Environmental sustainability assessment of batch versus continuous manufacturing: Lessons learned in primary and secondary pharmaceutical manufacturing of Small Molecules

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Finite supply of fossil fuels, resource efficiency, carbon footprint. All of them are megatrends within international production environments. But how to measure environmental sustainability? What is the environmental impact of your Supply Chain?

Innovative production technologies require cutting edge resource consumption assessment methods, e.g. based on thermodynamics.

→ Exergy Analysis (EA) at process (α) and plant (β) level
→ Exergetic Life Cycle Analysis (ELCA) at overall industrial level (γ)

Results:
• Continuous processing has proven to be an effective approach for process intensification; reducing resource consumption in the production site and throughout the overall supply chain
• For low dose drugs, the primary packaging phase is an important resource contributor. Assessing complex primary packaging processes like it is the case of lyophilization can lead into significant resource savings

Future outlook:
• Environmental assessment of a batch lyophilization technology versus a (new) continuous lyophilization technology

Potential valorisation:
• Direct cost reduction (26% resource consumption reduction) → Lean Manufacturing
• Corporate Sustainability Reporting
• Marketing, communications
• Meeting (European) legislations and voluntary initiatives

Sustainability indicators can facilitate the improvement of technologies such as lyophilization by quantitatively supporting decision making; leading to new, more efficient and more sustainable pharmaceutical production processes. These indicators should look further than the process level, taking into consideration the whole life cycle production chain