



Sustainability: Increasing Ecoefficiency with chip management

Quantifying the impact

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ARCM-Arch

Agenda

- 1** Introduction
- 2** Quantifying the usage of cutting fluid
- 3** Case Study: SMPtec

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WHY AM I HERE?

The Goal is to provide ecoefficiency to companies in the manufacturing sector



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2.1 How to think about sustainability?

2.2 Quantify Sustainability: Impact of Cutting fluid

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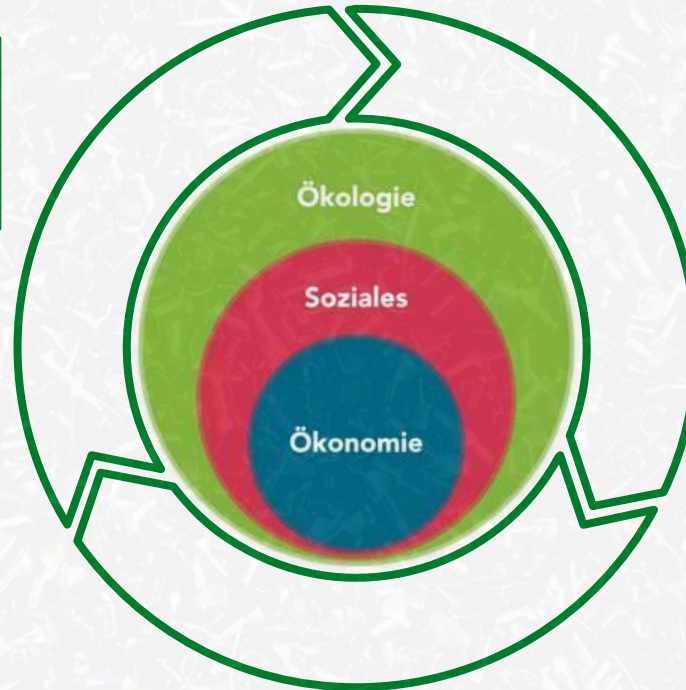
3 Case Study: SMPtec

How to think about sustainability

The triple bottom-line approach

PLANET:

- Energy Efficiency
- Renewable Energy
- Efficient Use of Resources



PRODUCT:

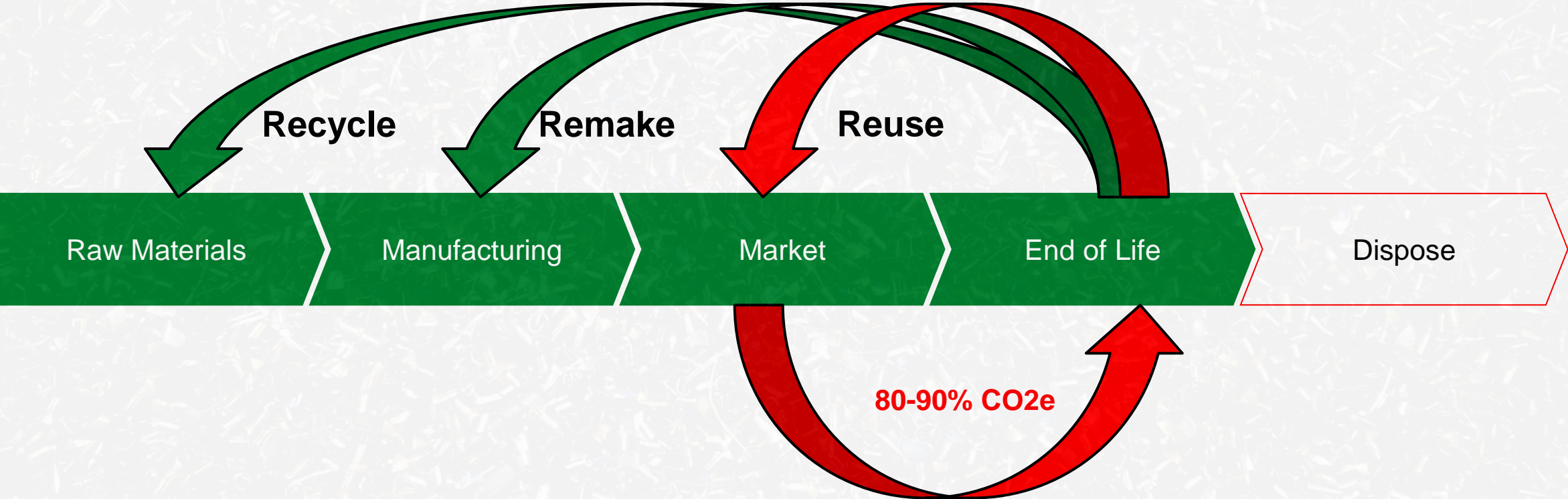
- LEAN production
- Reduction of waste
- Circular Economy
- Efficiency in production
- Quality in Production

PEOPLE:

- Attractive workplaces
- Safe and Healthy environment
- Happiness
- Social work
- Development of workforce
- Inclusion

How to think about sustainability

The R models applied to cutting fluid



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Importance of Oil in Machining Energy

Impact of Oil on Machining Processes



- effective cooling and lubrication between workpiece and cutting element



- reducing heat development
- minimizing tool wear



- improves the quality of the threads
- extends the service life of the taps



- improving surface quality
- reducing tool wear



- controlling the temperature of the grinding process
- ensuring good surface quality at the same time..

Precision

Quality

Chip removal

Durability

Ecological and Economic impact of Reusing cutting fluid

Quantifying

Ecological



- Annual cutting oil consumption in Germany is 75491 tonnes



- 1.5 million tonnes** of chips fall every year in the industry [2]



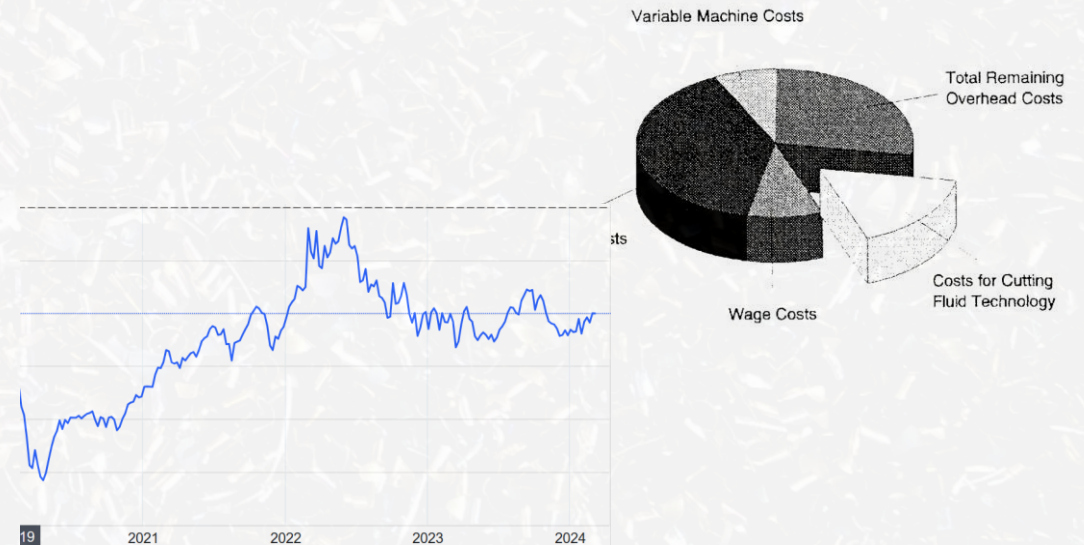
- 30% of the annual total consumption** of coolant lubricants is lost due to removal from the system [1/4]



- By using a **chip centrifuge**, a **global oil saving of 400 million liters** and **100 million kg of CO2** can be achieved

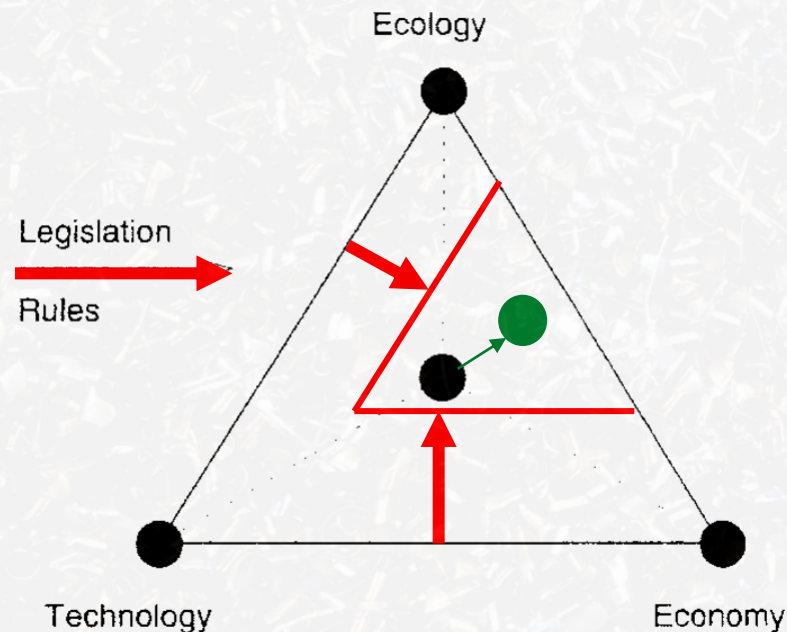
Economical

- More than 15% of the total manufacturing costs of products are costs for cutting fluid. [1]
- The disposal costs for cooling lubricants are between 15 and 17%. [5]



Lack of Research and Industrial Analysis - There is Potential

The Trilemma in Manufacturing



Lack of Research

- No identified research in the metal-mechanic sector that has used waste recycling as a CE (Circular Economy) strategy.

Unknown Environmental Impacts

- No measurement of the reduction of environmental impacts in the abiotic, biotic, water, and air sectors.

Uncalculated Economic Gains

- No calculation of economic gains through cost reduction, net revenues, return on investment percentages, and payback periods for invested capital. [6]

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3.1 Scopes of Emissions

3.2 Ecoefficiency Analysis

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The Sustainability Strategy of SMPtec

Classification of Emissions



SCOPE 1

- Direct emissions from company facilities
 - Machines
 - Transport

SCOPE 2

- Purchased heat, steam, and cooling for own use
- Purchased electricity for own use

SCOPE 3

- **Production/processing of raw materials:**
 - Raw materials
 - **Oil**
 - Tools
 - Water
- **Disposal and waste**
 - Chips
 - Coolant
 - Scrap
- **Contracted transport services**

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Eco-efficiency of chip centrifuges for oil recycling

Case Study: SMPtec - Resources saved in procurement only

- Competence: Machining (Turning/Milling)
- Employees 30
- Annual chip volume: 100 tons

Economic efficiency increase:
**100'000
CHF/ year**

Ecological efficiency increase:
**6500
kgCO2/ year**



**56'000 km/
year**



**1.4x around
the globe**

Summary & Questions

- See Sustainability through an economic, ecologic lens
- Use simple models like the R-models to think about making your products more sustainable and reduce their footprint
- Unsustainable operating materials such as cutting fluid must be reused to prevent from taxation in the future
- Quantifying the impact of sustainable technology on economic and ecologic value is important to actually find out the real benefit you achieve with this

- Come to us later with a number of your oil use or chip use and we can tell you how much you can benefit

Literatur

- [1] Byrne, G., & Scholta, E. (1993). Environmentally Clean Machining Processes — A Strategic Approach. *CIRP Annals ... Manufacturing Technology.*, 42(1), 471–474. [https://doi.org/10.1016/S0007-8506\(07\)62488-3](https://doi.org/10.1016/S0007-8506(07)62488-3)
- [2] Pähler, Norbert et al. (2021): Rückführung kostbarer Wertstoffe durch Entölen von Spänen. Online unter: <https://nbn-resolving.org/urn:nbn:de:hbz:464-20210601-084748-2>.
- [3]: Brecher, Christian, and Manfred Weck. *Werkzeugmaschinen Fertigungssysteme 1: Maschinenarten und Anwendungsbereiche*. Springer-Verlag, 2018.
- [4] Weck, M., 1992, Produktentwicklung im Werkzeugmaschinenbau. Conference Presentation, "Markt, Arbeit und Fabrik - Mut zum industriellen Aufbruch in Ost und West", Colloquium for Production Technology, Berlin
- [5] Gurpreet Singh, Sehijpal Singh, Vivek Aggarwal, Jujhar Singh, Neelkanth Grover, Amoljit Singh Gill, Ecological aspects of cutting fluids applications in small scale industries of Northern India region, *Materials Today: Proceedings*, Volume 48, Part 5, 2022
- [6] Geraldo Cardoso de Oliveira Neto, Auro de Jesus Cardoso Correia, Wagner Cesar Lucato “Economic and environmental benefits by means of recycling processes grounded in the CE: Case studies in the metal mechanical sector”
- [7] Gurpreet Singh Vivek Aggarwal Sehijpal Singh Critical review on ecological, economical and technological aspects of minimum quantity lubrication towards sustainable machining” *Journal of Cleaner Production* 271 2020 122185 10.1016/j.jclepro.2020.122185