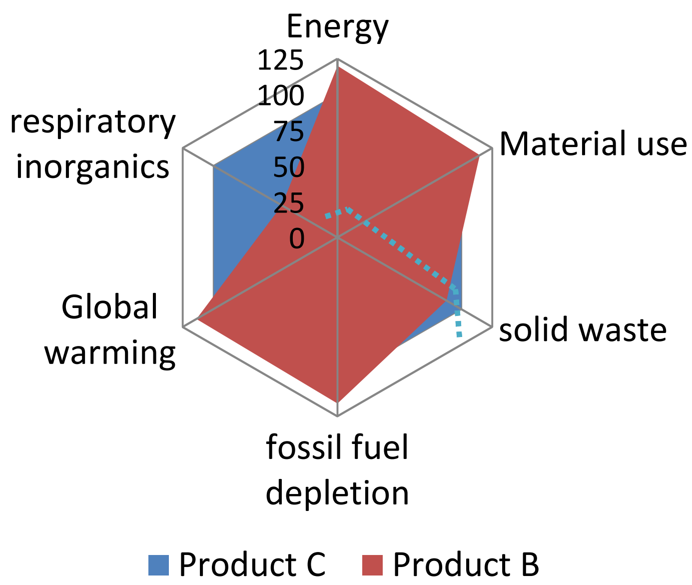
- **GHG**: the GLASS Bottle is more environmental friendly
- **Natural Gas**: Bottles production requires high usage of gas (*)
- **Electricity**: Aluminium requires high consumption due to the Electrolysis phase during the ingot preparation

(*) Natural Gas (CH4) produces 50-60% less CO2 emissions than traditional fuels (oil and coal), however CH4 produces an atmosphere warming effect which is 34 times higher than CO2 over 100 years and 86 times over 20 years.
Spillage and leakages form well and transportation occurs to be 5-10% of the overall Life Cycle.

LCA –INTERPRETATION
Comparative Analysis advantages

TRADE-OFFS?



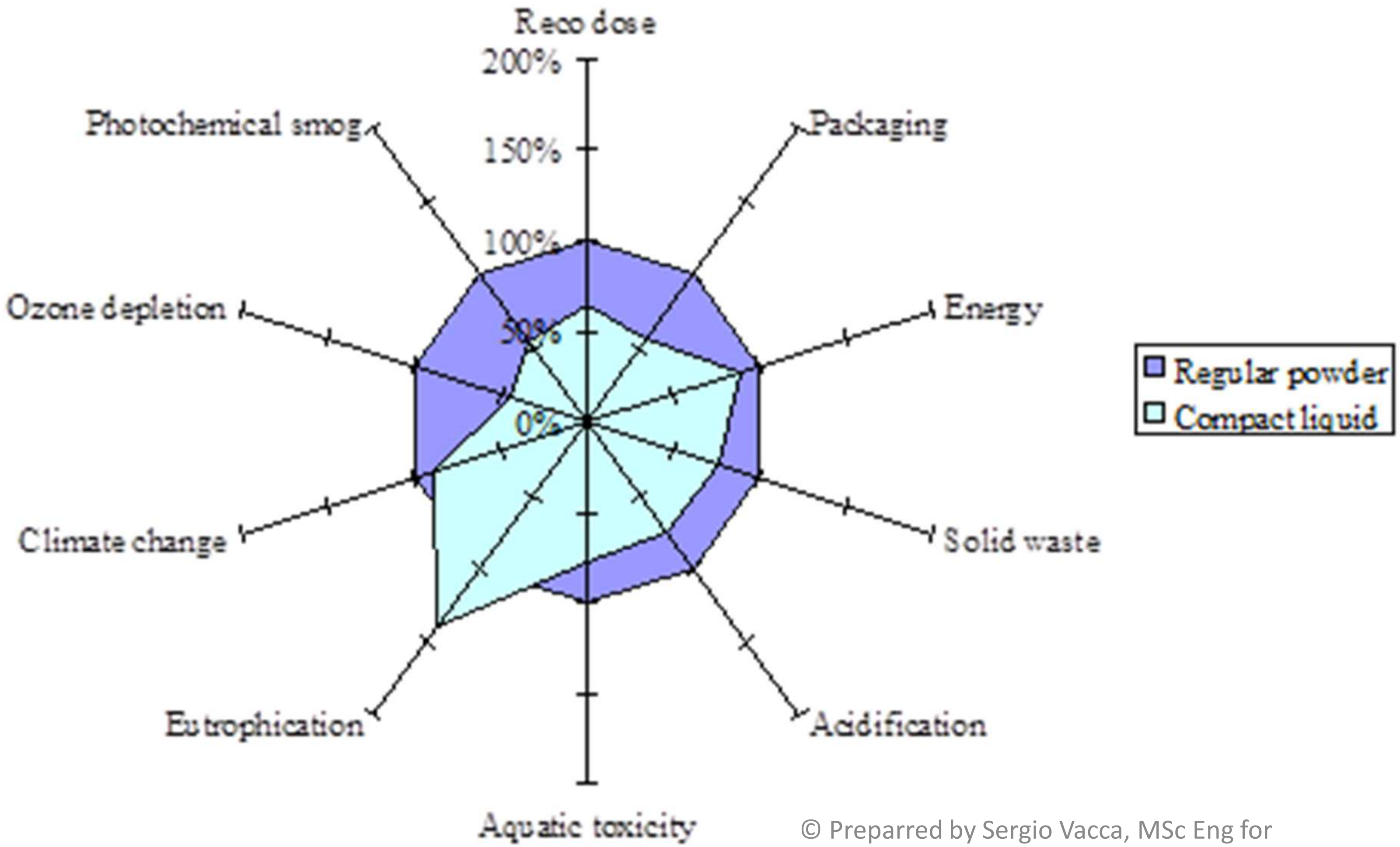


LCI and LCIA:

- Prod. A vs Prod. B (B looks better)
- Prod. B vs Prod. C (C looks better)

Performance? Maybe Trade Off's are needed

EXAMPLE ON DETERGENTS



LCA – Software

TECHNICAL AND NUMERICAL LCA CAN/MUST BE PERFORMED AND SUPPORTED BY SOFTWARE, LOCAL AND/OR SAAS/CLOUD.

- Open LCA (Green Delta) – partially free
- Sima Pro
- Umberto LCA+ (trial period)
- …

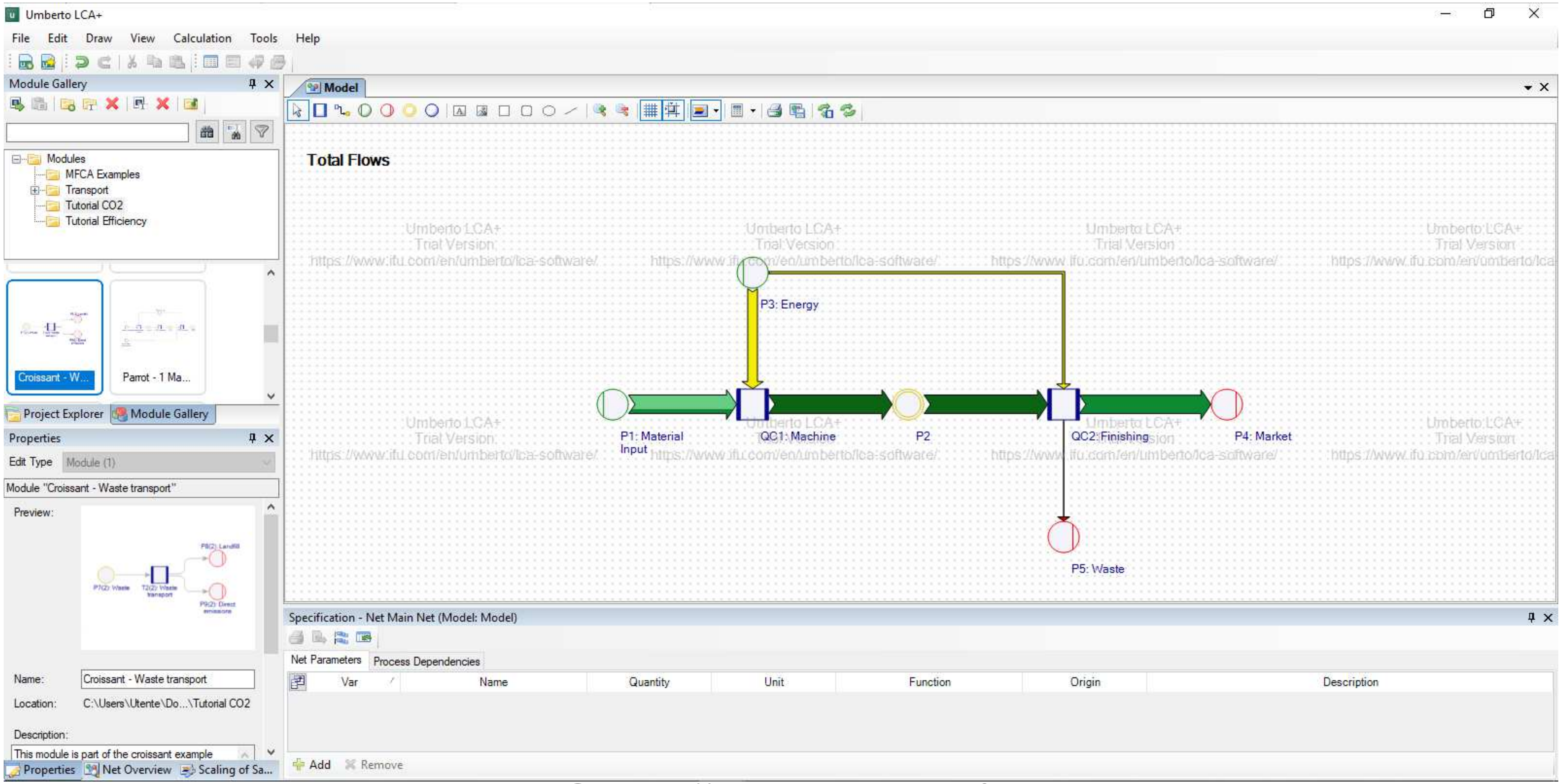
NUMEROUS DATABASE ARE AVAILABLE IN SUPPORT OF LCIA ELABORATION AND STDS APPLICATION

- Open LCA Nexus (free and payment)
- GABI
- ELCD (European Reference LC Database)
- IMPACT 2002+
- …

LCA – Software
Main features

- Volume of Data
- Windows™ environment
- Network Capabilities
- Impact Assessment
- Graphical representation of the inventory results
- Sensitivity analysis
- Units
- Cost
- User Support
- Flow Diagrams
- Burdens allocation
- Transparency of data
- Input & output parameters
- Demo version
- Quality of data

LCA – Software
Main features



Supply Chain Sustainability in practice
Agenda

1. Sustainability: do we need a trigger to start taking action in depth? examples:
   - Fairtrade in South America; big Corporations as Walmart
   - The EOD - Earth Overshoot Day
2. Cultural and Managerial direction setting to make things happen
3. Sustainability Model structure: convergence of Social, Environmental and Economic factors
   - Risk Mgmt and Brand reputation
4. The SC Manager role: focus on the very basics (Emissions, NPD) while monitoring the external social and political factors
5. LCA – Life Cycle Assessment: a methodology to measure and improve the Sustainable Supply Chain:
   - Sustainable SCOR – an holistic methodology for environmental impact accounting
   - ISO 14000 stds, GRI, Sustainable SCOR framework
6. **Case study: work together to get a «feeling» on how to influence results** ***(case study material distributed)***

It is time for your presentation

Thank you !

Q&A

sergiovacca@aol.com