A prospective perspective in LCA

SLC network conference

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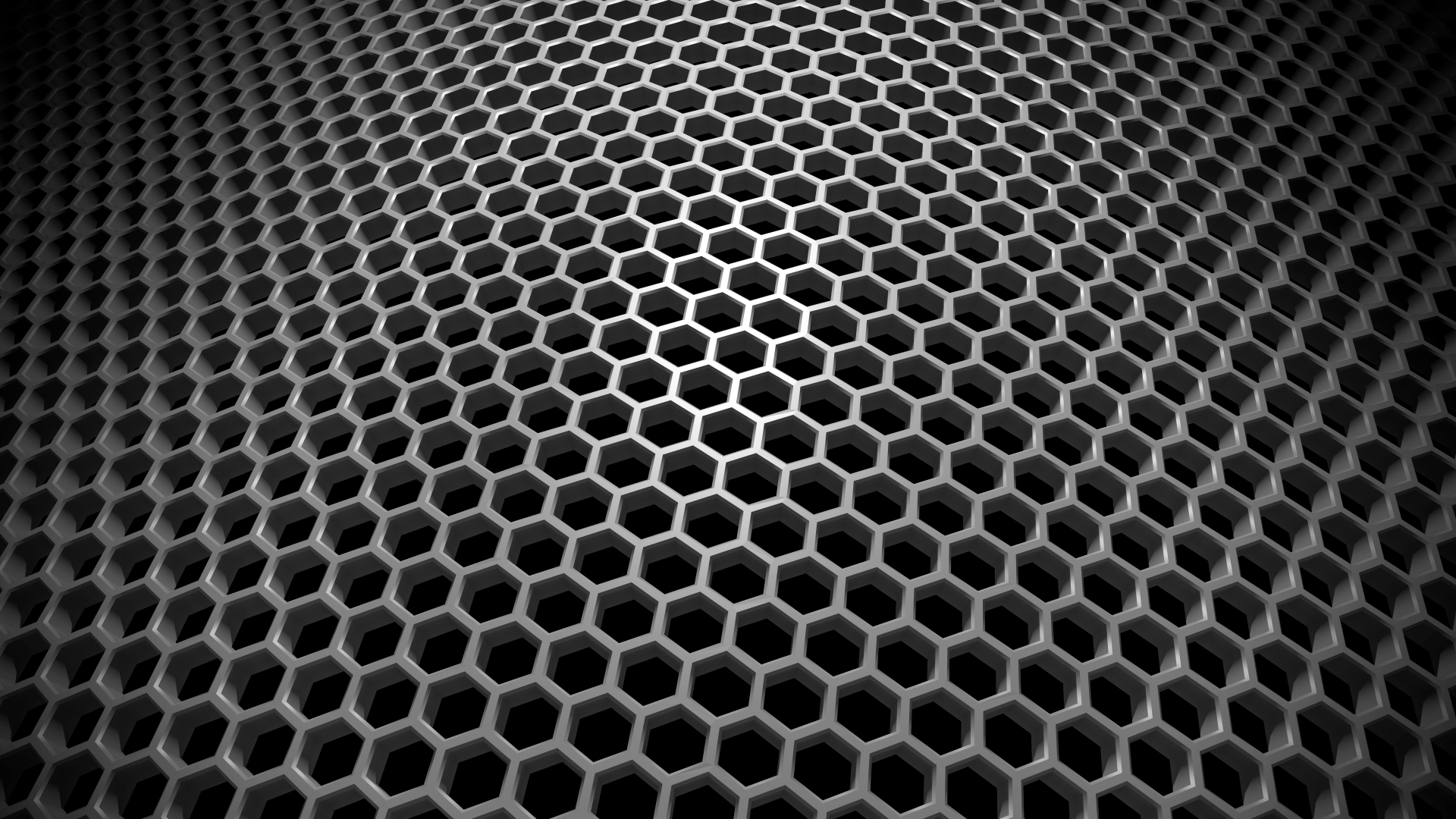


Problems with conventional LCA of emerging technologies

1. Technologies might change over time

Table 1. Typical lead-acid battery and electric vehicle performance.

Battery and vehicle assumptions	Vehicle scenarios	
	Available technology	Goal technology
Energy density of battery (Wh/kg)	18	56
Number of driving cycles per battery	450	1,000
Vehicle energy requirements (Wh/km)	310	310
Average distance per driving cycle (km)	80	80
Energy for driving cycle (kWh)	25	25
Battery mass for driving cycle (kg)	1,378	443
Battery life-cycle distance (km)	36,000	80,000
Lead percentage of battery mass (%)	70	70
Battery lead mass (kg)	964	310
Battery lead per life-cycle kilometer (g/km)	27	4
Lead releases per life-cycle kilometer		
Virgin production (4%) (mg/km)	1,072	155
Recycling production (2%) (mg/km)	536	78
Battery manufacture (1%) (mg/km)	268	39

Lave et al. 1995. *Science* 268(5213): 993-995.

Problems with conventional LCA of emerging technologies

1. Technologies might change over time

2. Production processes might change over time

Lab-scale production

- No solvent recycling
- High yields *OR* high quality with low yields
- Different energy requirement
- Byproducts not utilized

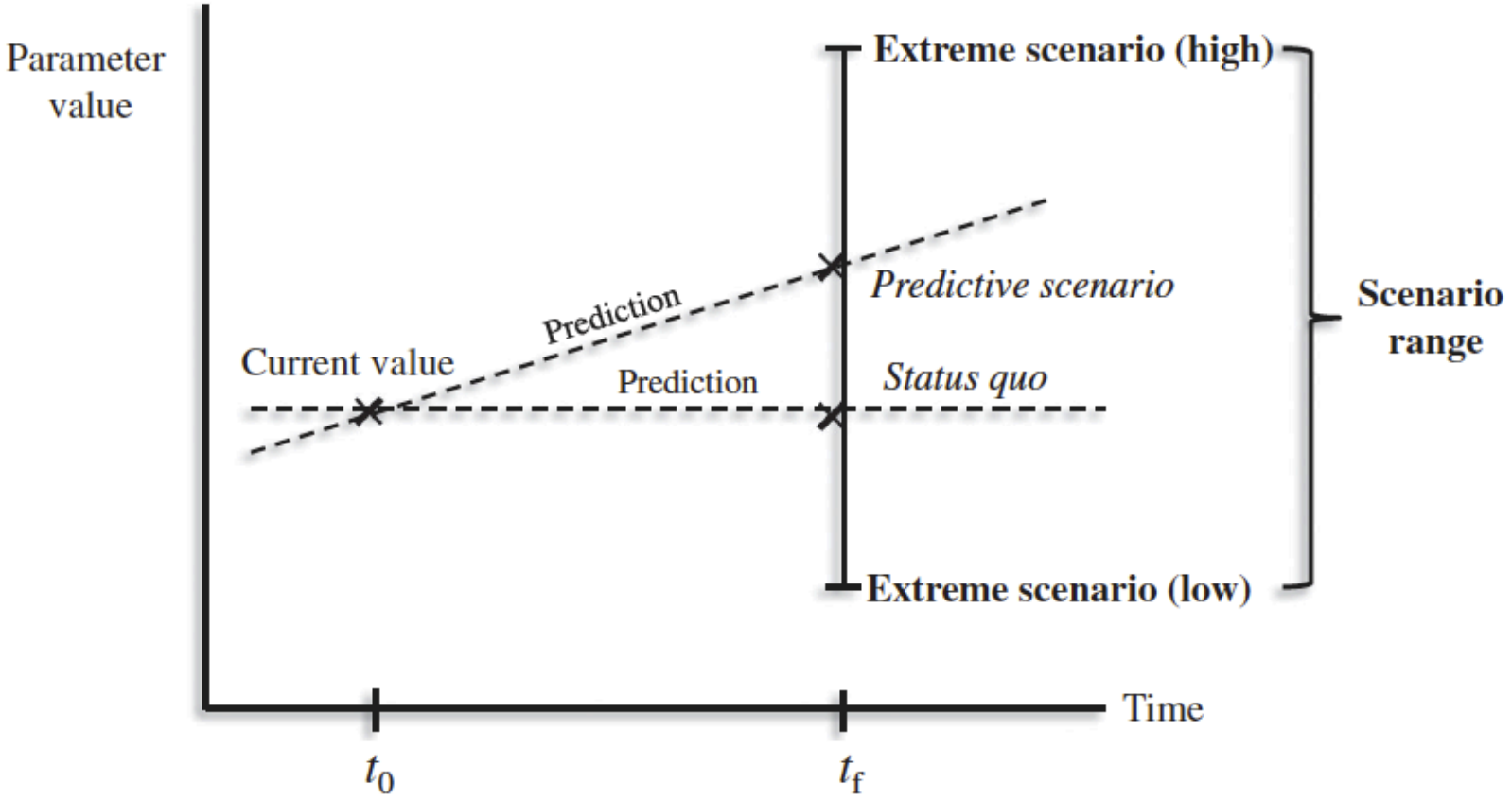
Problems with conventional LCA of emerging technologies

1. Technologies might change over time
2. Production processes might change over time
3. Surrounding systems might change over time

Prospective LCA =

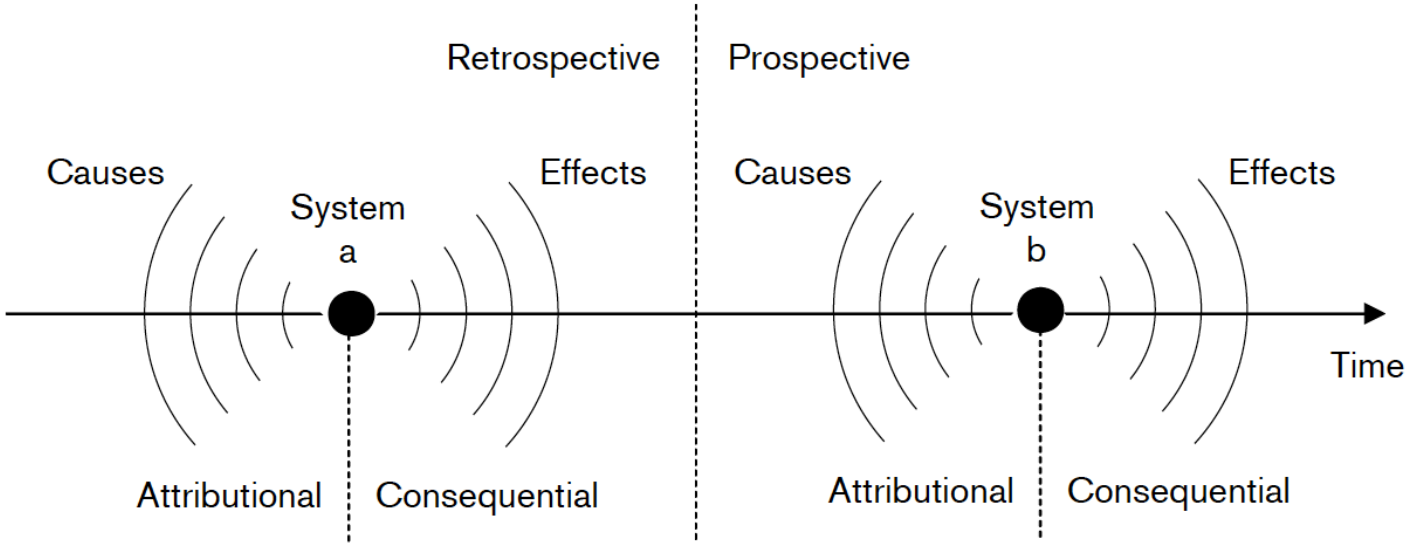
[LCA] studies of emerging technologies in early development stages […]. In order to capture the potential future environmental impacts of a technology in such cases, the system modeled is placed in a more distant future […].

Arvidsson, et al. 2018. *J Ind Ecol* 22(6): 1286-1294.



Arvidsson, et al. 2018. *J Ind Ecol* 22(6): 1286-1294.

Prospective vs Consequential and Attributional LCA

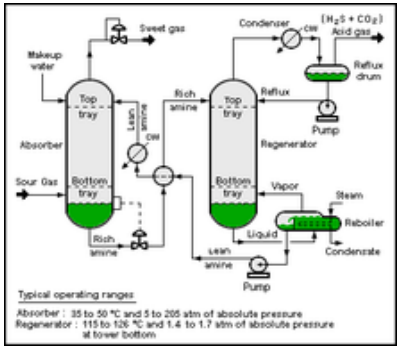


Hillman 2008 PhD thesis, Chalmers

How to actually do the predictions / scenarios?

× 0.1

$$E_{stir(1000\ l)} = \frac{0.79 * \rho_{mix} * 1.417^3\ s^{-3} * 0.373^5\ m^5 * t}{0.9} = 0.0180\ m^5 s^{-3} * \rho_{mix} * t$$



Simplified — In between — Complicated

Main messages

1. Prospective perspective in LCA of emerging technologies is needed because:
   - Technologies change
   - Production processes change
   - Surrounding systems change

2. Prospective LCA is a useful approach for considering such possible changes

3. The big question: How can relevant up-scaling, predictions and scenario construction be done in practice?