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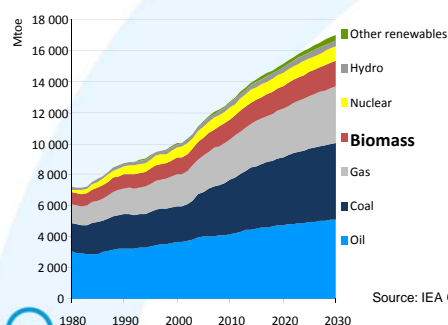
Biomass related risks and their management using the LCA method

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Biomass and the world primary energy demand

- ❑ The total annual growth of biomass delivers an amount of energy of about 660,000 TWh.
- ❑ The world's total bio-energy consumption in 2003 was approximately 11 percent (13,366 TWh) of the world's total energy consumption.



- ❑ Especially the population in developing countries is heavily dependent on biomass (wood, dried manure, charcoal) as energy source for cooking and heating.
- ❑ Bio-energy is used as main energy source for at least half of the world's population.



World energy demand expands by 45% between now and 2030 – an average rate of increase of 1.6% per year

The Life cycle Assessment (LCA) method

❑ What is LCA?

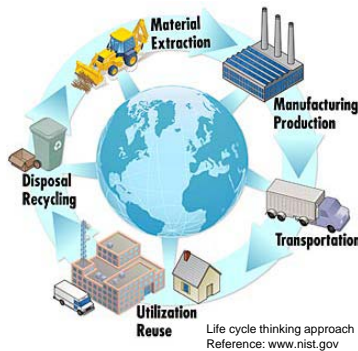
- It is an analytical tool that quantify and assess the potential impacts of a product, based on a holistic view, often referred to as a "cradle to grave perspective".
(Includes evaluation of multiple environmental impacts – in parallel)

❑ Why use the LCA method?

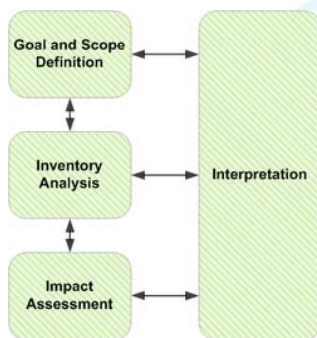
- To ensure a **holistic systems perspective** on technological systems and their interactions with the environment
- To help biomass **producers** manage their value chain and potential risks.
- To help **decision makers** understand the scale of environmental and human health impacts compared to competing energy systems.

❑ How to use the LCA method?

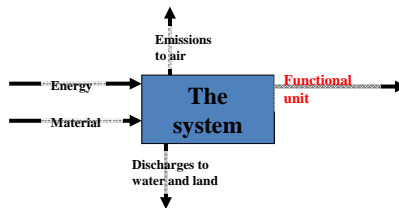
- Standardized approach in ISO 14040-series



The LCA framework



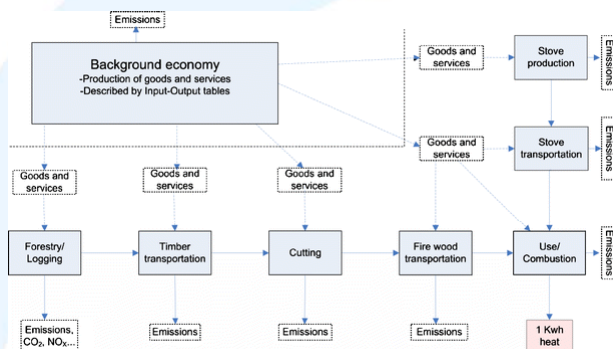
- ❑ The goal could be to perform consistent comparisons of technology options with regard to the environment.
 - ❑ Define a functional unit, i.e. quantitatively measure the delivered function (e.g. 1 kWh heat generated).
- ❑ Collect information data on emission factors etc. from the relevant processes.
- ❑ Assess the impacts.



An example- Goal and scope definition

Example:

Comparative LCA on a wood based heating system using an old and a modern stove, **functional unit**; 1kWh of heat delivered.



Example from:

Solli, C., Renaas, M., Strømman, A., Hertwich, E.G. 2009. Life cycle assesment of wood-based heating in Norway. Int J Life Cycle Asess (2009) 14:517-528.



An example- Inventory analysis

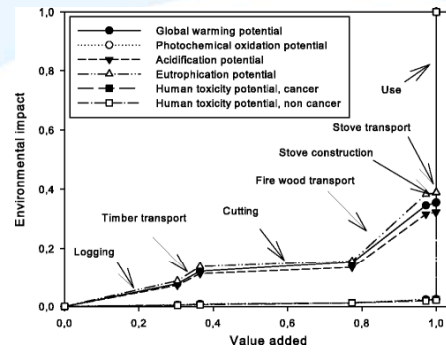
Substance	Unit	Old stove	New stove	Change
CO ₂	kg	3.6E-02	2.6E-02	-28%
CH ₄	kg	2.9E-03	2.1E-03	-29%
N ₂ O	kg	1.9E-05	1.3E-05	-28%
SO ₂	kg	1.1E-04	8.0E-05	-28%
NO _x	kg	7.7E-04	5.5E-04	-28%
NM VOC	kg	3.5E-03	2.5E-03	-29%
CO	kg	7.3E-02	1.8E-02	-76%
NH ₃	kg	1.5E-06	1.1E-06	-27%
PM ₁₀	kg	8.5E-06	6.3E-06	-27%
PM _{2.5}	kg	1.9E-02	2.2E-03	-89%
Lead	kg	2.3E-09	1.7E-09	-26%
Cadmium	kg	4.9E-08	3.5E-08	-29%
Mercury	kg	2.4E-10	1.8E-10	-25%
Arsenic	kg	6.4E-10	4.8E-10	-25%
Chrome	kg	3.9E-09	2.9E-09	-25%
Copper	kg	1.5E-08	1.1E-08	-28%
PAH-4	kg	1.3E-06	1.0E-08	-99%
Dioxins	kg	4.9E-13	3.5E-13	-29%

Source: Solli, C., Renaas, M., Strømman, A., Hertwich, E.G. 2009. Life cycle assesment of wood-based heating in Norway. Int J Life Cycle Asess (2009) 14:517-528.



An example- Impact assessment

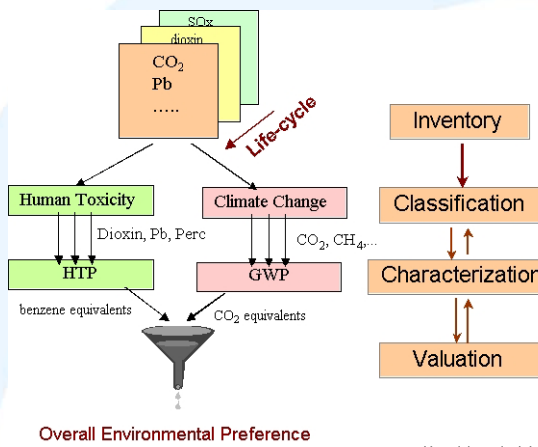
Impact category	Unit	Old stove	New stove	Diff.
Global warming	kg CO ₂ -eq.	1.1E-01	7.7E-02	-28%
Photochemical oxidation	kg C ₂ H ₂ -eq.	5.5E-03	3.0E-03	-45%
Acidification	kg SO ₂ -eq.	5.2E-04	3.7E-04	-28%
Eutrophication	kg PO ₄ -eq.	1.0E-04	7.2E-05	-28%
HTP air, cancer	kg benzene eq.	3.8E-03	7.5E-04	-80%
HTP air, noncancer	kg toluene eq.	1.2E+00	4.6E-01	-61%



Source: Solli, C., Renaas, M., Strømman, A., Hertwich, E.G. 2009. Life cycle assesment of wood-based heating in Norway. Int J Life Cycle Assess (2009) 14:517-528.



Impact assessment



Hertwich et al., J. Ind. Ecol. 4(1)

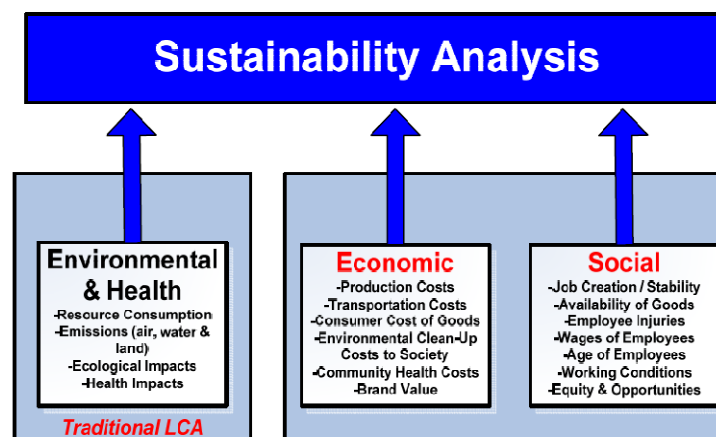


How to manage risks using LCA?

- ❑ Where in the value chain is it likely that risks occur?
 - Will transport itself contribute to greenhouse effect?
 - Degradation of natural resources
 - conflict with local food production/nature conservation interests
 - exploitation of workers
 - Combustion of biomass can produce harmful emissions (nitrogen oxides, sulphur dioxides, bottom & fly ash); proper gas treatment processes are not always guaranteed



Management using the LCA method



J.S. Golden & P. White (2007): Arizona State University



Acknowledgements

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Thank you for your attention

For more information, www.nilu.no

