Aalto University
School of Arts, Design
and Architecture

Design Approaches to Sustainable Consumption

Session 6: Assessing and communicating sustainability impacts

Tatu Marttila

Thursday 26.1.2023 (9:15-12:00)

Agenda

9:15–9:40	**Case work status and next sessions; Recap of last week** – *All good with case work?* – *Recap of last week sessions* – *Next sessions*
9:40–10:30	**Assessing environmental and social impacts in design**
10:30–10:45	***Break***
10:45–11:10	**Communicating impacts in/with design**
11:10–11:40	**Exercise in case groups**
11:40–12:00	**Closing session**

Case work status and next sessions…

Case work progress – status check

Presentation session on Tuesday:

- General insights: How did you perceive groups' idea presentations
- Any general questions about progress and next steps?
- Remember to fix a meeting with tutor to discuss progress…

Course and case work schedule

Working days	Tuesdays (13-17)	Thursdays (9:15-12)
Week 1 (10. & 12.1.)	Introduction to course; DfS introduction (F101)	**Case introduction:** **Food system sustainability** (Q201)
Week 2 (17. & 19.1.)	Systemic (PSS) design and circular economy (Q201)	Design for sufficiency (Q201)
Week 3 (24. & 26.1.)	**Presenting case work ideas** (F101)	Assessing and communicating sustainability impacts (Q201)
Week 4 (31.1. & 2.2.)	Negotiating food systems experiments (Q201)	Scaling-up design ideas (Q201)
Week 5 (7. & 9.2.)	One planet game session (L1–241, Puunjalostustekniikka 1)	**Case work tutoring** (Q101) ***Concept poster by Friday!***
Week 6 (14. & 16.2.)	**Final presentations** (F101)	Summary discussion (Q101)

Next week sessions: Topics & readings

Tuesday (31.1.):
Negotiating food systems experiments

Guest: Philip Hector

Lecture reading:

- Ceschin, F. (2014). How the Design of Socio-technical Experiments Can Enable Radical Changes for Sustainability. *International Journal of Design.*

Remember to begin to reflect on weekly topics and progress in your learning diary!

Thursday (1.2.):
Scaling-up design ideas

Lecture reading:

- Irwin, T. (2018). The Emerging Transition Design Approach. DRS 2018 Proceedings.

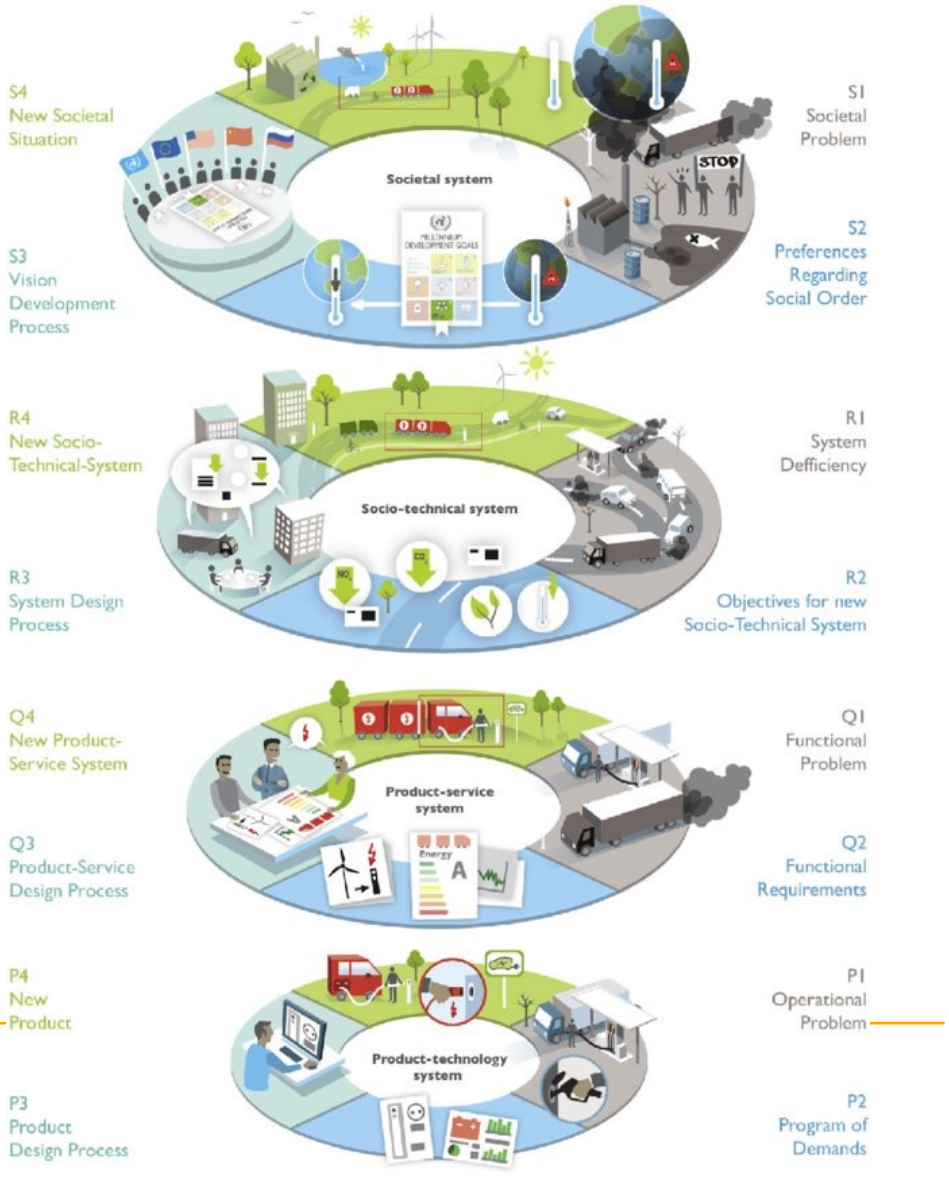
Recap of previous sessions

Multilevel focus for design

Multilevel perspective adapted to design:

”The role of designers is broadening, from the creators of physical arte-facts to the potential role of facilitators of complex societal change processes. To support the widening role of the designer, there is a need for a design supportive model.”

Multilevel Design Model (MDM) by Joore & Brezet (2014)



Socio-technical systems and sustainability transitions

Transition Management (TM) methodology is based on a *multi-level perspective* on sustainability transitions within the socio-technical system context, with focus on:

- **Macro-level (landscape)**
- **Meso-level (regimes)**
- **Micro-level (niches)**

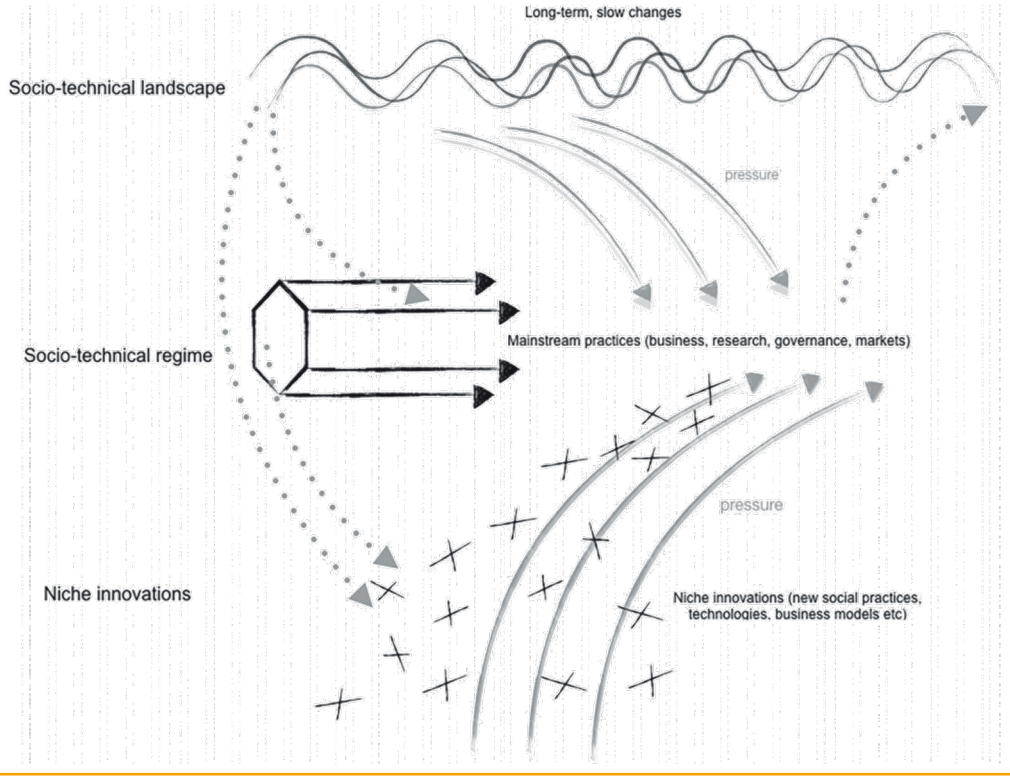


Figure 11.1 The MLP of system innovations model
Source: Adapted from Geels (2005a, 2005b) and Geels & Schot (2007).

Different types of PSS solutions

PSS design is a perspective to designing any product or service. However, there are different types of PSS depending on how and where the value is created.

- **Product oriented PSS** focuses mainly to extend the existing product-offering
- **Use oriented PSS** covers various models of leasing/sharing/pooling of products
- **Result oriented PSS** focuses to deliver a (novel) service with a 'functional result' (i.e., satisfy user need without product/material ownership)

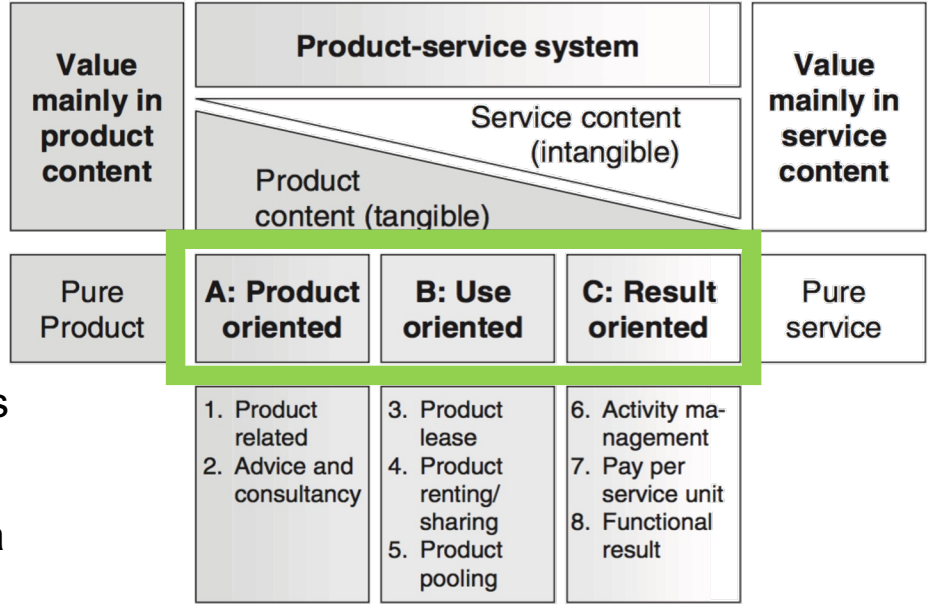


Figure 1. Main and subcategories of PSS

Figure based on Tukker, A. (2004). "Eight types of product–service system: eight ways to sustainability? Experiences from SusProNet." *Business Strategy and the Environment* (13/4). https://doi.org/10.1002/bse.414

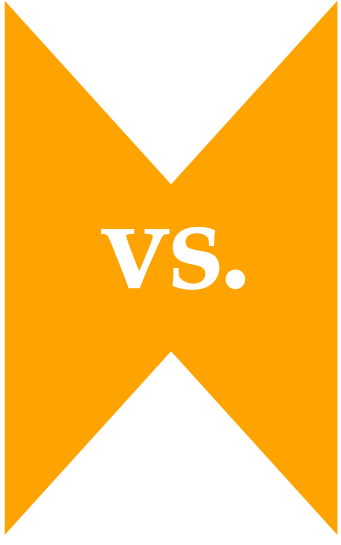
Some examples of sustainable PSS:
Services for mobility, food systems, and products

Car leasing service: no owner-ship or maintenance, guaranteed access with monthly fee

Food delivery service: online service with 3rd party delivery

Repair service by mail: ability to repair selected product via mail

B2B offerings: sustainability improvements (e.g., efficient energy, transport) as services



Car sharing and peer-repair service: platform for peer-sharing and repairing vehicles

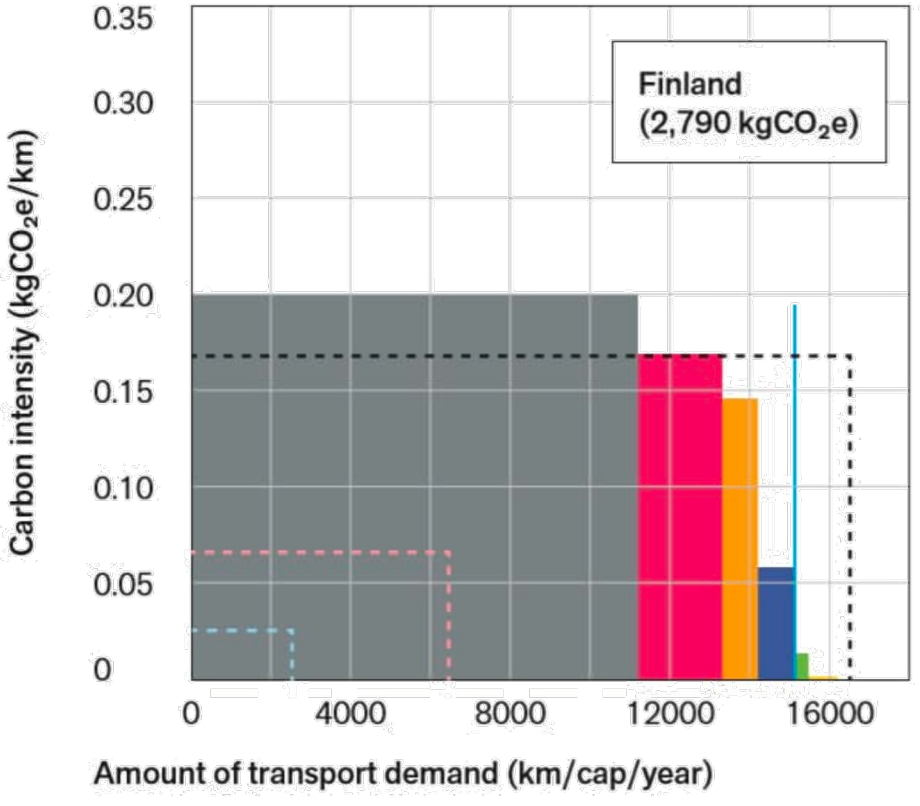
Community kitchen: a place for community to gather around food

Open repair workshop: a supported workshop for repair and tool rentals

B2B collaborations: gather into networks to create platforms for peer-service and development

...Remember a critical perspective in considering sustainability improvements!

Suffiency – Enoughness



Watching TV ... requires

		Euro/year	MJ/euro
A09112	TV, DVD, and other equipment	117	0,81
A09141s2	DVDs, VHS casettes	6,3	0,72
A09423	TV-license, service fees	93,7	0,75
A0915	TV and PC repair	5,2	0,72
Energy	Domestic electricity for this purpose		

Derived from Input-Output tables
See e.g. for exiobase.eu

Assessing and communicating sustainability impacts

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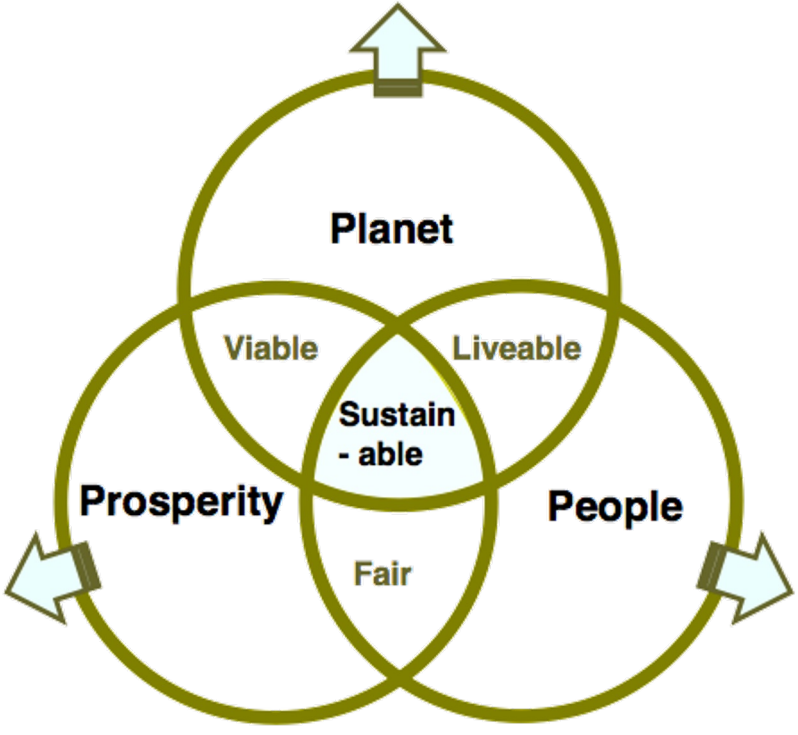
Sustainability – complex to assess…

Prioritization: “Sustainability” vs. “Sustainable development”?

Triple-bottom line reporting:

- Financial bottom line
- Social / ethical performance
- Environmental performance

Decouple the circles
– unpack their meaning…



Source: Ashby et al. (2013) Materials & SD

Bill of materials:

- Mass, density, price; recycled, recyclable?
- Critical materials? (rare, no substitutes, supply chain risks, geopolitics)

Energy / carbon footprint:

- How much energy is needed?
- When and where is it needed?

Environment:

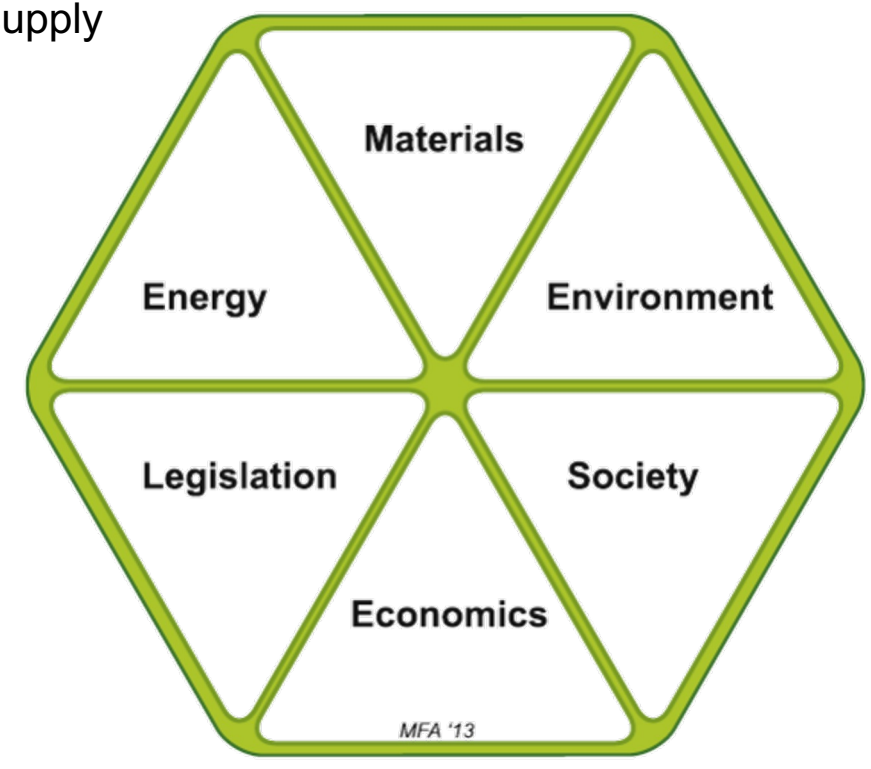
- Ecological footprint/handprint
- Toxicity/accumulation

Legistlation:

- Policies & legislative frameworks
- Guidance & Costs

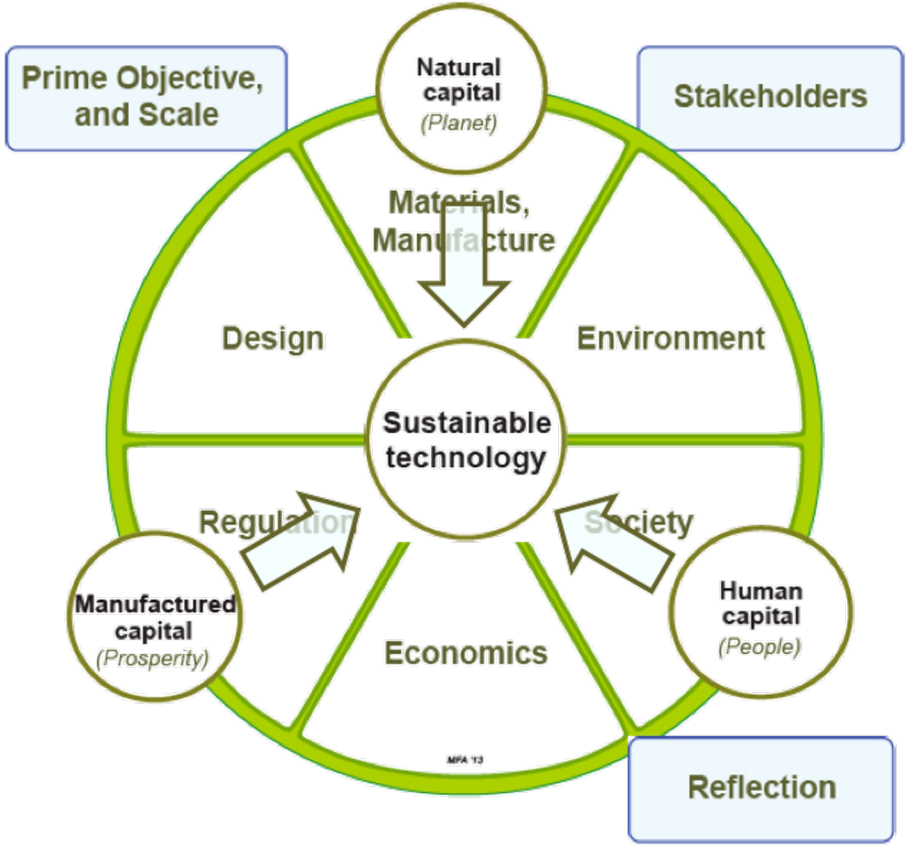
Society and Economics:

- Fairness and quality of life, good jobs
- Risk, investments, competitive advantage



Source: Ashby, M. (2012) Materials and the Environment: Eco-Informed Material Choice

Process for assessing sustainability of a product-system/technology:



Step 1: Clarify Objective

Step 2: Stakeholders

Step 3: Fact finding
- objective

Step 4: Integration
- subjective

Step 5: Reflection

Source: Ashby, M. (2012) Materials and the Environment: Eco-Informed Material Choice

Where to find improvement?

Researching the problem context and its surrounding system, situation and use context helps to identify sustainability potential, for example in:

- **Design process**
- **Ecological impacts**
- **Social context**
- **Cultural context**
- **Context of use**
- **Economic opportunities**

Assessing and communicating impacts of consumption and use

Sustainable design considers and communicates the social and environmental effects in addition to the economic effects of organizations' actions

- Environmental impact often communicated in the form of carbon footprint
- Social sustainability also becoming an increasingly important component also in corporate social responsibility (CSR) communication

Main methods for assessment:

- Material and product life-cycles and life-cycle assessment (LCA) as the cornerstones
- Input-output assessment; Investments of energy, materials vs. output of CO2 etc.
- Also Social LCA connecting with social (& broader economic) impacts
- Environmental return on investment (EROI); Social return on investment (SROI)
- Quantified vs. qualitative data; Remember to consider data validity and comparability!

Assessing sustainability – Identifying and analyzing impact ’hotspots’

Analyzing ’hotspots’ of impacts in the system is a necessary step in assessing impact

This calls for mapping of supply chain, stakeholder network, and production system

Hotspot analysis as a general approach:

- **Life cycle assessment and design** as a method to identify dominant impacts of production, and their mitigation
- Technology assessment also considering connections to **regulation and policy development**
- Social impacts also assessed by identification of production hotspots, for example in UNEP’s **Social LCA**

Organizations promoting impact assessment

UNEP, UN Environment Programme, promotes LCA in The Life Cycle Initiative and offers also tools for social impact assessment

SETAC, Society of Environmental Toxicology and Chemistry, has promoted LCA and other environmental assessments worldwide since 1990s

ISO, International Standardization Organization, has standardized LCA in ISO 14040:2006 (Environmental management — Life cycle assessment — Principles and framework)

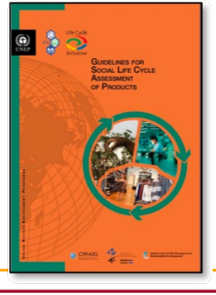
EMAS, The EU Eco-Management and Audit Scheme, is a management tool developed by the European Commission for companies and other organisations to evaluate, report, and improve their environmental performance.

C40 Cities and their Climate Leadership Group is a group of 96 cities around the world providing tools for cities' and organizations' impact assessment

Golden standards for sustainability assessment

Sustainability

	Natural	Manufactured and financial	Human and social
Capitals			
Tools	(E-) LCA Environmental life cycle assessment	LCC Life cycle costing	S-LCA Social life cycle assessment
Origins	SETAC (1991 on)	Multiple – EU, US, Other	UNEP/SETAC (2009) (2)
Methods	ISO 14000 series (1997 onwards)	Technical cost modeling(1)	
EduPack Tools	Eco-audit tool	Eco-audit with cost Part-cost estimator	



(1) http://ec.europa.eu/environment/gpp/pdf/WP-LifeCycleCosting.qx.pdf

(2) http://www.unep.fr/shared/publications/pdf/dtix1164xpa-guidelines_slca.pdf

Assessing environmental impacts

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Types of assessing environmental impacts

Environmentally extended input–output analysis (EEIOA) is used in environmental accounting as a tool reflecting different production and consumption sectors of the economy

- (Carbon) impact per euro in particular production/consumption system (e.g., buying vegetables vs. buing meat products)

Environmental impact assessment (EIA) aims at reducing or fully preventing negative environmental impacts of products/systems

- (Carbon) impact per product (or e.g., kg of food) or functional service-unit

Not only carbon impact assessment, but also other areas of focus (water use, toxics, etc.)

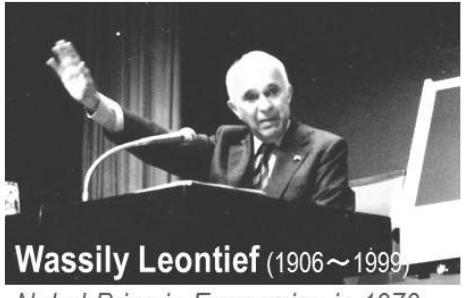
Input-output perspective

Originally, an **input-output table** is a matrix representation of a nation's (or region's) economy, and an economic tool for quantitative analysis of the structure and interdependencies of producing and consuming sectors in the economy

Environmental input-output analysis extends the assessment to ecological aspects

Utilized in studying impacts of complete sectors in production (eg. automotive sector)

As a model, the effect of changes in one industry on others and by consumers, government, and foreign suppliers on the economy is predictable.



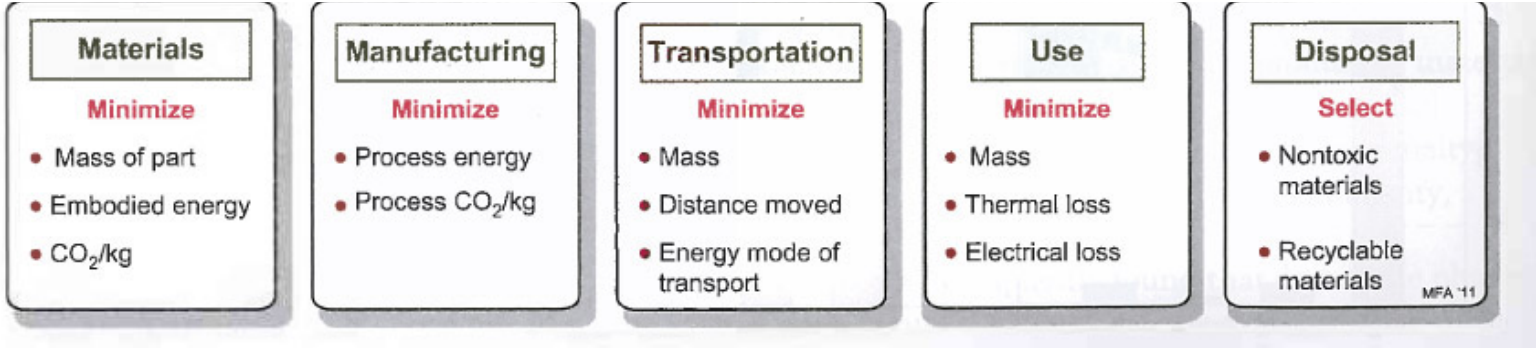
Wassily Leontief (1906～1999)

Nobel Prize in Economics in 1973

For more info, see for example:
https://ec.europa.eu/jrc/en/publication/world-input-output-database-environmental-accounts

Life-cycle perspective

Sustainable design considers assessment of impacts of every phase of product-life, from materials production to use and to disposal. **Life-cycle analysis or assessment** (LCA) is an overall term of the assessment of life phase impacts of products and systems.



Source: Ashby, M. (2012) Materials and the Environment: Eco-Informed Material Choice

Life-cycle assessment (LCA)

Design tools for life cycle design range from guidelines and checklists to qualitative tools, light-weight eco-auditing tools and finally to full-scale quantitative LCA research, often made by specialized industry-specific consultants.

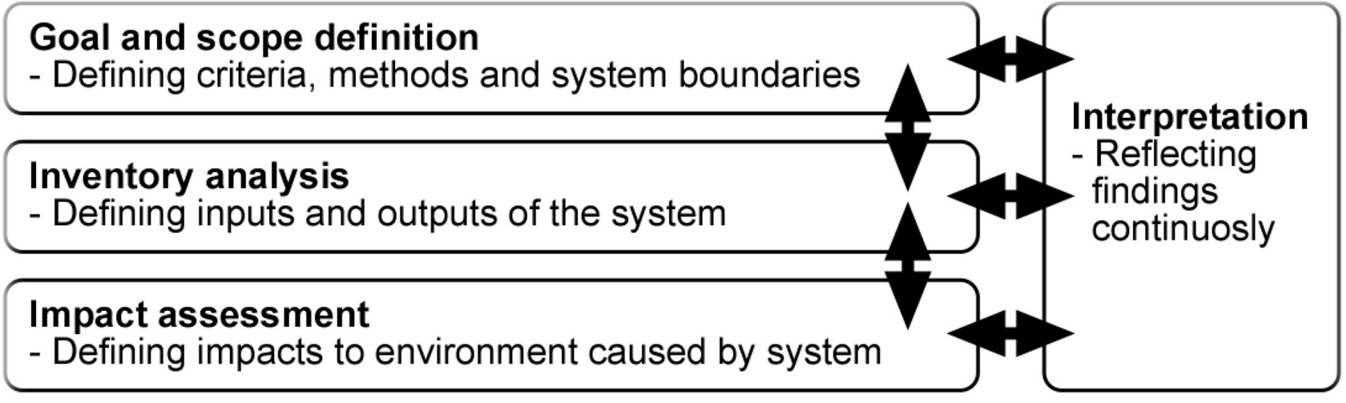


Figure 2. The process of LCA (according to ISO 14040 and ISO 14044).

LCA including an analysis of system boundaries:

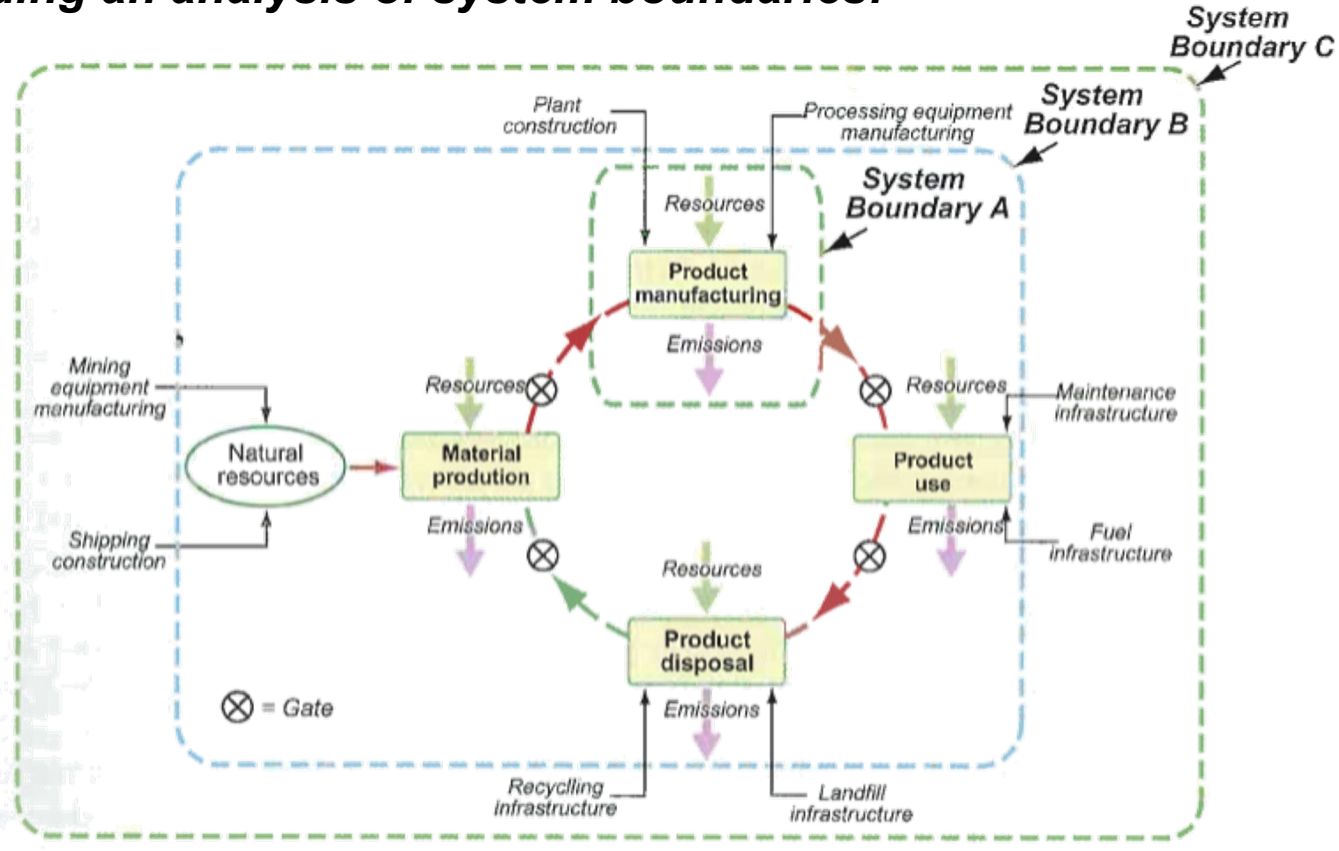
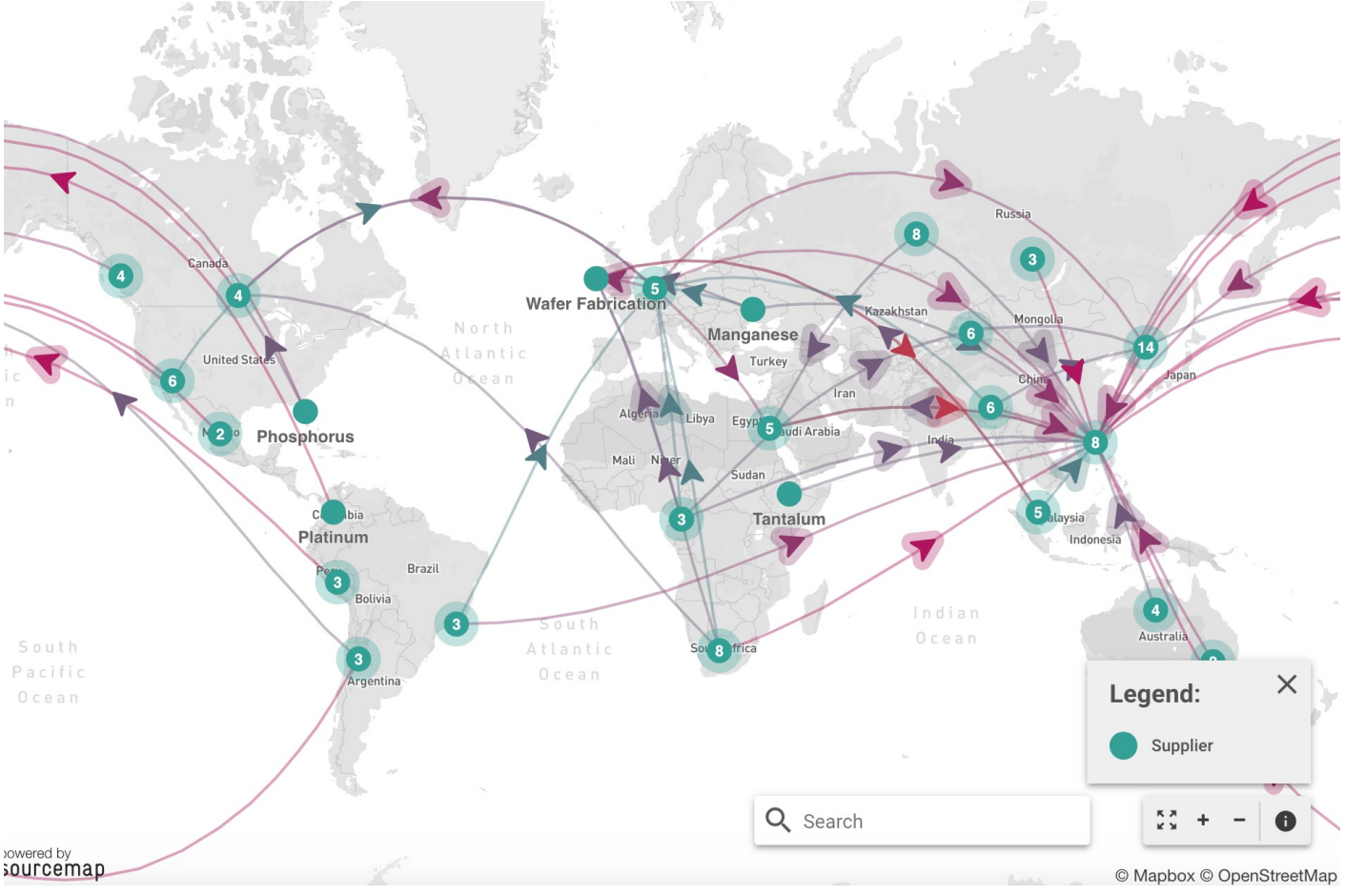


FIGURE 3.3 *LCA system boundaries with the flows of resources and emissions across them. System Boundary A encloses a single phase of the lifecycle. System Boundary B encloses the direct inputs and emissions of the entire life. It does not make sense to place the system boundary at C, which has no well-defined edge.*

Source: Ashby, M. (2012) Materials and the Environment: Eco-Informed Material Choice

Studying value chains, sourcing, and logistics:



See: https://open.sourcemap.com/

Simplified life-cycle assessment (SLCA)

The methodologies used in LCA process can be divided in approaches utilizing quantitative or semi-quantitative approach with comparable data on life-cycle impacts, or qualitative approach that aims to identify important aspects more broadly

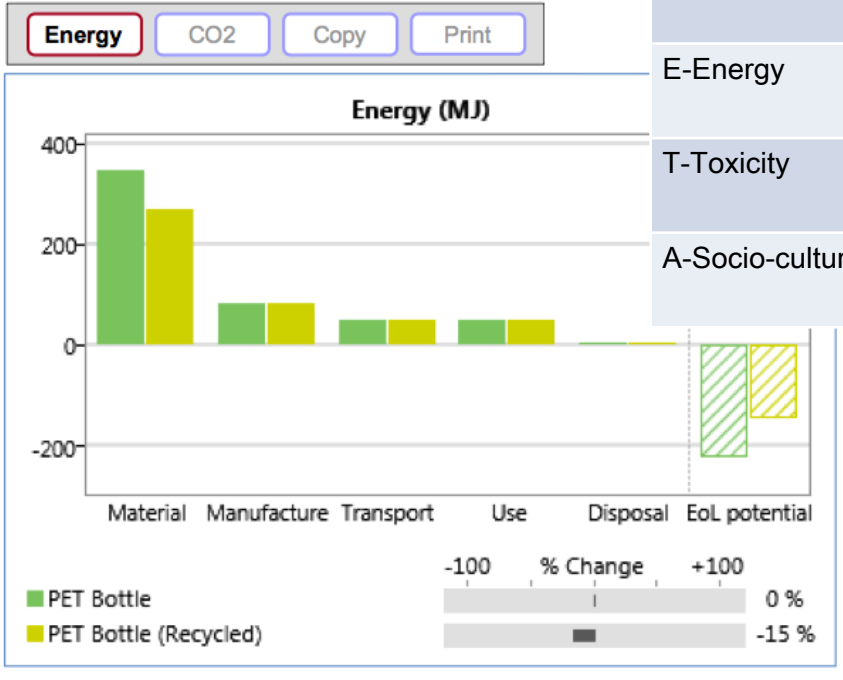
Simplified, or streamlined LCA (SLCA) is divided also in semi-quantitative and qualitative strategies, including input-output tools and matrix approaches

Commonly, SLCA tools often emphasize general values over specific numbers from a specific assessment: many of them can also combine quantitative and qualitative aspects

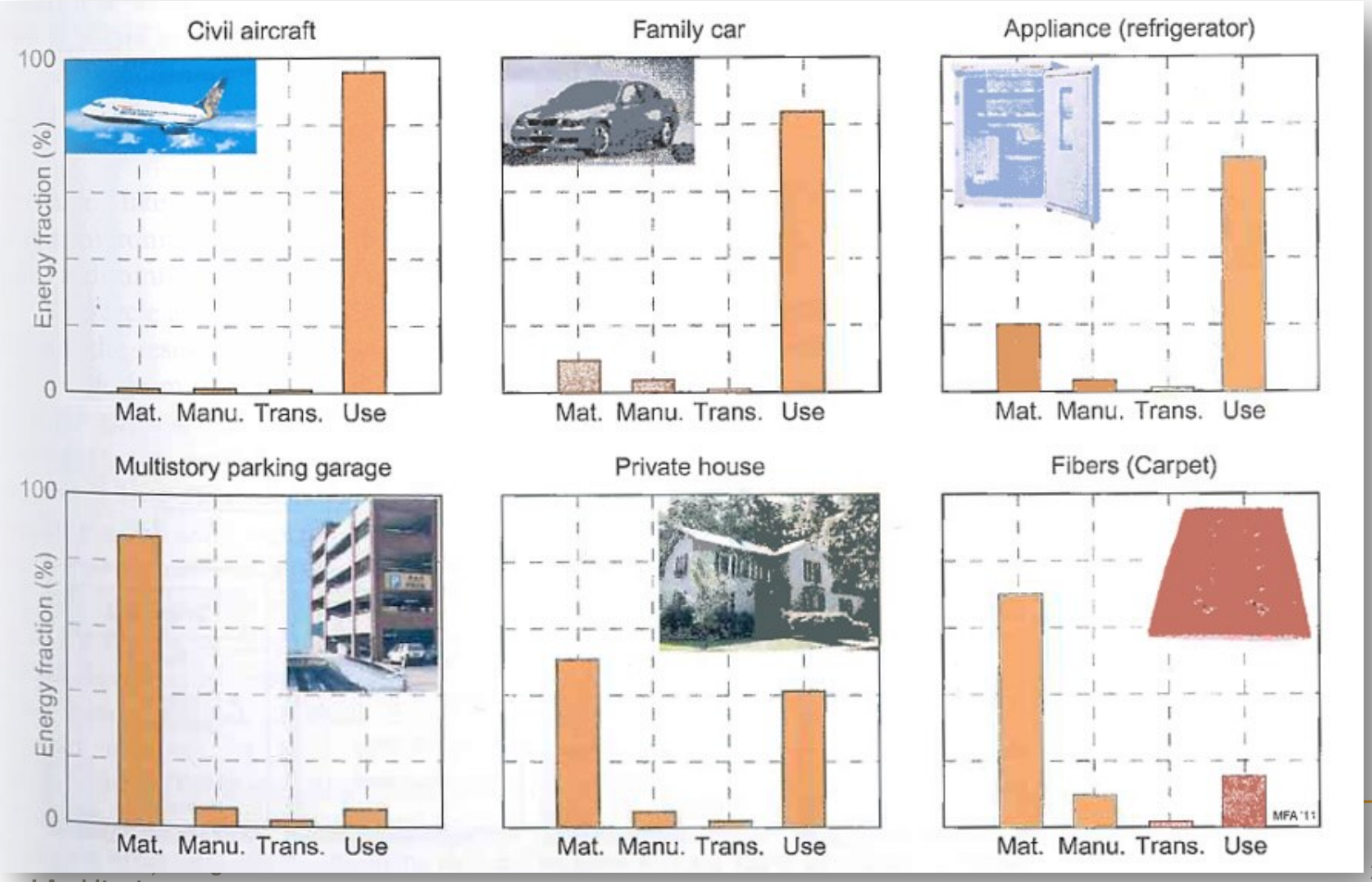
For design guidelines to supports life-cycle design, see also Design for Sustainability (SDO) toolkit/checklist, in MyCourses.

Studying and improving life-cycle impacts:

Impact category	Material production	Manufac-turing	Use-phase	End-life	Transport
M-Materials					
E-Energy					
T-Toxicity					
A-Socio-cultural					



Identifying main impacts for different products:



Source: Ashby, M. (2012) Materials and the Environment: Eco-Informed Material Choice

Information to support impact assessment

To be able to compare products and materials and make design choices, there is a need for **comparable data to support impact assessment**

- Ashby, Ferrer, & Bruce (2013). Materials & SD (in MyCourses as optional reading): **Granta EduPack Sustainability database** (on Aalto computers) provides a resource for assessing sustainability of products and materials
- The Edupack database can be used to help to gather information on materials (and also nations), support material selection, or to perform (product) eco-audits.
- For food impacts, see: The big climate database (denstoreklimadatabase.dk)

Bill of materials:

- Mass, density, price; recycled, recyclable?
- Critical materials? (rare, no substitutes, supply chain risks, geopolitics)

Energy / carbon footprint:

- How much energy is needed?
- When and where is it needed?

Environment:

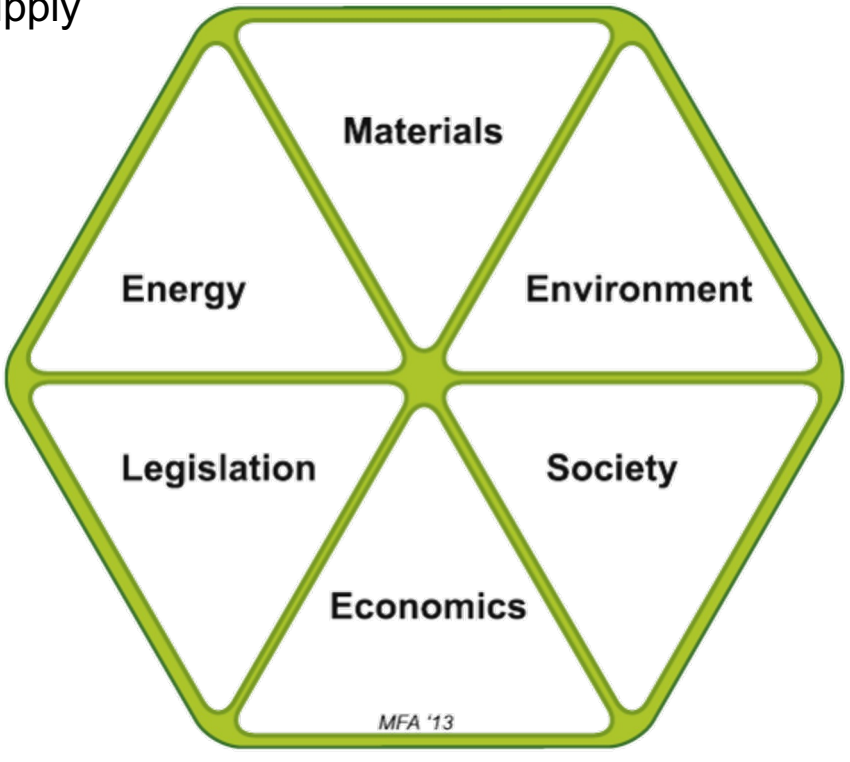
- Ecological footprint/handprint
- Toxicity/accumulation

Legistlation:

- Policies & legislative frameworks
- Guidance & Costs

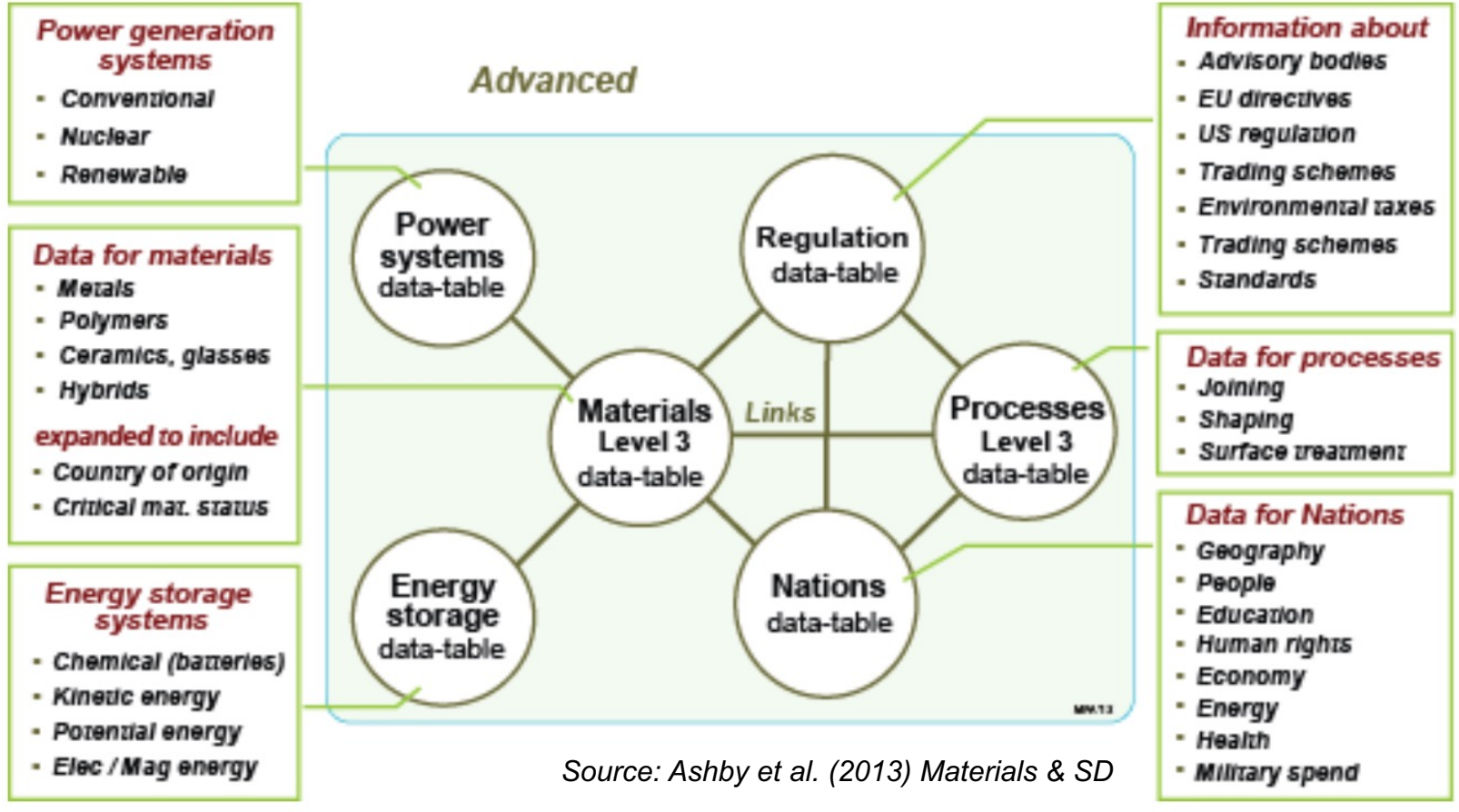
Society and Economics:

- Fairness and quality of life, good jobs
- Risk, investments, competitive advantage



Source: Ashby, M. (2012) Materials and the Environment: Eco-Informed Material Choice

Data-tables in Granta Edupack program:



Source: Ashby et al. (2013) Materials & SD

Material input per service-unit (MIPS)

- MIPS is an assessment method developed by European Wuppertal Institute, used also in Finland
- It moves focus to ‘functional efficiency’ (remember the functional approach in PSS)
- Used to calculate impacts per ‘service unit’, ie. per km travelled, meal served, or single use of a product (eg. T-shirt for a day)
- Impact indicators in five categories: Biotic, abiotic, air, water, erosion
- However: Complex calculations; Limited library of values

I. Abiotic raw materials

- mineral raw materials (used extraction of raw materials, such as ores, sand, gravel, slate, granite)
- fossil energy carriers (amongst others coal, petroleum oil, petroleum gas)
- unused extraction (overburden, gangue etc.)
- soil excavation (e.g. excavation of earth or sediment)

II. Biotic raw material

- plant biomass from cultivation
- biomass from uncultivated areas (plants, animals etc.)

(Domesticated animals are already part of the technosphere, and are therefore referred back to biomass taken directly from nature, e.g. plant or animal fodder.)

III. Earth movement in agriculture and silviculture

- mechanical earth movement or
- erosion

IV. Water

(separated according to processing and cooling water)

- surface water
- ground water
- deep ground water (subterranean)

V. Air

- combustion
- chemical transformation
- physical transformation (aggregate state)

See: http://pavogy.web.elte.hu/Kornyez/Koz_kis/MIPS/ws27e.pdf

Boundaries for impact assessment – Tiers / scopes 1–3

In assessing impacts of activities, the scope of assessment varies covering only direct emissions and emissions (tier [or 'scope'] 1), with less focus on supply chain emissions; In contrast, approaches based on comprehensive environmental life-cycle assessment track total emissions across the entire supply chain (tier 3)

- **Tier / scope 1: Direct emissions from an industry (factories, vehicles)**
  14% of total supply chain impact (according to Matthews et al. 2008)
- **Tier / scope 2: Direct emissions with energy inputs** including Tier 1; represent 26%
- **Tier / scope 3: Emissions of the total supply chain up to the production gate**, also known as cradle-to-gate (note! may or may not include end-of-life impacts)

Matthews, Hendrickson, & Weber (2008). "The Importance of Carbon Footprint Estimation Boundaries." *Environ. Sci. Technol.* 2008, 42, 5839–5842

Assessing impacts of organizations and communities (companies and cities)

C40 Cities network has developed Greenhouse Gas (GHG) Protocol for Cities, which is an accounting and reporting standard for cities

- A global protocol to assess community-scale greenhouse gas Inventories

Greenhouse Gas Protocol provides widely used greenhouse gas accounting standard also for companies

- See: https://ghgprotocol.org/

Assessing social impacts

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Social impact assessment

Social impact assessment (SIA) as the process of identifying and managing the social impacts of industrial projects or activity.

It involves economic and also cultural considerations, and potentially risk assessments.

Open questions:

- What are the expected boundaries of assessment, where can a company be expected to have impact?
- What are taken as focus areas for improvement and how to balance trade-offs (eg. human health vs. local economy)
- How to measure, communicate, and regulate?

Social LCA (S-LCA)

The objective for conducting a S-LCA is to promote improvement of social conditions and of the overall socio-economic performance of a product/material production, throughout its life cycle for all of its stakeholders.

The Guidelines for Social (or socio-economic) Life Cycle Assessment of Products provides a map, a skeleton and a flash light for stakeholders engaging in the assessment of social and socio-economic impacts of products life cycle.

Concept is promoted by UNEP/SETAC in a publication (2009). As an optional reading in MyCourses.

By the end of 2003, the UNEP/SETAC Life Cycle Initiative recognized a need for a Task Force on the integration of social criteria into LCA.

It was motivated by a consensus that *"the use of LCA is hampered in developing countries [economies][4] clearly due to lack of expertise, data etc., but also due to the inability of LCA to engage in developing countries key issues." Negative perceptions of LCA in developing countries include:*

1. *LCA can be considered to be 'anti-development'-orientated because it provides only a picture of negative environmental consequences, but does not reflect any of the positive aspects of development, i.e. social and economic benefits.*
2. *Even if the value of LCA is appreciated, a justification for the high costs is lacking since it does not address the developing countries' most significant concerns, i.e. poverty eradication together with other social aspects such as employment rates, wages, accidents, working conditions and human rights."*[5]

	People	Planet	Profit/Prosperity
Internalities (Costs and benefits)	E.g. health and safety expenditures.	E.g. costs for pollution prevention.	E.g. costs of raw materials, taxes, interest on capital.
Externalities (Costs and benefits)	E.g. impacts on human well-being due to social impacts	E.g. biodiversity or human health impacts from pollution	E.g. reduction in crop yields due to pollution

Figure 1 – Detailing the full assessment of goods and services within the context of sustainable development

Source: UNEP/SETAC (2009) Guidelines for Social Life Cycle Assessment of Products

S-LCA framework: Stakeholder mapping

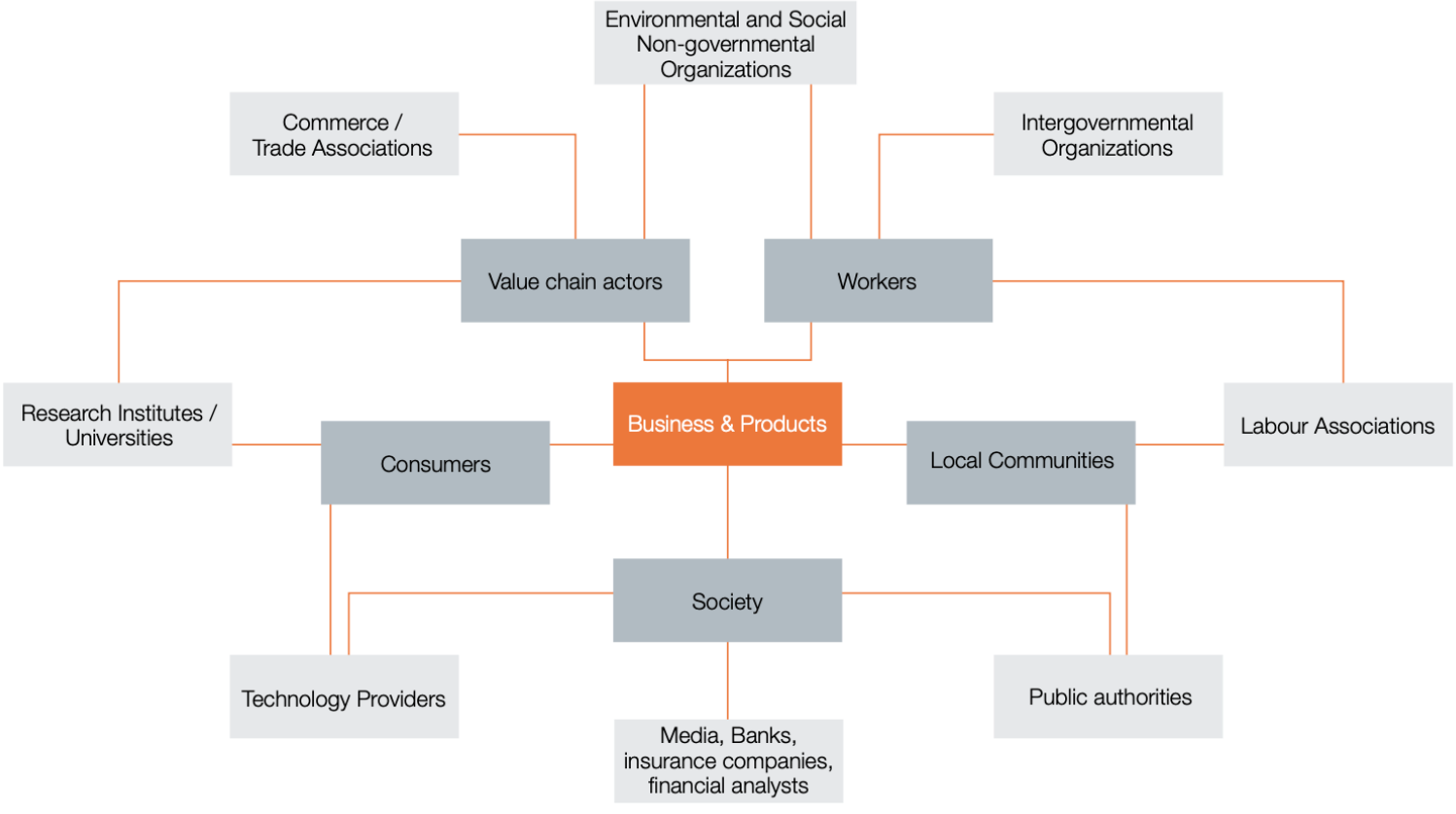


Figure 2 – Hub and spoke stakeholder diagram

Source: UNEP/SETAC (2009) Guidelines for Social Life Cycle Assessment of Products

S-LCA framework: Impact categories

Stakeholder categories	Impact categories
Workers	Human rights
Local community	Working conditions
Society	Health and safety
Consumers	Cultural heritage
Value chain actors	Governance
	Socio-economic repercussions

Stakeholder categories	Subcategories
Stakeholder "worker"	Freedom of Association and Collective Bargaining Child Labour Fair Salary Working Hours Forced Labour Equal opportunities/Discrimination Health and Safety Social Benefits/Social Security
Stakeholder "consumer"	Health & Safety Feedback Mechanism Consumer Privacy Transparency End of life responsibility
Stakeholder "local community"	Access to material resources Access to immaterial resources Delocalization and Migration Cultural Heritage Safe & healthy living conditions Respect of indigenous rights Community engagement Local employment Secure living conditions
Stakeholder "society"	Public commitments to sustainability issues Contribution to economic development Prevention & mitigation of armed conflicts Technology development Corruption
Value chain actors* not including consumers	Fair competition Promoting social responsibility Supplier relationships Respect of intellectual property rights

Social impact assessment – data for assessment

In assessing social sustainability, also external background research is often needed (eg. earlier research, public media); Even more emphasis is also on local actors and networks that can help to access information and identify issues

On a general level, UNDP human development data center (http://hdr.undp.org/en/data) offers a variety of national and demographic data

Also other LCA datatables such as Edupack often include information on social considerations (eg. demographic data)

Orientation for sustainable design: From preventing/mitigating negative impacts to improving conditions across the value chain!

Social LCA with Granta Edupack data:

Example: a cotton T-shirt

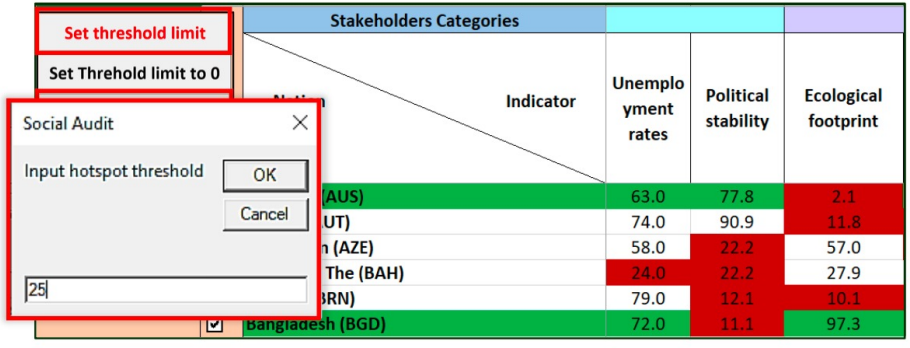
Cotton T-shirt

Material:	**Australia**
Manufacture:	**Bangladesh**
Transport: Sea	**Panama**
Use:	**UK**
Disposal:	**Kenya**

Are there reasons for social concern here?

1. Highlight Nations in Source page of spreadsheet

2. Set Hotspot threshold



Stakeholders Categories	Unemployment rates	Political stability	Ecological footprint
(AUS)	63.0	77.8	2.1
UT)	74.0	90.9	11.8
n (AZE)	58.0	22.2	57.0
The (BAH)	24.0	22.2	27.9
BRN)	79.0	12.1	10.1
Bangladesh (BGD)	72.0	11.1	97.3

3. Copy selected rows to Report

Stakeholders			S4 Society				S5 Valu	
Nation Indicator	Unemployment rates	Political stability	Ecological footprint	UN Human Development Index	R&D spend	Control of corruption	Regulatory quality	Press freedom
Australia (AUS)	63	77.77551	2.076087	95.05	83.5	95.05	97.5	90.20879
Bangladesh (BGD)	72	11.10204	97.30978	28.865		18.82	23.5	19.49451
Kenya (KEN)	3	9.081633	88.70109	25.703		13.87	44	46.14835
Panama (PAN)	75	60.60204	49.42391	65.755		47.53	69	45.6044
United Kingdom (GBR)	78	62.62245	21.44565	93.159	73.6	94.06	95.5	75.52198

Communicating sustainability impacts in/with design

Aalto University
School of Arts, Design
and Architecture

Communicating sustainability impacts (…with design action)

Different ‘units of analysis’ to assess and communicate:

- Environmental/social input (investments) vs. output (impacts) throughout product life-phases
- Environmental/social input/output in product-service-system (on what tier-level?)
- Environmental/social input/output per service encounter
- Environmental/social input/output per ‘functional unit’ that a product-service system offers (e.g. washing a shirt; driving 1 km etc.) -> Material Input per Service (MIPS)

Design amplifying and scaling-up sustainability considerations and solutions, and enabling connecting to action!

Communicating impacts of a product

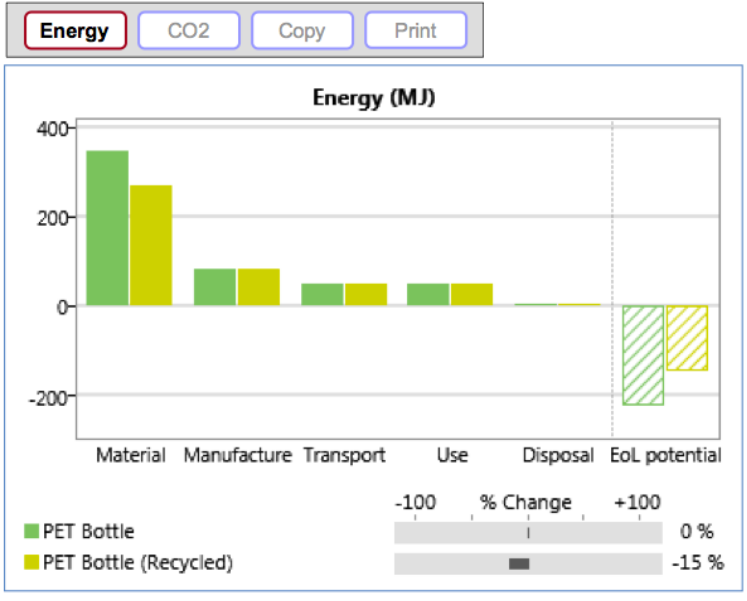
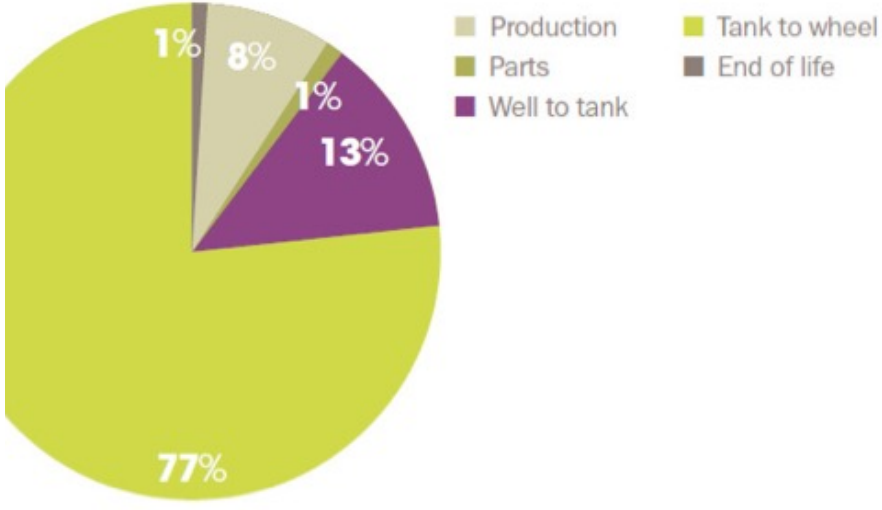


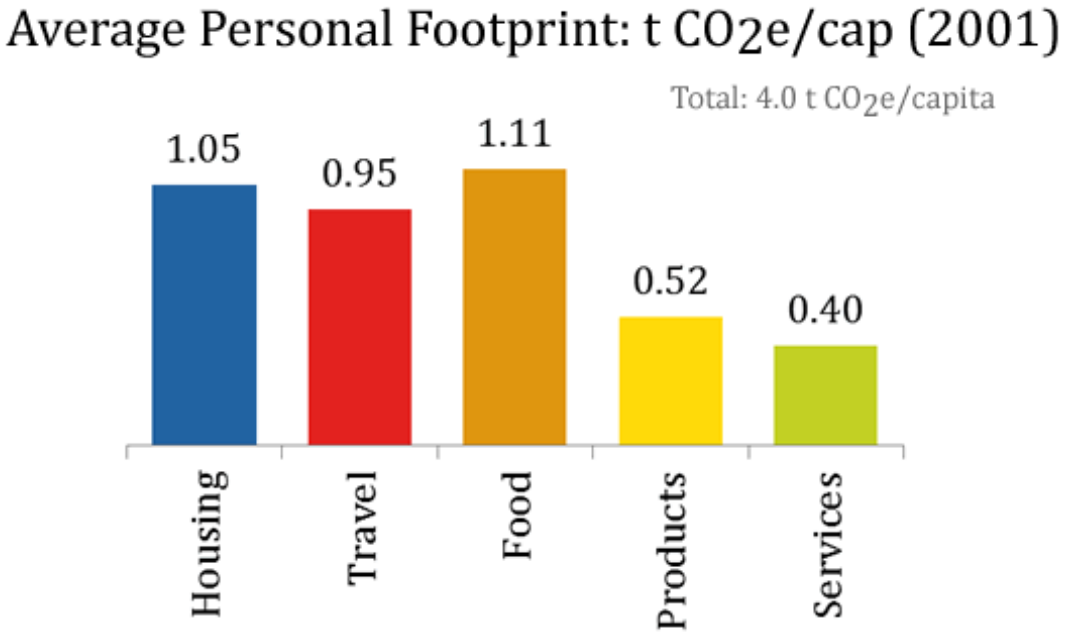
FIGURE 6. Environmental impacts during the lifecycle of a car



http://www.interfacecutthefluff.com/wp-content/uploads/2013/04/Screen-Shot-2013-04-18-at-16.37.32.png

Communicating impacts of personal consumption

(For example, see: https://lifestyletest.sitra.fi/)

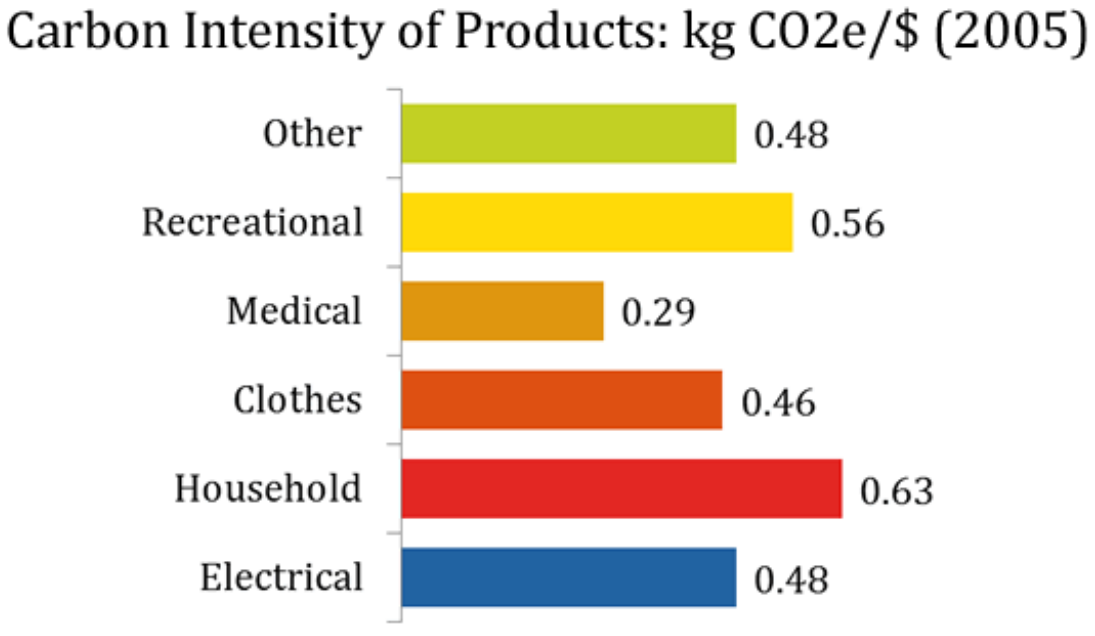


Note: Based on the average global footprint per capita in carbon dioxide equivalents. Figure excludes capital, government and land use change emissions. In 2010 the average personal footprint is estimated to be about 5.0 t CO_2e/capita.

Sources: Hertwich & Peters 2009, WRI

Shrink That Footprint

Communicating carbon intensity of consumption choices

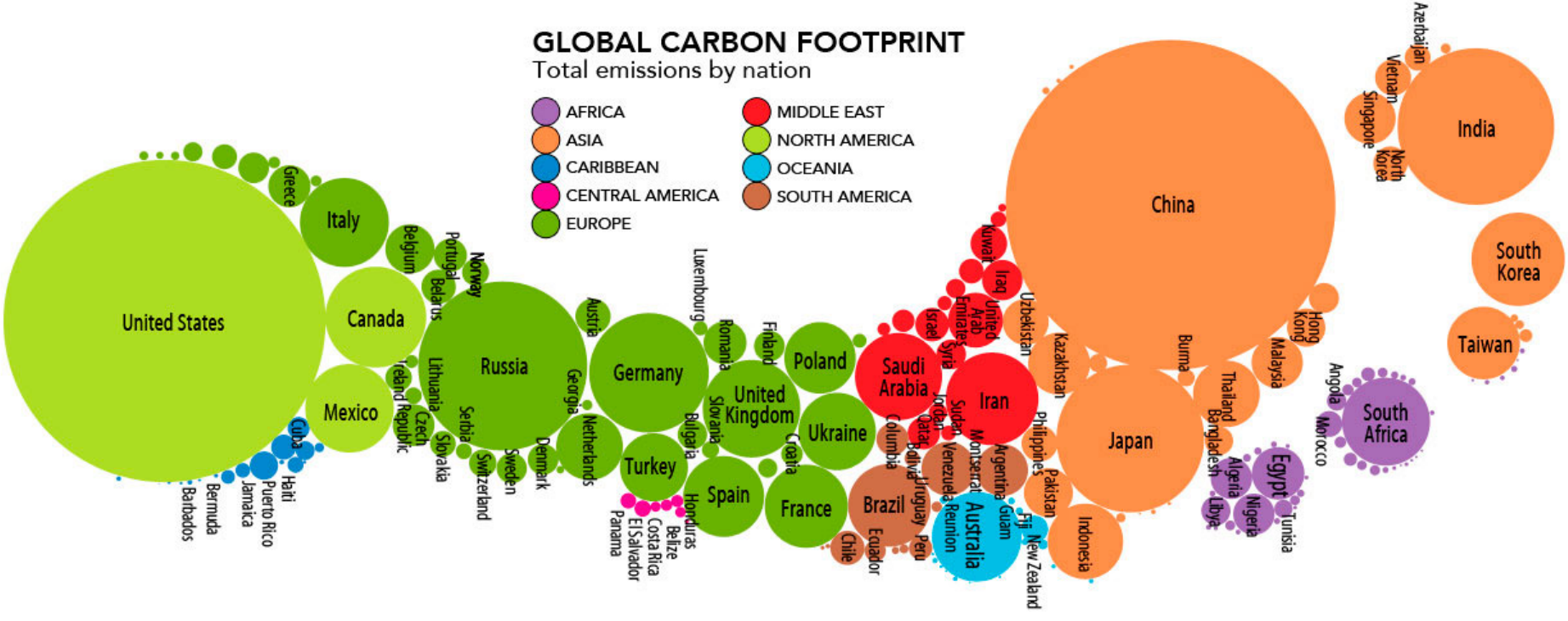


Note: All results are kilograms of carbon equivalents per 2005 US dollar (kg CO_2e/$). Based on authors own calculations for each group average using multiple sources. Due to aggregation of numerous goods within each groups average intensities appear quite similar. This aggregation disguises large variation between individual products.

Sources: EPA, IO-LCA studies

Shrink That Footprint

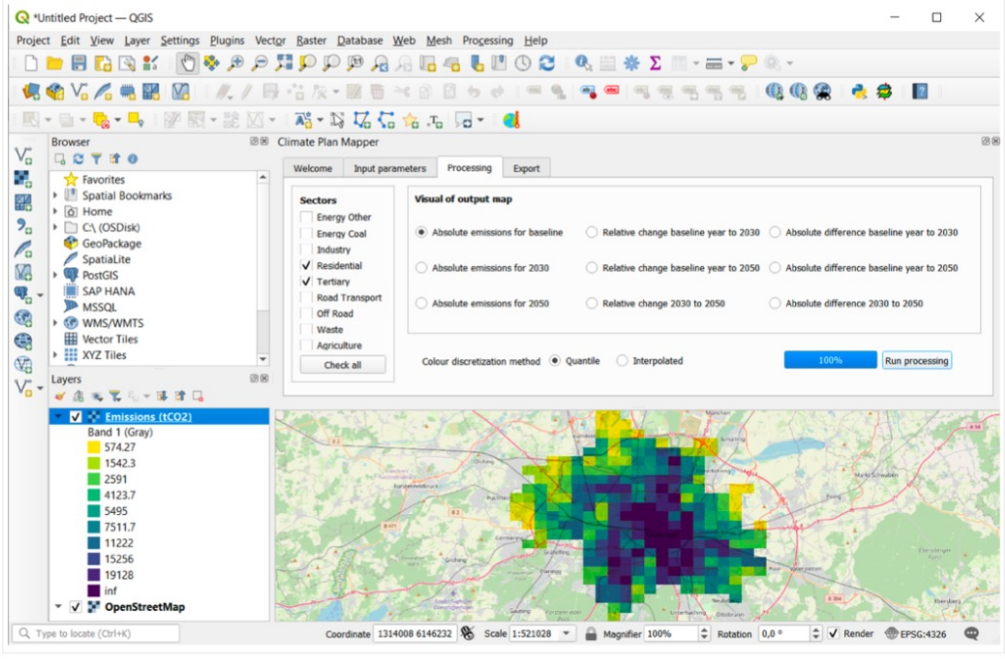
Communicating impacts in global view



Communicating impacts of regions and actions

Climate Plan Mapper tool

- Developed by Origins.earth in the ICOS PAUL project, based on TNO-GHGco inventory[12] data the tool allows to assess the expected changes in impacts in relation to various climate actions.
- Currently, Munich and Paris are example cities (requires assessment of climate plans).
- The tool builds the basis for a more rigorous design of urban monitoring networks capable of tracking long-term emissions trends beyond the simple assessment.



Communicating with Sustainable Development Goals

Communicating with consumer labels, ratings, guidance

Communicating impacts in corporate social reporting

Communicating sustainability with design, style, and material choices

Hapé Eco-toys

FAIRPHONE

ETHLETIC™ THE ETHICAL ALTERNATIVE

Group activity

Exercise in case groups

Working in case groups, ~30 minutes:

- **Continue to work on your case idea in case groups:**
- What could be meaningful ways to assess sustainability?
- What are the possible sustainability improvements?
- How to make them visible? How would you communicate main messages?
- Who are at the focus of communication?

Thank you!