Renewable Energy Assessment within the Cumulative Energy Demand Concept: Challenges and Solutions

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Problem setting and Thesis

Cumulative Energy Demand (CED) lacks sound and consistent foundation. Different concepts exist:

- resource conservation: only non renewable energy
- climate change oriented: only fossil energy
- proxy indicator: non renewable plus hydro energy
- "total energy demand": all energy sources

CED sometimes even considered as part of LCI!

How to account for renewable energy sources?

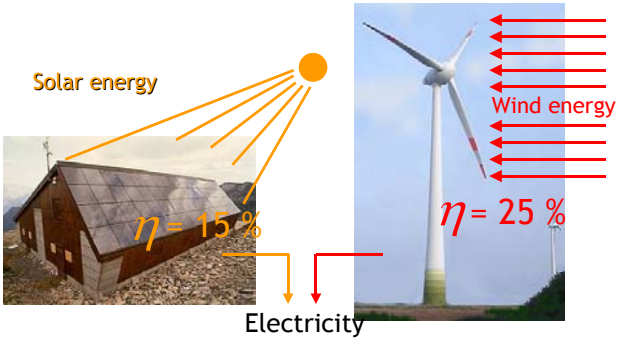
Thesis:
Renewable energy *harvested* is the key information from a total energy demand perspective leading to best achievable consistency.

Weighting factors in CED

The weighting factors of Cumulative Energy Demand are determined based on the following concept:

- energy resources do have an intrinsic value
- intrinsic value of energy resource is determined by the energy extractable with today's technology
- no other aspects (such as substitutability, suitability for storage) add to this intrinsic value

Harvesting efficiencies of energy resources



System boundaries are not the same. Conversion efficiency of solar energy to electricity via photovoltaics is different from the conversion efficiency of kinetic energy in wind to electricity from wind power. To be consistent with photovoltaics, the solar energy required to "produce" kinetic energy would be the appropriate input to calculate the wind power conversion efficiency. The same would apply on fossil energy sources as well. This is neither sensible from a resource protection perspective (sun energy is unlimited in a human time scale) nor practical.

Harmonisation: amount harvested

Life cycle inventories of processes harvesting renewable and non renewable energy resources need harmonisation.

The amount of energy *harvested*, not the amount of solar irradiation ultimately required is more suited and thus registered in the inventory:

IN: energy in lignite extracted

OUT: lignite fuel

Harvesting efficiency: 100 %

IN: energy in Uranium extracted and finally burnt-up in LWR

Out: nuclear fuel

Harvesting efficiency: 100 %

IN: energy in wood felled

OUT: round, industrial and residual wood

Harvesting efficiency: 100 %

IN: rotation energy transmitted to gearbox

OUT: electricity

Harvesting efficiency: 93 %

IN: electric energy transmitted to inverter

OUT: electricity

Harvesting efficiency: 93.5 %

IN: rotation energy transmitted to generator

OUT: electricity

Harvesting efficiency: 95 %

The CED factor of the renewable energy IN is weighted with 1 MJ-eq/MJ_{IN}

Conclusions

- Consistent modelling of energy resource input
- "Amount harvested" is most sensible and practical