Consequential system boundaries: Social responsibility, rebound effects, and aggregation error

Bo P Weidema

LCA discussion Forum, **Zürich**, 9th September 2016

2.-0 LCA consultants
www.lca-net.com

Consequential system boundaries

- Our experiences with practical applications since 1996
- Reactions of clients / stakeholders
- Differences in understanding of social responsibility
- Experience with including rebound effects
- Experience with including elasticities
- Improvement needs: Reducing errors in background databases, notably aggregation errors

Experiences with practical applications

- Since LCA as a model of changes was initially suggested by Heintz & Baisnée (1992) and Weidema (1993)
- …and built into the ISO standards (1996-98)
- Read the history at http://lca-net.com/blog/
- Over 20 years we have applied consequential modelling to:
  - All kinds of activities (production and consumption)
  - ecoinvent unit processes
  - IO industry data
  - Trade data (geographical location of marginal suppliers)

Reactions of clients / stakeholders

Happy when showing an advantage for their product

…less happy when it shows unexpected impacts

Joke aside:

- Few clients/stakeholders know the difference between attributional and consequential modelling

→ Pressure does not come from clients, but from "tradition": What do my peers do?

- If all consultants could agree on how to interpret ISO there would be no clients that would argue

Social responsibility – for what?

- Your value chain (→ economic allocation)
- Your physical supply chain (→ mass allocation)
- The consequences of your actions (→ consequential system)

No right or wrong system!

…but:

- In LCA it is always the consequences (impacts) of our system that we choose to be responsible for
- It is not consistent to take responsibility for the consequences of actions of others (in our value chain or supply chain) and *not* to take responsibility for the consequences of our own actions (the consequential system)
- Thus, the system we take responsibility for must always be the consequential product system, but may *additionally* include consequences of other activities in our value or supply chains

Social responsibility – for what?

- Relatively new insight:

  "Social responsibility must always include the consequential product life cycle and may additionally include consequences of other activities in your value or supply chain"

- Share your opinion and/or arguments at:

  https://lca.consider.it/social_responsibility

Litterature: Weidema B P. (2002). *Quantifying Corporate Social Responsibility in the value chain.* <lca-net.com/files/csr.pdf>.

SR (ISO 26000): "responsibility of an organisation for the **impacts** of its **decisions** and activities on society and the environment, through transparent and ethical behaviour that

- **contributes to sustainable development**, including health and the welfare of society;
- takes into account the expectations of stakeholders;
- is in compliance with applicable law and consistent with international norms of behaviour; and
- is integrated throughout the organization and practised in **its relationships**"

Experience with rebound effects

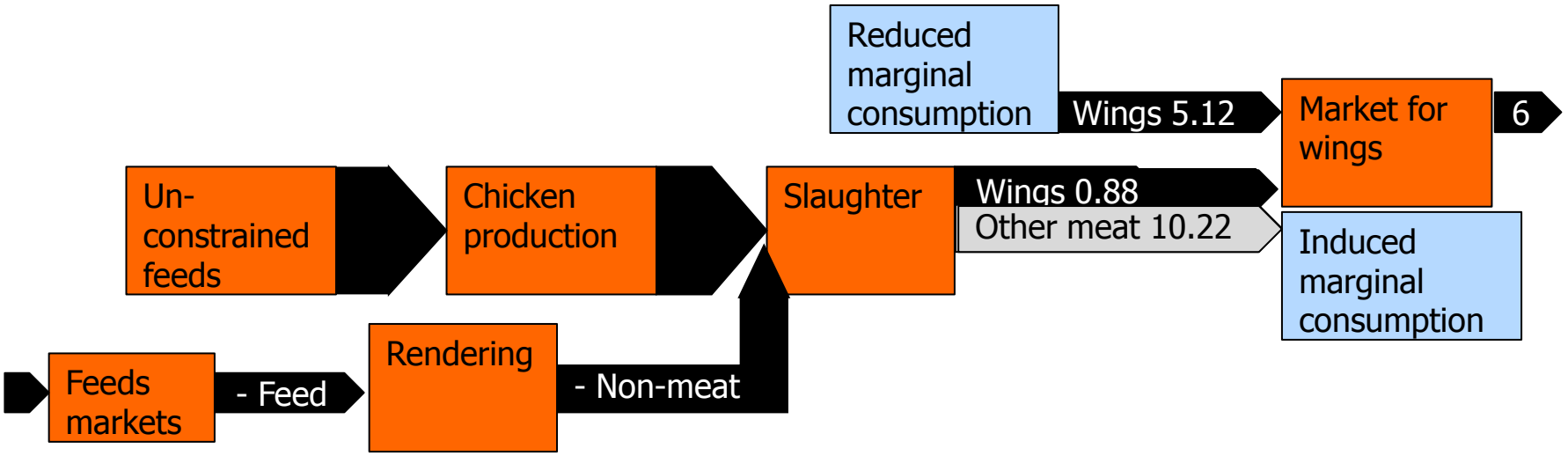
- For comparisons, first-order rebound effects must always be considered
- This follows from the requirement that compared systems must always have same functional output
- Ignoring price rebound effect leads to underestimating the sustainability effect of technologies that involve economic costs – and overestimating the effect of technologies that involve a cost saving
- We use own- and cross-price elasticities to distinguish specific and general price rebounds (on own product, direct substitutes, or generic marginal consumption)

Experience with including elasticities

- Elasticities are basic information about change: Elasticity is the ratio of relative changes in two variables, e.g. change in supply per change in price
- When an increase in demand can be met in several ways, elasticities show the reaction of each of the supplying technologies ("Composite marginals")
- Example: Demand for biomass production capacity is met by both deforestation (37%) and by more intense utilisation of already available agricultural land (63%)
- When supply is *fully* or *partly* constrained, changes in consumption (demand) are also involved

Changes in consumption (demand)

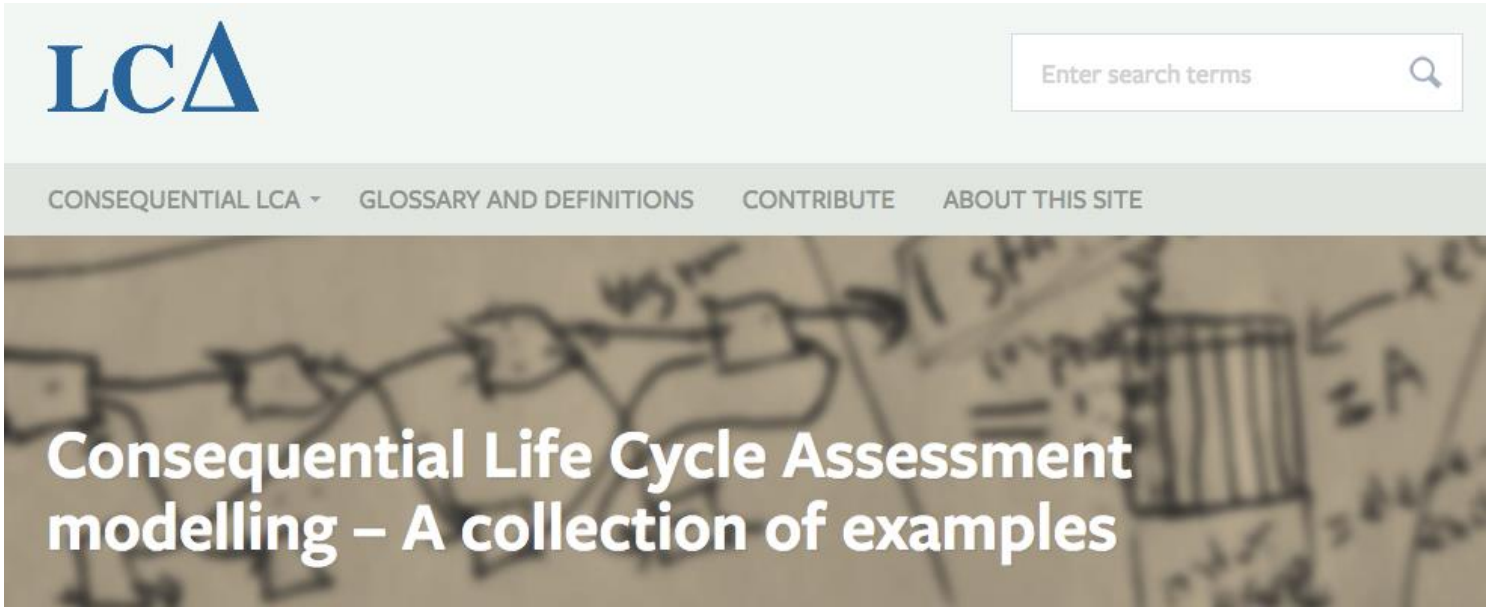
Example for chicken wings:



Based on price data from FAO LEAP (2015)
Full example and references at: goo.gl/UX78tS

Many more examples at:

http://consequential-lca.org/



- Share your own examples there too !

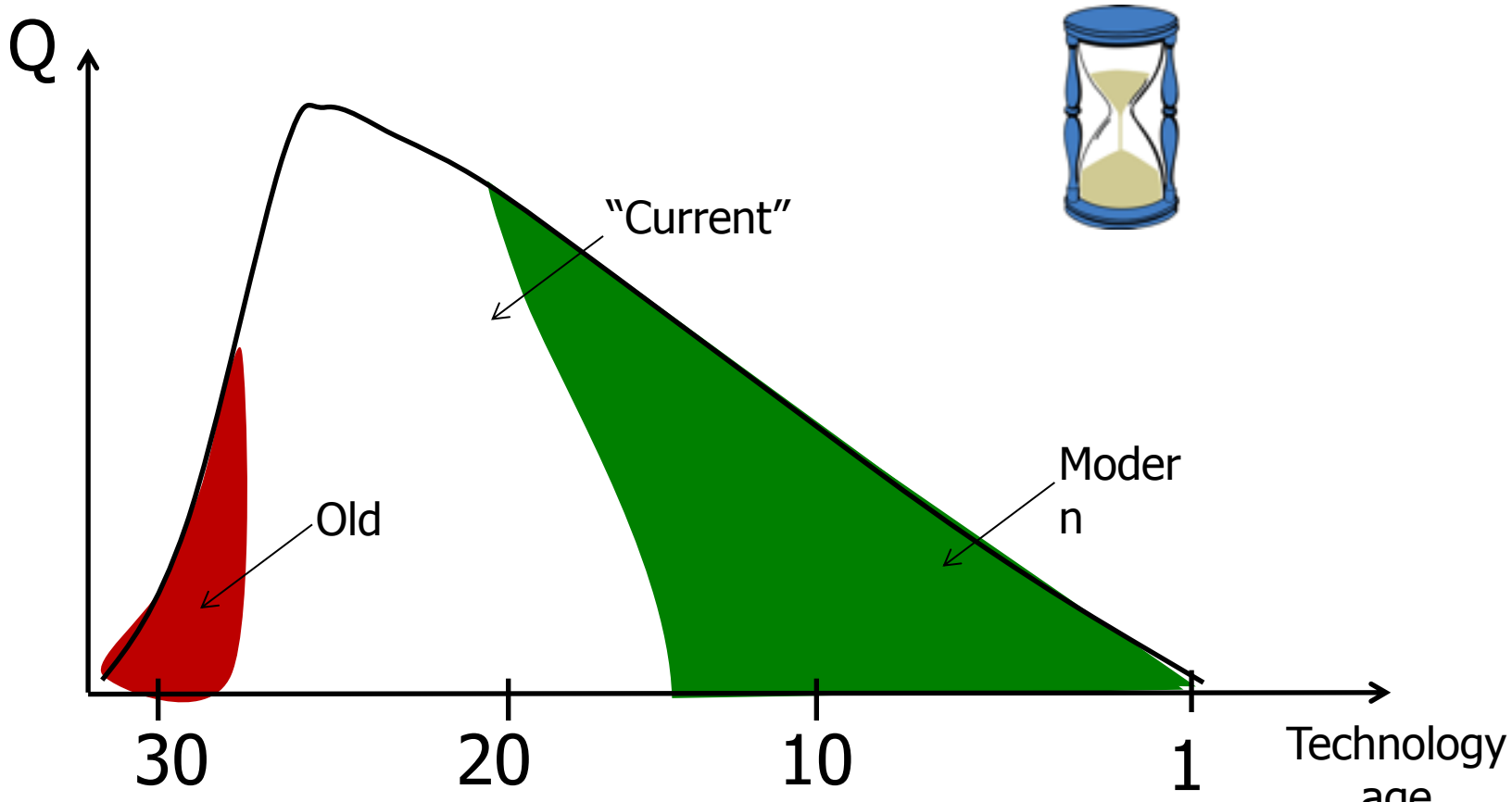
Improvement needs: Reducing errors in background databases

- The required algorithms are available, documented, and implemented reasonably well by ecoinvent, although:
  - User interface makes it difficult to follow the modelling of negative physical flows (reductions in demand), especially when the sign changes several times in a supply chain
  - Mass balancing is not implemented in a way that allows to use this functionality to identify errors in the modelling
- Manually induced errors in modelling still appear, e.g.:
  - Some cases of joint production are treated as combined, implicitly using hidden physical allocation, e.g. forestry
  - Manure emissions still part of crop production instead of the animal husbandry systems
  - Indirect land use not implemented according to causal relations

More general problem in background databases: Aggregation errors

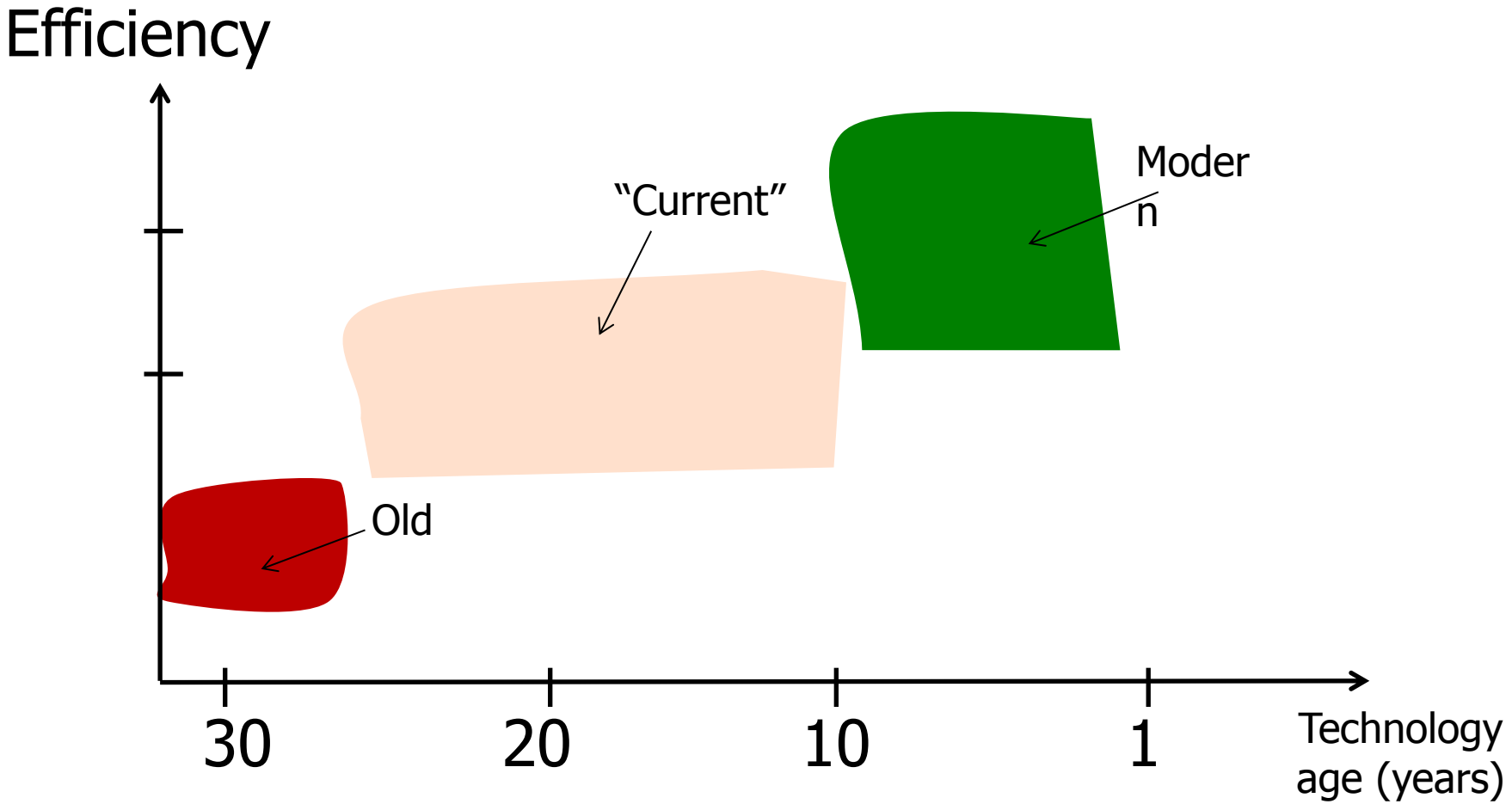
- When only one dataset exist:
  - For a specific activity (or product)
  - For only one geographical location (and a global market)
  - For only one point in time
- Even in the lucky situation that this dataset represents the global average:
  - This is not likely to well represent the technology and/or location of the marginal suppliers
  - This does not inform us of changes over time

More general problem in background databases: Aggregation errors



- Modern technology is typically what we want to model

More general problem in background databases: Aggregation errors



- Using aggregated averages will typically overestimate impacts
- The extent of bias will not be uniform across industries / products

Improvement needs: Reducing errors in background databases

Solutions to the aggregation problem:

- Long-term: More differentiated data
- Short-term: Can a correction factor marginal/average be estimated (e.g. from learning curves) ?

Thanks for your attention!

Some useful links again:

- Join: https://lca.consider.it/social_responsibility
- Share your examples: http://consequential-lca.org/
- Read: http://lca-net.com/blog/