



LCA methodologies for Regions

- from theory to practice

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Content of presentation

- Part A – Recall of key points in LC thinking
- Part B - Applications at regional level

Part A – Recall of key points

- Why Life cycle Approaches for Regional Development ?
- Sustainable Development framework
- Life cycle thinking process - impacts along the life-chain
- Life cycle toolbox

Typical sustainability initiatives by regions

Numerous policies presently try to address the sustainability challenges of regions. For example:

- renewable energy, climate change and carbon neutral territory
- **resource efficiency, cleaner production** and industrial innovation
- sustainable agriculture and forestry
- **zero waste, recycling**, circular economy, bio-economy
- safe production, social cohesion, health for all
- sustainable consumption, **green procurement**, eco-products
- sustainable buildings, sustainable transport, sustainable tourism

... and many more

The most common method is still the 1-dimensional “*one at a time*” method

Some common weaknesses

Regions fall short in a number of important ways in their policies towards sustainable development:

- Limited set of sustainability goals e.g. only Fair Trade, or only climate change ('cherry-picking')
- Not considering the entire life cycle impacts of their actions ("short-sighted")
- Not considering spill-over impacts e.g. biofuels, recycling residues ("parochial")

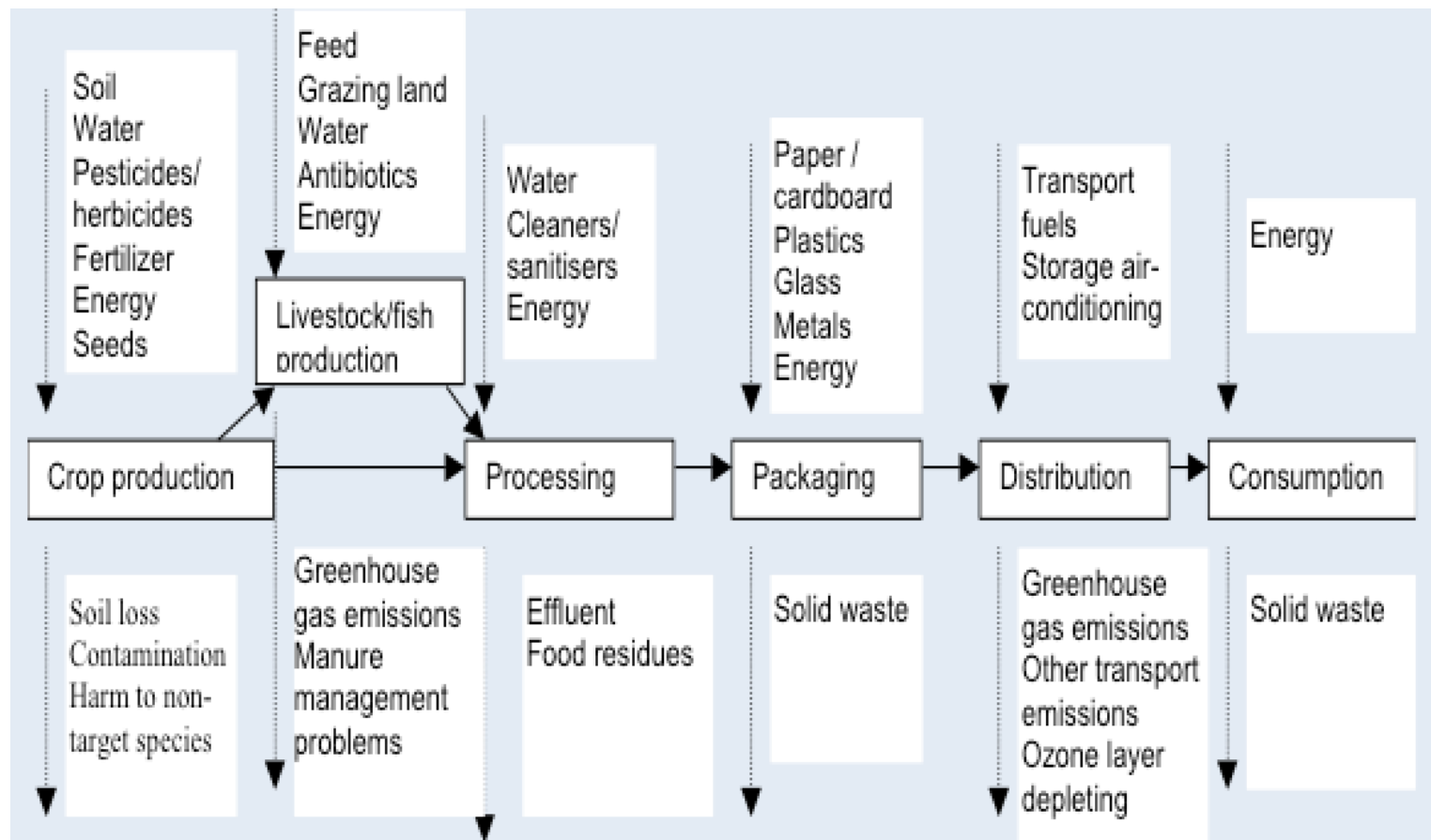
There is also the rebound effect to take into account

Multiple objectives: Sustainability is a diverse agenda



Life chains have many impact points

example of the food sector life chain



Unwanted spill-over effects

Improving sustainability in one area may create unexpected impacts elsewhere

Biomass harvesting for bio-energy can impact on land quality and on biodiversity.

Example of fuel-wood from South American forests, or palm oil from Asia.

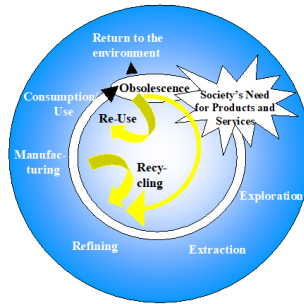
Convenient single-use plastics in food and health services reduces need for detergents for cleaning but greatly increases the problems of waste disposal.

Example of growth in medical waste

Promotion of mass tourism often overwhelms local communities, and adds stress to scarce local services (waste, water supply, transport, etc.)

Example of social impacts in Venice, and other small communities generally

Life Cycle Thinking



"Consumers are increasingly interested in the world behind the product they buy. Life cycle thinking implies that everyone in the whole chain of a product's life cycle, from cradle to grave has a responsibility and a role to play, taking into account all the relevant external effects."

« The world behind the product »

Klaus Toepfer,
Former Executive Director,
UNEP

Source: Secretariat, UNEP/SETAC Life Cycle Initiative

Life cycle thinking:

- Promotes sustainability
- Is resource efficient
- Reduces waste
- Avoids unwanted secondary impacts
- Designs and produces sustainable products
- Encourages sustainable social conditions

This can apply to materials, products, organisations, territories, biodiversity, land, resources, infrastructures, etc.

Life cycle thinking for sustainability

- 1. Identify all relevant sustainability targets (SDGs) and other local objectives**
- 2. Understand the life cycle impacts (LCA) of products and actions**
 - build (or borrow) data bases, choose assessment methods, draw correct conclusions, communicate the footprints
- 3. Manage (reduce) the life cycle impacts (LCM)**
 - build stakeholder partnerships to: select best infrastructure options, procurement to avoid impacts in the supply chain, support sustainable product innovation, choose sustainable resource development options, manage own organisational footprint, influence societal and organisational consumption patterns

Selected Life Cycle Tools, Procedures and Concepts useful for efficient and effective implementation of SDGs

Life cycle systems and concepts

- Circular economy
- Industrial ecology
- Product-service system
- Cradle to grave/cradle to cradle
- Environmental/sustainability footprints

Life cycle assessment tools and methods

- Life cycle assessment LCA* (materials, energy)
- Materials flow assessment (MFA)
- Input-Output tables
- Social LCA (SLCA)
- Sustainability LCA
- Organisational LCA (O-LCA)
- Life cycle Costing (LCC)
- Chemicals assessment*
- Risk assessment
- Evolving assessment tools for biodiversity, LULUC, landscape etc.

Action tools based on LCA

- Eco-labels*
- Environmental Product Declarations (EPD)*
- Product environmental footprint (PEF)*
- Eco-design

Life cycle Management Tools

- Sustainable supply-chain management (SSCM)
- Circular materials management
- Sustainable and/or circular public procurement (SSP, CPP)
- Green purchasing (GP)
- Extended Producer Responsibility (EPR)
- Environmental Management Systems* (EMS, EMAS)
- Sustainability reporting* (e.g. GRI)

*1. Some of the above have been standardized procedures under international agreements or practices**

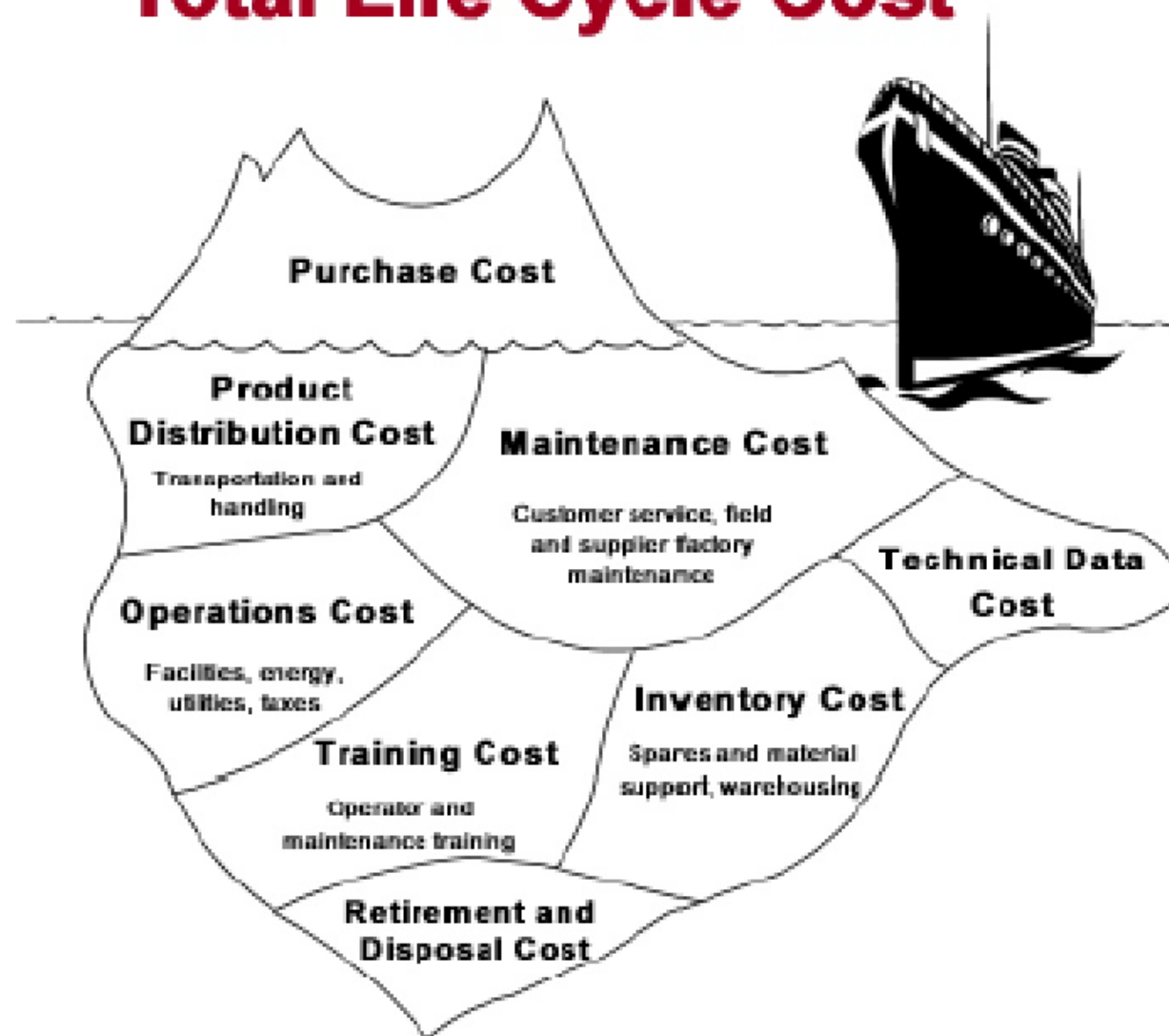
2. Other concepts such as sustainable production, resource efficiency, etc. also provide useful frameworks for implementing selected SDGs

An illustration of life cycle thinking

Example of **life cycle costing** (LCC) -

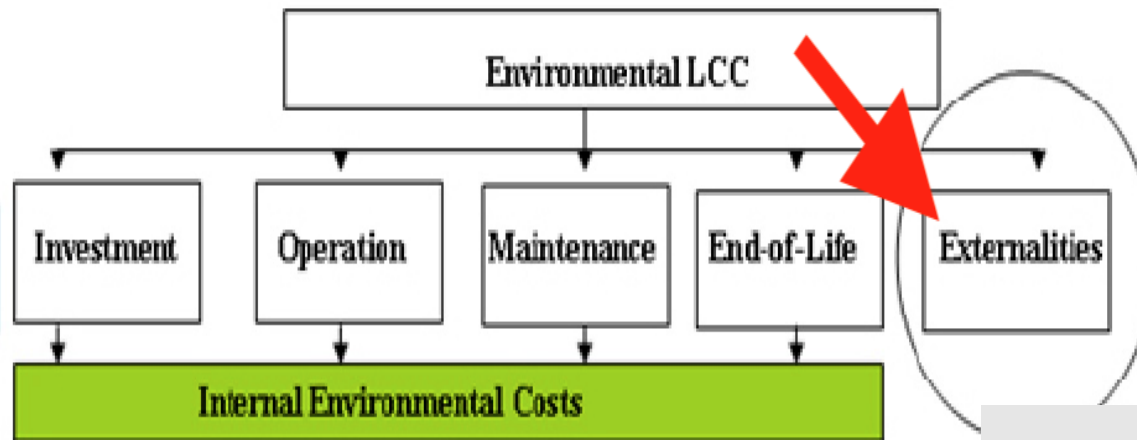
- Traditional costing – consider only initial purchase price
- Internal life cycle costing – account for internal cost flows
- Full life cycle costing – address internal + external costs

Total Life Cycle Cost



The Iceberg Effect

Environmental LCC Structure



Some LCA for common products & services

- **Two views on Electric vehicles** - <https://theicct.org/publications/EV-battery-manufacturing-emissions>
<https://thedriven.io/2019/12/15/is-a-diesel-cleaner-than-an-electric-car-in-australia/>
- **Palm oil as biofuel** - https://www.ifeu.de/landwirtschaft/pdf/rettenmaier_lca-biodiesel.pdf
- **Water footprint of national diet** - <https://www.mdpi.com/2072-6643/11/8/1846>
- **Organic farming produces higher greenhouse gas emissions**, but the biggest impact is from livestock raising, it can be deduced that a consumption-type solution would be more effective in reducing GHG. - <https://www.abc.net.au/news/science/2019-10-23/organic-vs-non-organic-farming-emissions/11623288>
- **The 'circularity paradox' in the European steel industry** — <http://theconversation.com/the-circularity-paradox-in-the-european-steel-industry-125613>
- 19/11/2019 At 05:20 this morning, easyJet flight EJU5841 took to the skies and made history. Because starting today, we will **offset the carbon emissions** from the fuel used for every single easyJet flight, domestic and international.
- 27/11/2019 Le Monde - **Circular economy under attack** by green NGOs? Debate over recycling vs reuse. The context is the French **bottle deposit legislation** proposal.
- How sustainable are **Green Credit cards**?

<https://unfccc.int/climate-action/momentum-for-change/ict-solutions/green-credit-card-i-republic-of-korea>

<https://www.creditcards.com/credit-card-news/environmental-eco-friendly-green-card-1273.php>

<https://doconomy.com/en>

Q: what is the regional policy implication of the above ?

Part B

Exploring the regional life cycle tool box

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useful for efficient and effective implementation of SDGs**

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Two main interest areas -

- * Assessment and analysis (**LCA**)
- * Management action (**LCM**)

Life Cycle Assessment methods - LCA

Measuring the life cycle impacts
of materials, products and issues important to
regions

Comparative impact assessment

LCA results for generalised energy options

Performance on 5 sustainability criteria is compared

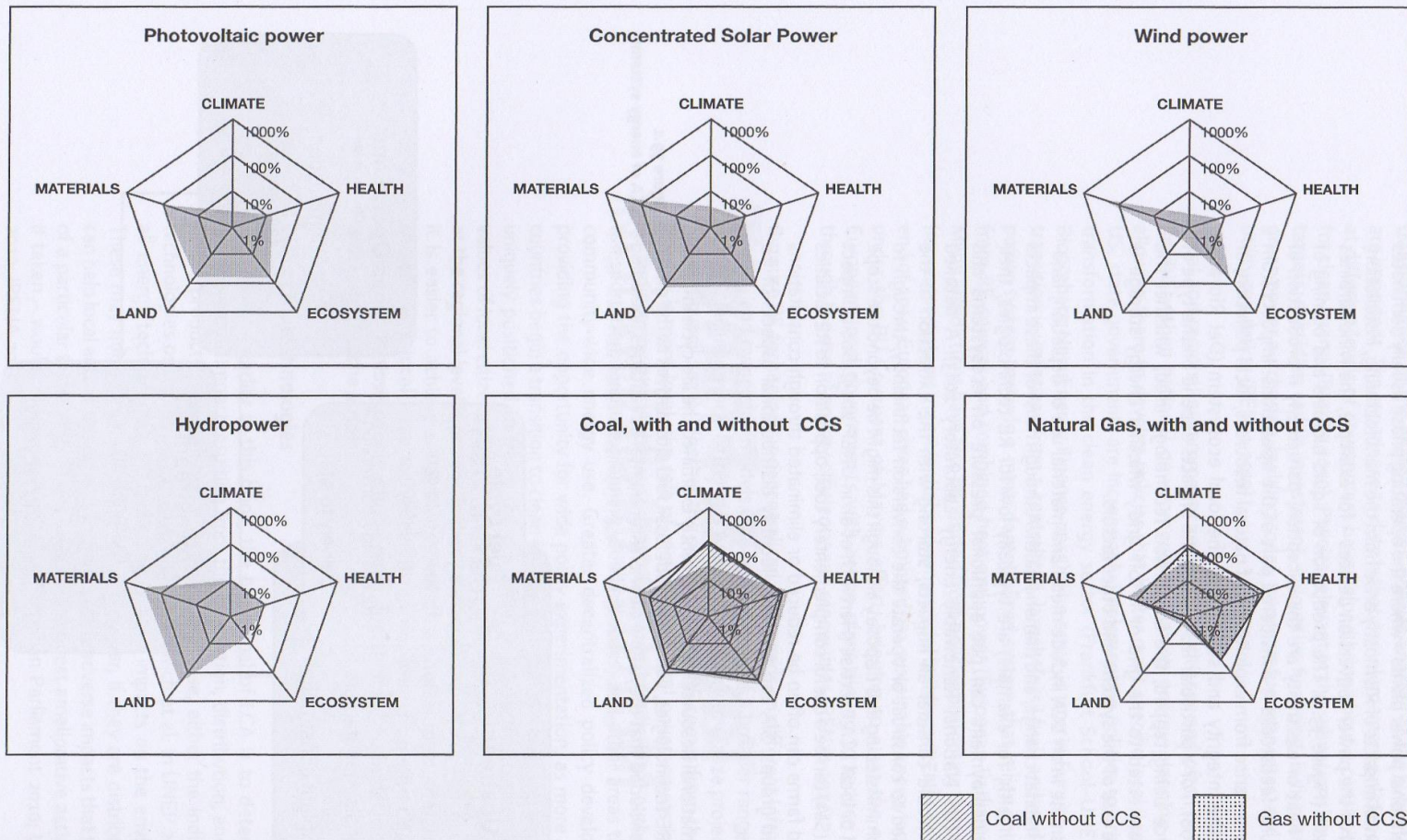
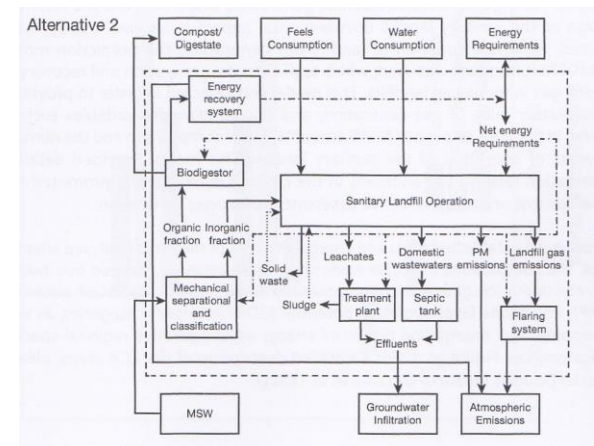
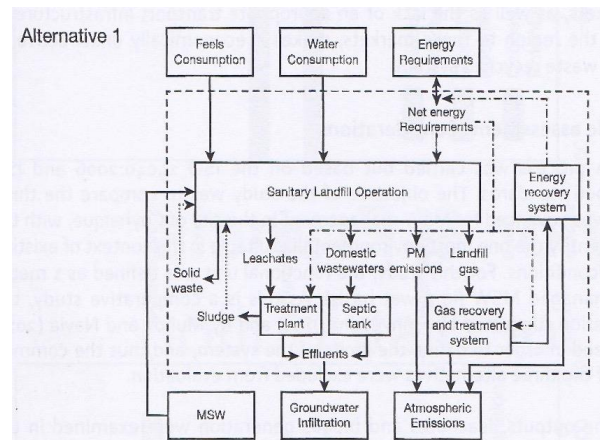
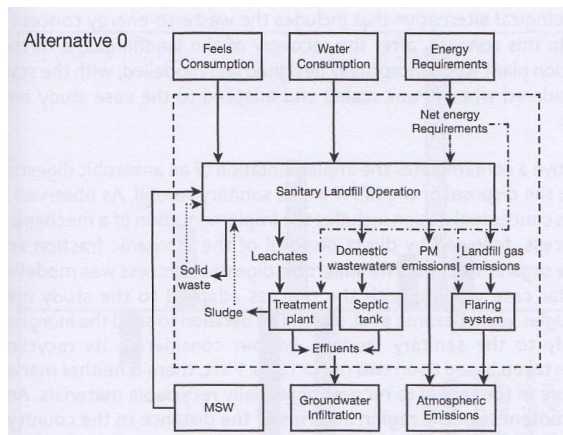


Figure 39.2

LCA for waste management options

What is the best technology option for a region? - example of Aysén region, Chile

Looking for sustainable options - LCA to evaluate economics and sustainability of waste incineration vs. biogas from landfill. Alternatives considered included biogas from landfill, incineration, and a reactor.



What are the sustainability consequences of each?

Based on Bezama et al

Water Footprint

1000 litres water



1 litre milk



16000 litres water



1 kg beef



140 litres water



1 cup of coffee



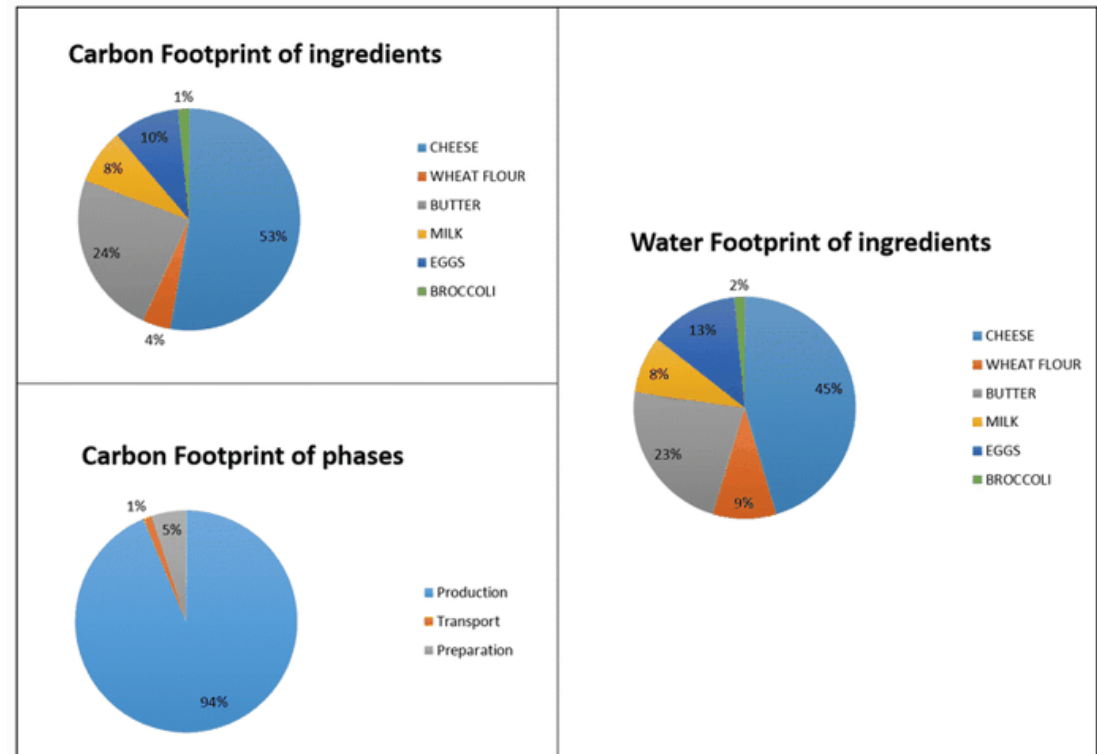
ISO 14046

The International Standard specifies the requirements and guidelines for the assessment and reporting of the LCA - based Water Footprint: Coherence between the carbon footprint and other impact categories of the LCA, including the scope and system boundaries

How relevant is this to regional agriculture policy?

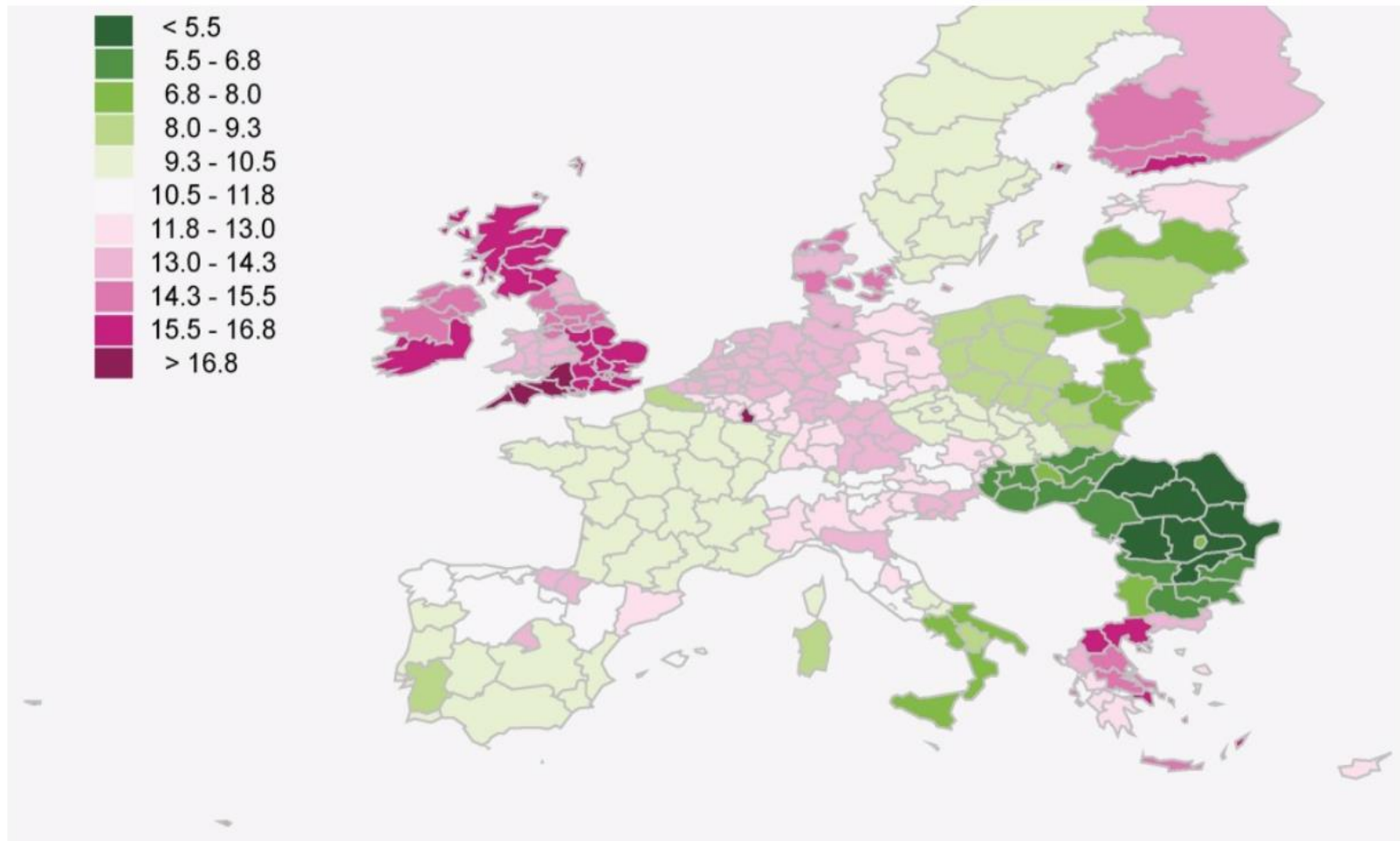
LCA for sustainable food management in schools

...a.... life cycle-based tool that provides the evidence base to support decision-makers responsible for providing school meals in the delivery of an environmentally sustainable service.



Based on Bezama et al

Regional carbon footprints



The average Danish household has a higher carbon footprint than many of its neighbours, including Sweden and Germany. (Illustration: Ivanova et al., 2017)

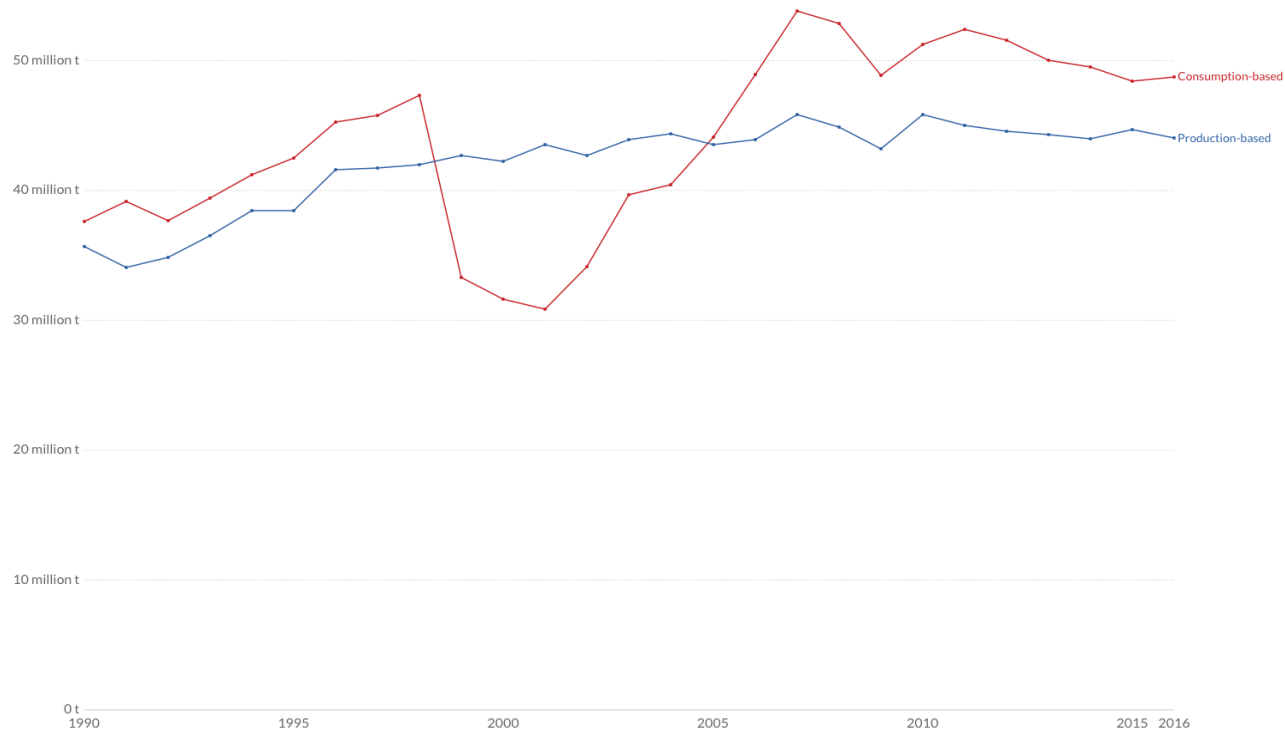
Life cycle based carbon footprints

- consider both production and consumption

Production vs. consumption-based CO₂ emissions, Norway

Annual consumption-based emissions are domestic emissions adjusted for trade. If a country imports goods the CO₂ emissions needed to produce such goods are added to its domestic emissions; if it exports goods then this is subtracted.

Our World
in Data



Source: Le Quéré et al. (2018), Global Carbon Project.
OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

► 1990 2016

Materials Flow Analysis (MFA)

example of biomass flows – 70% of biomass goes to animal feed !

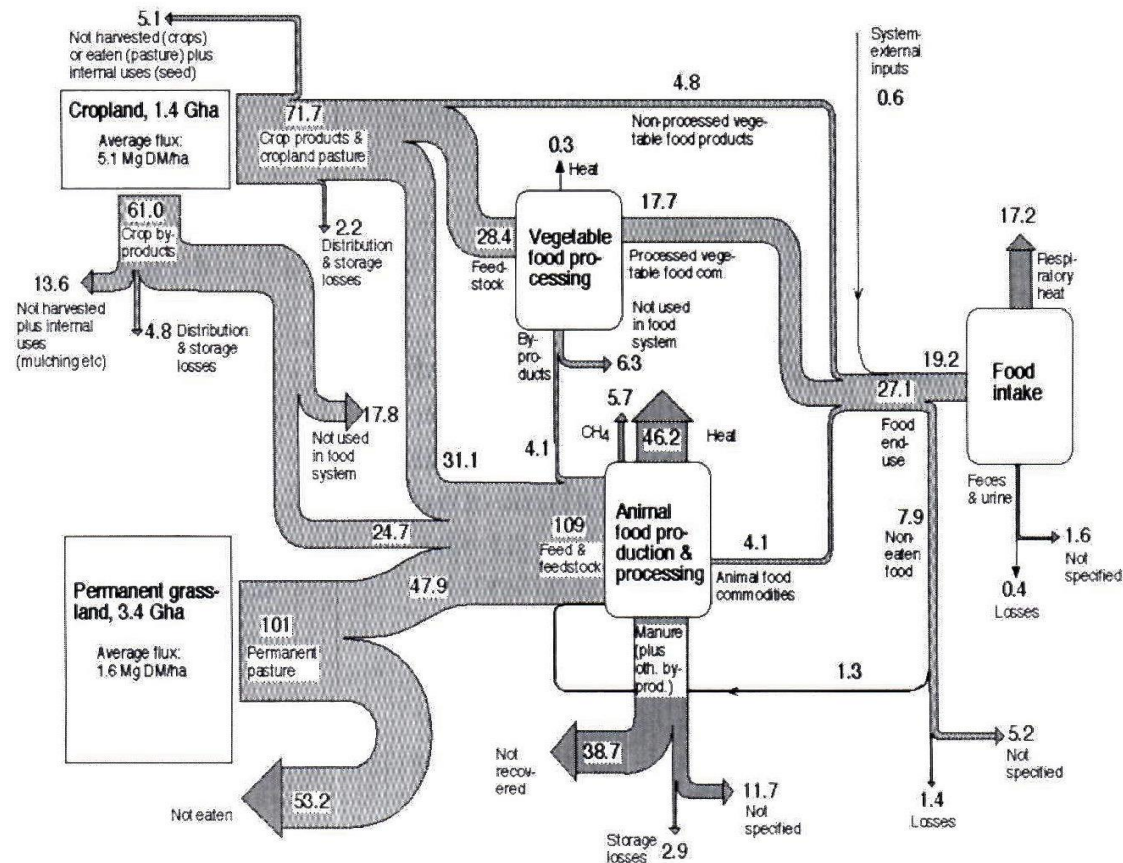


Fig. 1. Overview of the biomass flows in the global food system in 1992-94 (EJ gross energy per year). Animal food systems account for nearly 70% of biomass appropriation of the food system, whereas their contribution to the human diet is about 13%.

Trade policy and regional biomass flows

G. P. Peters et al.: A synthesis of carbon in international trade

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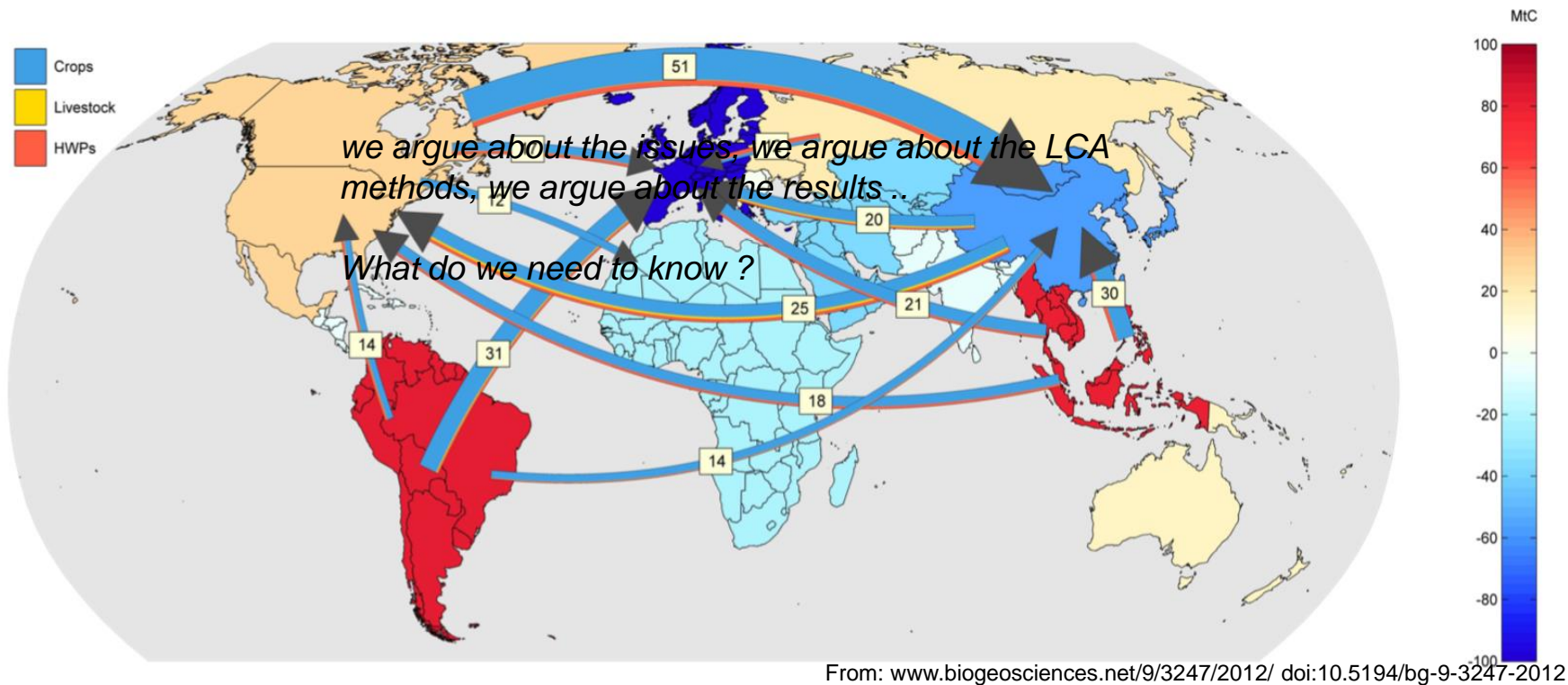


Fig. 10. The top 10 flows for carbon flows in HWPs, crops, and livestock products (2004). The region colours represent the net flows out of each RECCAP region (Table 13). The colours of the arrows refer to the different types of carbon flows. Most flows are dominated by carbon in crops, then HWPs, with the carbon in livestock products much smaller.

Materials Flow Analysis (MFA)

Two examples of materials and waste flows –

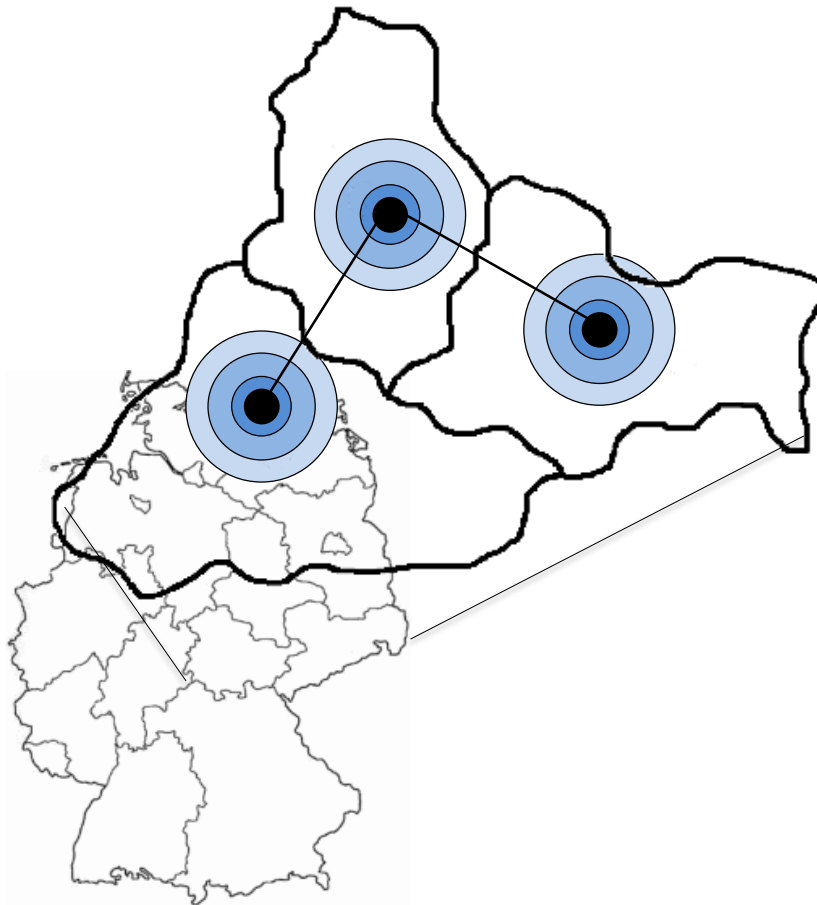
Combining material flow analysis with life cycle assessment to identify environmental hotspots of urban consumption

<https://metabolismofcities.org/resources/publications/1016>

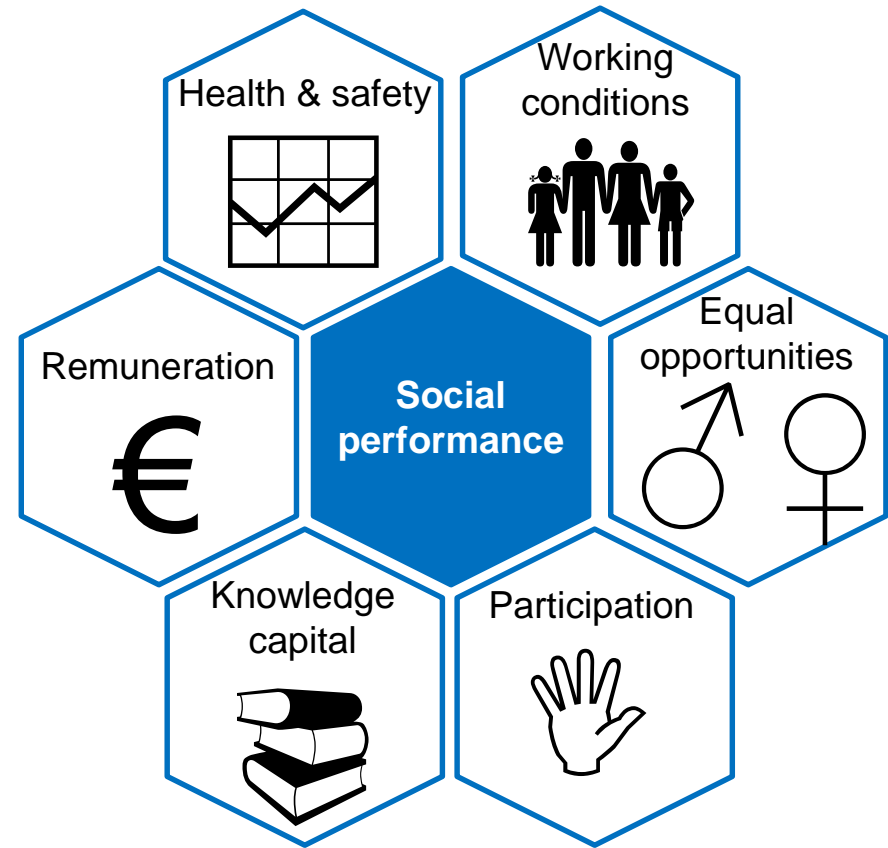
Material Flow Analysis of the City of Hamburg

<https://metabolismofcities.org/resources/publications/162s>

Assessment of wood-based products from German bio-economy regions and social performance



Bio-economy region in Germany

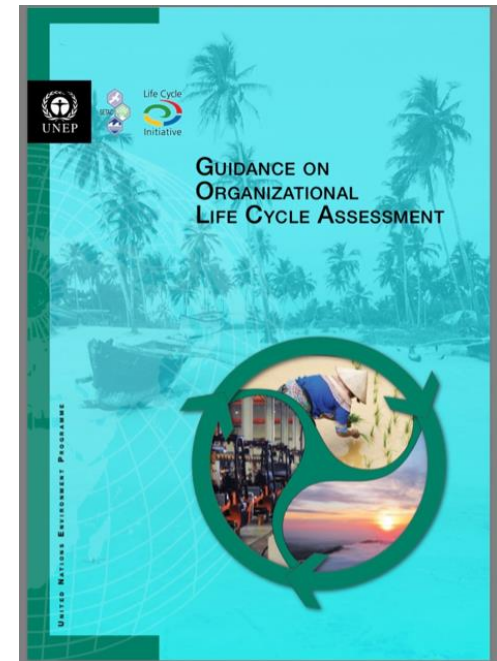


Aspects of social performance

Organisational Life cycle Assessment - O-LCA

O-LCA is an assessment of an entire organisation against the SDGs, using established LCA principles. Here LCA is used to assess the footprint of an administrative body rather than that of a product.

O-LCA is increasingly used by major companies. For public institutions it has been tested in Turkey, and applied also in Norway, to see how organisational priorities on SDGs are being implemented by public authorities.

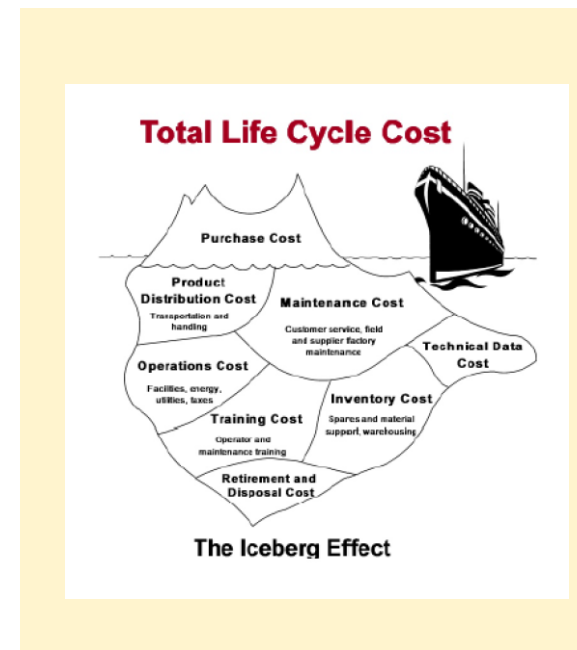
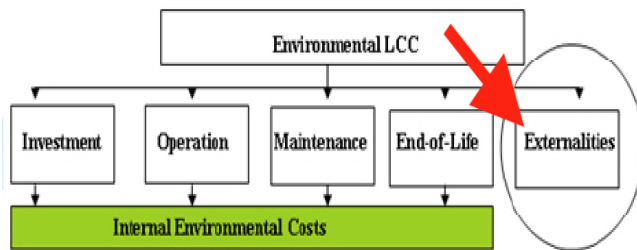


https://www.lifecycleinitiative.org/wp-content/uploads/2015/04/o-lca_24.4.15-web.pdf

<https://www.sciencedirect.com/science/article/pii/S0959652619340661?via%3Dihub>

Sustainable regional budgeting

Environmental LCC Structure

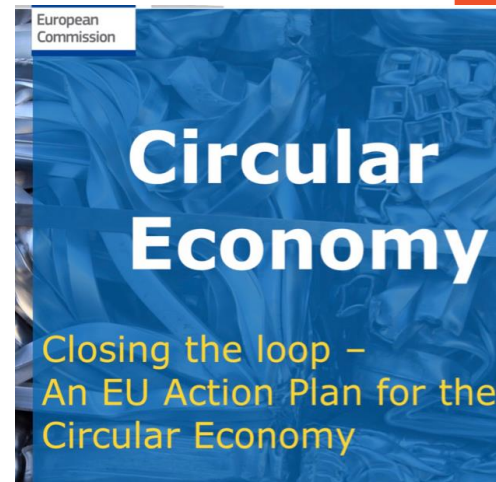
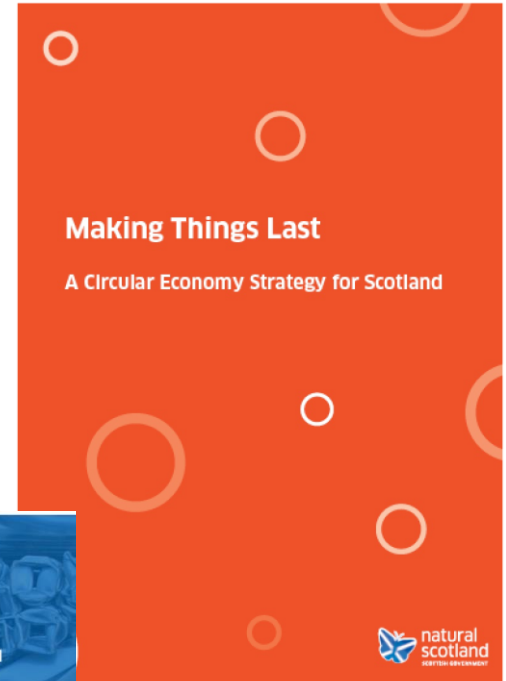


Life Cycle Management - LCM

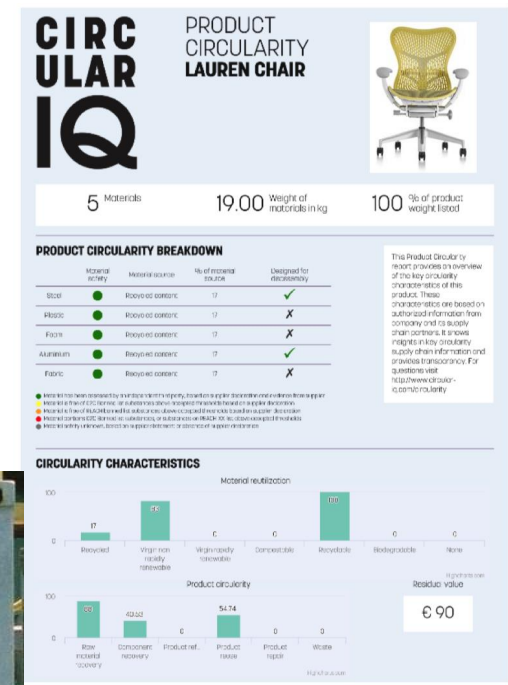
Translating assessment results into regional life cycle policy implementation

LCM example 1 – Zero waste circular economy

- Documenting problem areas
- Identifying significant waste streams
- LCA on priority wastes
- Reduction at source
- Innovation – think of CE ideas
- LCA for circular economy options
- LCM Stakeholder consultations
- Taking action
- Measuring results



LCM example 2- eco-labels, EPD, PEF



Q: Which regional policies are supported by labelling tools ?

Q: How are such labels selected?

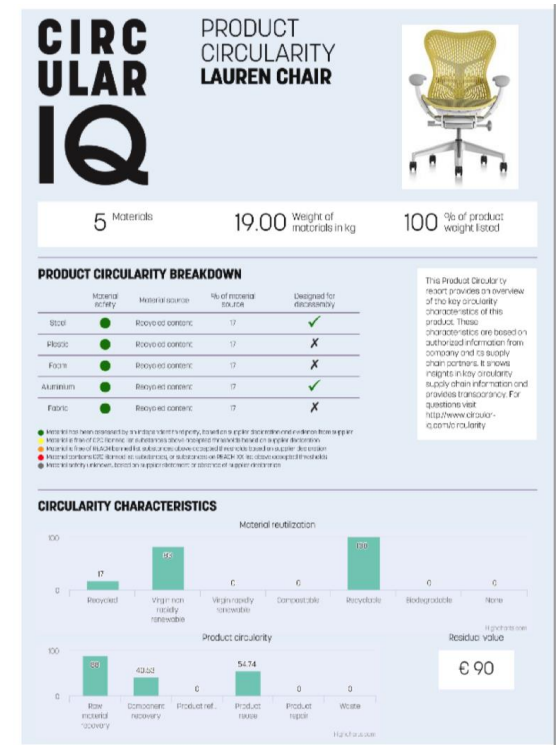
Q: Who are the stakeholders ?

LCM example 3 – Circular Procurement

Public authorities in the Netherlands are required by legislation to base at least 10% of their current purchasing on circular economy criteria.

This has resulted in rethinking of the design and life chain, and the after-use, of office furniture and furnishings.

It has also led to a rethinking of EPD criteria



See also the sustainable procurement policy in Barcelona

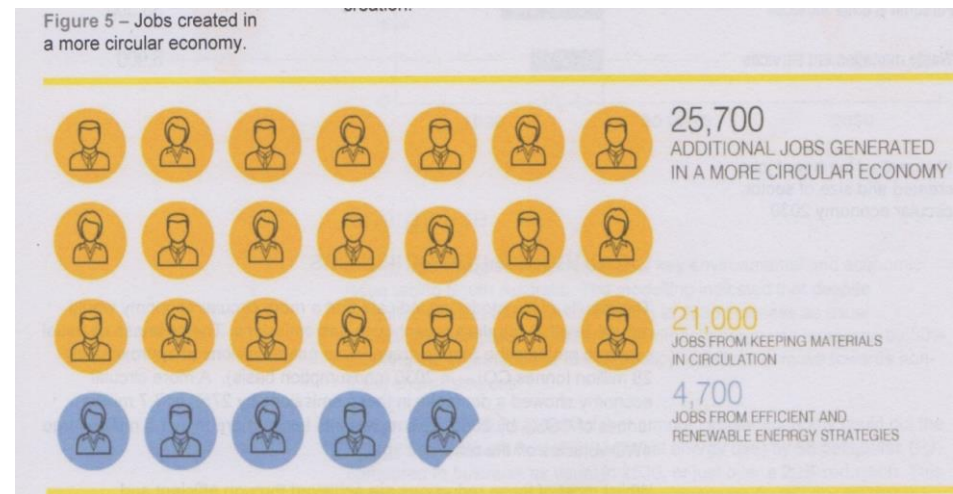
LCM example 4

– Circular Economic planning in Australia

Circular economy implementation depends on a life cycle view of materials flows – where they come from, where they go, and how they can remain valuable at all stages of their life cycle.

Social impact such as employment is a part of the CE/LCA calculation

Q: which life cycle tools underpin a circular economy?



Example – Regional circular economy action

France's "... Green Growth » Act 2015 included a section on circular economy that covered not only waste issues but obligation by repairers to propose reconditioned parts, outlawing planned obsolescence and demanding longer lasting product design.

France is now preparing further legislation to strengthen circular economy. Elements include food waste, waste separation and recycling, building waste, procurement to favour recovered materials and provide employment opportunities, extended producer responsibility, industrial ecology, among others.

The greater Paris region has taken a set of local actions covering more sustainable product and service conception, reduced consumption patterns, targeted waste reduction, re-use and or recycling of surplus materials and food, better waste management, sustainable procurement, among others

LCM example 5 – Resource efficient buildings

- Understanding the building life cycle
- Documenting impacts and consequences
- Identify main building materials
- LCA of key building components
- Identifying key stakeholders along the life cycle
- Consultation on objectives and means
- Agreeing on metrics
- Action plan
- Monitoring



LCM example 6 – Impact offsetting

Often impacts cannot be entirely avoided. This can be confronted by, among other things, an offsetting scheme whereby benefits are created in other places to offset the unavoidable impacts. The most popular of these is carbon offsetting, increasingly offered by airlines for example.

See <https://www.easyjet.com/en/sustainability> or <https://www.airfrance.fr/en>

Planting trees is the most popular offsetting scheme, but it is of doubtful value (see reference below).

Intuitively simple, offsetting nevertheless needs attention to several key issues for it to be successful

- Eliminate impacts first, as far as possible
- Rely on standards, not on intuition
- Activate the “additionality” principle
- Be wary of forestry offsetting, often it’s not as effective as claimed
- Choose renewable (energy) or impact prevention projects
- Ensure positive social and economic outcomes
- Beware of the “rebound effect”

From <https://www.thinkstep.com/blog/7-keys-offsetting-your-carbon-emissions>

Some possible life cycle management applications

Product improvement
and development

Design for the Environment

Resource development

Industrial optimisation

Pollution prevention

Sustainable procurement

Improving environmental
programmes

End-of-life product management

Sustainable infrastructure

Strategic public policy planning

Some elements for successful LCA and LCM

- Agreed SDGs for the region
- Understanding the life chains of products, materials & services
- Sensible scoping of the exercise
- Databases for regional materials, waste and energy flows
- Models for identifying SDG and CE options
- Building stakeholder networks for LCM, e.g. in key industry and agriculture sectors
- Agree on objectives and targets
- Tracking performance
- Political commitment to implement LCM programmes e.g. procurement
- Measure outcomes. Continuous improvement

Q: Can regions achieve this?

Support for Regional LCA

- LCA expertise – FSLCI, national associations
- LCA information exchange – LCA and LCM conferences, seminars
- Teaching and training on LCA – to identify..Barcelona, Bordeaux, ...
- LCSS series
- LCA literature – Springer, J Sustainability, J Cleaner Production,
- LCA4Regions, other Interreg
- UNEP-SETAC LCI – url
- EU initiatives on LCA
- Data bases – examples
- LCA research -

Summary

Many regions have adopted sustainability objectives, but are not always experienced in implementing them. It is common to address only a few issues (*'cherry-picking'*)

Regions engage in many activities, the sustainability agenda is broad (17 UN SDGs), and the activity or materials life chains are often long. There is a search for simple solutions. Simplicity comes at a price. By addressing only a limited few SDGs, applied to a small selected set of activities, focussed on isolated points in the life chain, the total sustainability outcomes are often weak, with a real risk also of merely moving impacts to another SDG or to another part of the life chain (the *'spill-over effect'*).

A life-cycle decision-making framework is a better approach.

Life cycle assessment tools can assist regions in evaluating their sustainability impact (*footprint*), and also that of possible sustainability responses (the *'solutions'*), in a more effective manner. Many assessment tools are sufficiently mature for use by regions. Some tools still need to evolve further.

Life cycle management frameworks are sector- or materials-specific, adapted to selected actions (e.g. construction), or embrace a more general approach across all areas (e.g. procurement).

A closer relationship between the life cycle community and regions would assist in implementation of a life cycle approach.



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Thank you!

Questions welcome

www.interregeurope.eu/LCA4Regions