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PRESOURCE, Berlin

VDI – Technical Guidelines as an example for ways to harmonise approaches to measure resource use in SME

VDI Association of German Engineers (VDI e.V.)

Wilfried Denz, Chairman of VDI Standard Committee
4598 “Resource Efficiency in SME”

Contents

- VDI Association of German Engineers (VDI e.V.)
- The **VDI framework guidelines on Resource Efficiency** - motivation and current status
- VDI standard on **Resource Efficiency in SME**
- Conclusion

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The Association of German Engineers (VDI)

VDI

about **150,000** members and **12,000** active honorary experts

Science and Technology	Profession and Society	Strategy and Communication	Regional Services

12 VDI- societies
55 Technical divisions

work out

ca. 220 new and revised VDI standards per year

ca. 2,000 existing standards

VDI Standards are…

- accepted rules of technology
- a benchmark of the „technically correct“
- describe/correspond to the state of the art
- formally, no legally binding effect
- but relevant in legislation and jurisdiction

source: illustration-konzept.de

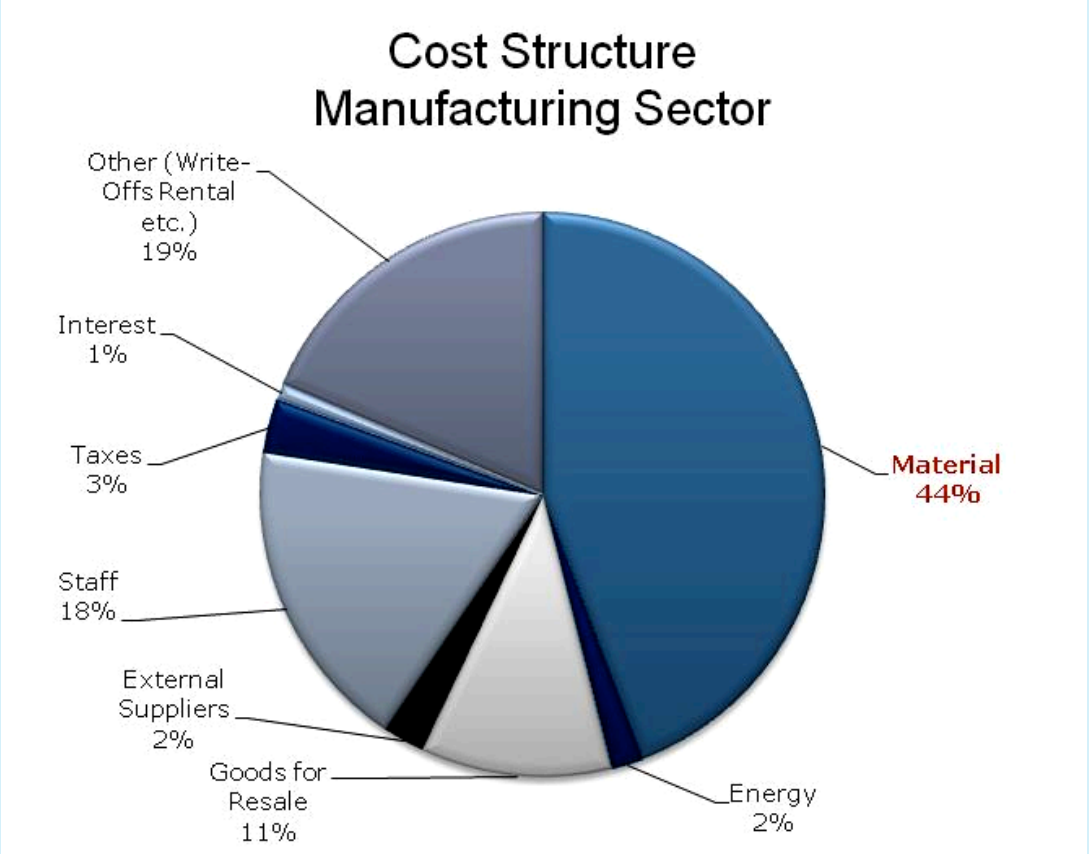
others:
Standards of the German Institute for Standardisation (DIN)
Standards of the International Organisation for Standardisation (ISO)

VDI Standards are…

- worked out by honorary experts
  - work in standard committees
  - independant
  - vocation ad personam
- worked out by involving all interested parties:
  business, research, consulting, administration
- discussed as draft with the (professional) public within an opposition procedure (duration 4 to 12 months)
- Database on VDI standards:
  www.vdi.eu/engineering/vdi-standards/

Resource Efficiency potentials in SMEs

Materials are the main cost factor in the manufacturing sector
→
RE with the reduction of materials and energy use is an important tool for cost reduction



Source: Federal Statistical Office Germany, 2012

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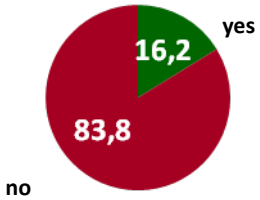
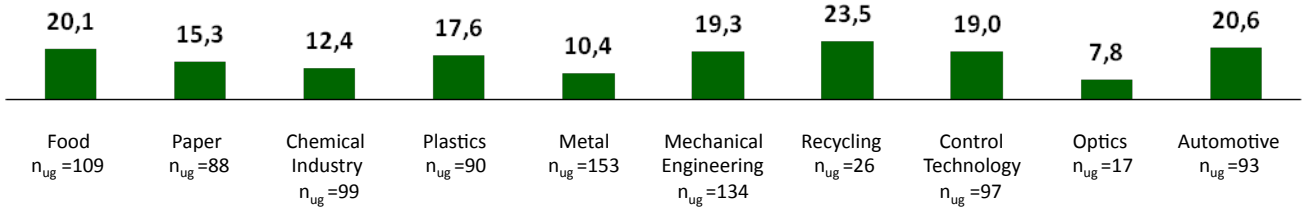
Resource Efficiency potentials in SMEs

n_{ug} = 906, answers in percent

In our sector all resource efficiency potentials are already tapped.

Do you agree with this statement?

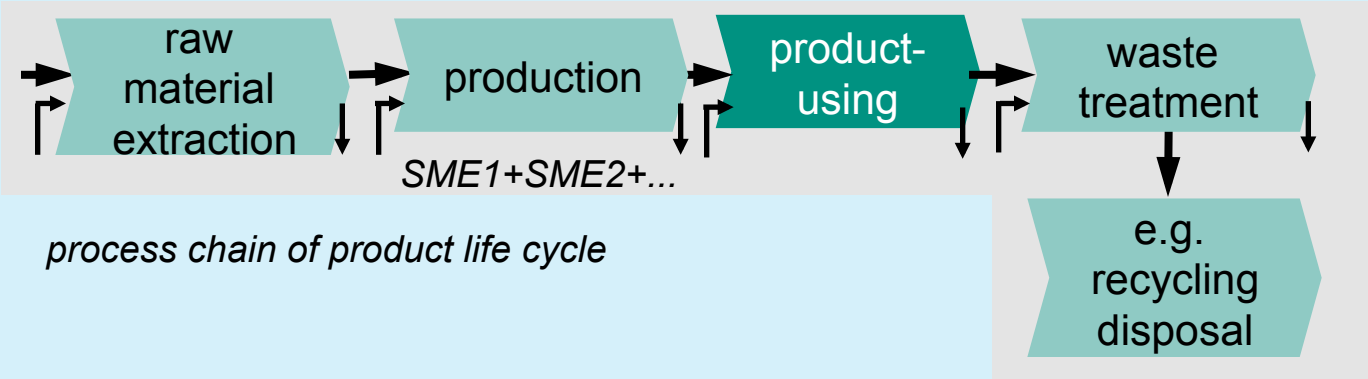




Source: Study „Implementation of Resource Efficiency Measures in SME‘s and their Driver“ (VDI ZRE, 2011: www.vdi-zre.de/fileadmin/user_upload/downloads/studien/28-11-2011_Broschuere_Web.pdf (german))

Resource consumption in the life cycle

Resource consumption occur in the whole product life cycle



Optimisation in one phase of life cycle can lead to a worsening in other phases of life cycle and, possibly, in the overall balance

To **avoid improvement for the worse**, a holistic and manageable set of RE-indicators for product-related assessments is required

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Motivation for VDI Standards on Resource Efficiency „How to measure Resource Efficiency?“

Water Footprint
Cumulative raw material demand
Eco-Efficiency-Analysis
Cumulative energy demand
Material flow cost accounting
Life cycle assessment
Material Input per Service Unit
Carbon Footprint
Recycling rate
Raw material productivity
.....

Many results and questions
economic system?
system boundaries?
combinability of parameters?
comparability of results?
interpretation modalities?
„life-cycle-thinking“?
criticality and vulnerability?

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The VDI standards 4597-4601 on Resource Efficiency

industry-wide methodological concept

methodological principles

VDI 4597 **Framework guideline on Resource Efficiency**
Objective of RE, **accounting principles**, strategies to implement RE measures

VDI 4600
cumulative energy demand

VDI guideline since 1997
2nd edition 01/2012

VDI 4599
cumulative raw material demand with raw material criticality

VDI 4601
environmental indicators

Application

VDI 4598 **Resource Efficiency in SME**
strategies to implement resource efficiency **in SME**

What is Resource efficiency?

Calculating Resource efficiency:

$$\text{Resource efficiency} = \frac{\text{benefit}}{\text{effort}}$$

benefit:
- product function
- functional unit

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effort:
- natural resources
  - energy resources
  - raw materials
  - water
  - land and soil
  - biodiversity
  - sink-function of nature

VDI 4597:

VDI 4600 + VDI 4599 + VDI 4601

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Methodological principles

VDI 4597 **Framework guideline on Resource Efficiency**

chairmen:	Jürgen Giegrich, Prof. Dr. Mario Schmidt
constitution:	March 18th, 2011
target:	Decision makers in organisations and companies that deal with the issue of resource efficiency

Contents:

- Rules for **application the VDI standards 4599-4601** on RE analysis and **interactions of the Guidelines with other standards and regulations:** e.g. DIN EN ISO 14044 – LCA, DIN EN ISO 14051 - MFCA
- Analysis based on the **life cycle concept**
- Determining the **benefit** (product, function…)
- **Statements to principles, strategies and actions for the RE analysis and recommendations for calculating uncertainties**

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How can benefit be measured?

Benefit can be fulfilled by product-systems (goods, services)

Examples for quantifying benefits

- 5 cups of coffee per day over a period of 7 years
- transport of 2 people on route from A to B
- 5.000 gears for transmitting torque from x Nm or a specified geometry and material
- specified output from the production process
  (most relevant for SMEs)

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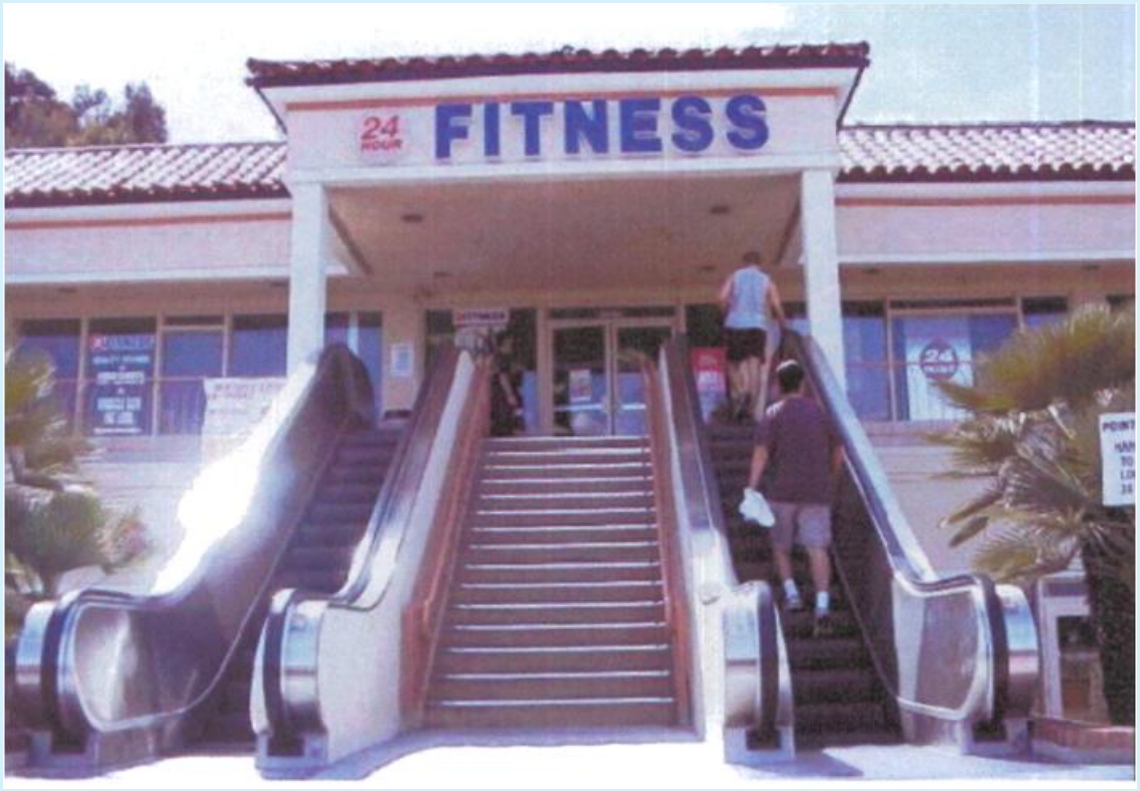
Always think about the sense of benefit…



source: Hellmich (2010), Vortrag anlässl. des VFA-Aussprachetags zur VDI 4707 am 23.06.2010

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Clarification of procedures – Expls.

Chapter 6: Methodological principles for calculating resource efficiency

Example: Allocation procedures for resource consumption in coupled production

"…If possible and appropriate, the resources **are allocated according to the mass ratios** of the coupling products…."

"...In the case of energy conversion to several energy products (e.g. electricity, various streams of vapor, heat, cold) the **exergy method** for the several energy fluxes should be applied…"

"…If these types of allocation aren't possible, the next preference is to allocate by the market price (long-term average to avoid fluctuations). It should be noted that mass balances could be hurt…"

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Methodological principles

VDI 4599

Raw material demand with raw material criticality

chairmen:	Prof. Dr. Uwe Lahl, Dr. Christof Oberender
constitution:	March 11th, 2011
target:	Decision makers in organisations and companies that deal with the issue of resource efficiency

Contents:

- **Specifications** for inventory analysis (e.g. how to deal with “used or unused extractions”?) of raw materials within the life cycle
- Selection and validation of indicators to assess the scarcity or availability - the **criticality** - of raw materials based on current researches

Comparison

analysis / method		assessment / focus	indicators / focus	aims / result
MFCA DIN EN ISO 14051	Inventory data set	costs environmental impacts	(physical flows) waste flows costs	improving efficiency improving competitiveness reducing environmental impacts saving and protecting resources
LCA DIN EN ISO 14044		environmental impacts (biotic / abiotic nature)	GWP acidifaction eutrophication toxicity…	
Resource Efficiency **VDI 4597+ 4599-4601**		natural resources use / efficiency environmental impacts raw material criticality	cum. energy demand cum. raw material demand environmental indicators criticality	
⋮				

Calculation of Resource Efficiency in **SME**?

- Calculating or measuring the **RE of a product over its life cycle** based on VDI 4597/4599-4601 is - like for a LCA - a task for experts and very time-consuming
- SMEs do not employ experts for RE or Environmental Protection and they barely have time for any additional tasks
- From countless Cleaner Production projects in SMEs we know, that in practice even the generation of material + energy flow balances for relevant production processes often fails

→ It is unrealistic to expect that SMEs could calculate the RE of their products “state of the art” or even collect the respective life cycle data

Resource Efficiency in SME:

*[Taking only one or few of the RE-indicators (like CO2 or quantity of material) for **simplifying** may lead to wrong decisions]*

Most SMEs are contract manufacturers and have only very little influence on the product.
A relevant number of RE-measures affects only one phase of the life cycle (e.g. Cleaner Production) resp. the other phases only by same or smaller amounts of the same resources (e.g. some types of lightweight)

→ **no need for a RE-calculation** over the life cycle, task of SME

But for RE-measures like changing the material a RE-Calculation by **an expert is required** to **avoid improvement for the worse**

→ **VDI 4598 Resource Efficiency in SME**

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RE in SME practice

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Resource Efficiency in SMEs

chairmen:	Wilfried Denz, Dr. Tobias Heinen
constitution:	May 05th, 2011
target:	Decision makers in SMEs

Contents and main targets:

- **Getting more resource efficient production and products** without calculating the RE over the product's life cycle with:
- Finding starting points for activities on RE in the life cycle
- Focus on gate-to-gate activities (similar to Cleaner Production)
- Avoiding improvement for the worse:
  for which RE-measures RE-calculations are needed, for which not ?
- List of resource efficiency instruments, strategies and measures

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Finding starting points in the life cycle

Starting points gate-to-gate:

based on energy and mass balances of production processes:
- where are the biggest amounts of energy and materials?
- where are the highest relative and absolute losses?
- use of hazardous substances

Starting points in processes outside the company:

using qualitative or semi-quantitative methods to find phases of the life cycle with high environmental effects (e.g. MET (M aterials, E nergy, and T oxicity) Matrix)

if available, using results from RE-calculations or LCA on similar products or data / information from suppliers

asking experts from institutions like VDI-ZRE

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Avoiding improvement for the worse

Always check, if the RE-measure has or may have a negative effect on other phases of life cycle (e.g. shortening lifetime)

VDI 4598 standard includes a table and examples of RE-measures which always, in some cases or never may have a negative influence

→ even without measuring or calculating the RE, a SME can realise a number of RE-measures*, but not knowing the positive effect quantitatively in %.

In other cases like using plastics instead of metals or using a renewable raw material: ask experts, e.g. from VDI-ZRE or demea

**Expls.: optimised instruction manual, less rejects, hold and not exceed quality specifications, using less and less hazardous auxiliary materials …*

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Table: strategies and measures with respect to product and production (excerpt)

(4) Miniaturisierung	Prinzipiell bestehen große Potenziale in Bezug auf den Werkstoffverbrauch. Fertigungsaufwand und Rebound-Effekte können dagegen wirken. **Beispiele:** Miniaturisierung elektronischer Bauelemente, Baugruppen und Produkte ermöglicht produktbezogene Effizienzsteigerung. Fertigungsaufwendungen können überproportional steigen. Aufgeladene Verbrennungsmotoren. **Einflussnehmender Akteur im Betrieb:** Produktentwicklung (auch strategische Produktplanung) **Relevante Lebensphasen:** Werkstoffherstellung, Herstellung, Nutzung, Recycling, Beseitigung, Transport **Lebensweganalyse:** erforderlich
(5) Fertigungsgerechte Produktgestaltung	Neben Effizienzpotenzialen im Fertigungsprozess selbst können Ausschuss und Nacharbeit vermindert werden. **Beispiel:** Kleben Anstelle von Schrauben oder Nieten (es können Zielkonflikte im Recycling auftreten) **Einflussnehmender Akteur im Betrieb:** Produktentwicklung, Arbeitsvorbereitung, Produktion **Relevante Lebensphasen:** Herstellung **Lebensweganalyse:** nicht erforderlich, wenn Material und Nutzen gleich bleiben

(23) Vermeiden von Verlust durch Entsorgung fertiger Produkte	Ursachen für das Entsorgen von Material oder fertigen Produkten aus dem Lager bestehen zum Beispiel in Überalterung, schlechtem Auslauf- und Änderungsmanagement, unzureichender Lagerverwaltung, überhöhten Sicherheitsbeständen oder Überproduktion. **Einflussnehmender Akteur im Betrieb:** Produktion, Vertrieb **Relevante Lebensphasen:** Werkstoffherstellung, Herstellung **Lebensweganalyse:** nicht erforderlich
(24) Vermeiden von Verlust durch Entsorgung eingekaufter Materialien	Insbesondere relevant bei Materialien mit kurzfristigen Haltbarkeitsdaten, bei der Umstellung von Fertigungstechnologien oder bei Nachfolgeprodukten. **Relevante Lebensphasen:** Werkstoffherstellung, Herstellung **Einflussnehmender Akteur im Betrieb:** Einkauf, Produktion **Lebensweganalyse:** nicht erforderlich
(25) Vermeiden Verlusten durch unsachgemäße Lagerung oder Überlagerung	**Beispiele:** Witterungseinflüsse, Haltbarkeitsüberschreitung **Maßnahmen:** Datenbankgestütztes Stoffstrommanagement trägt dazu bei, Haltbarkeitsüberschreitungen zu vermeiden und unterstützt bedarfsgerechte Lagerhaltung. **Einflussnehmender Akteur im Betrieb:** Einkauf, Produktion **Relevante Lebensphasen:** Werkstoffherstellung, Herstellung **Lebensweganalyse:** nicht erforderlich

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Realising RE-measures

VDI 4598 standard gives a lot of additional advices on

- selecting,
- developing,
- implementing,
- controlling and
- assessing

RE-measures

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(Good?)

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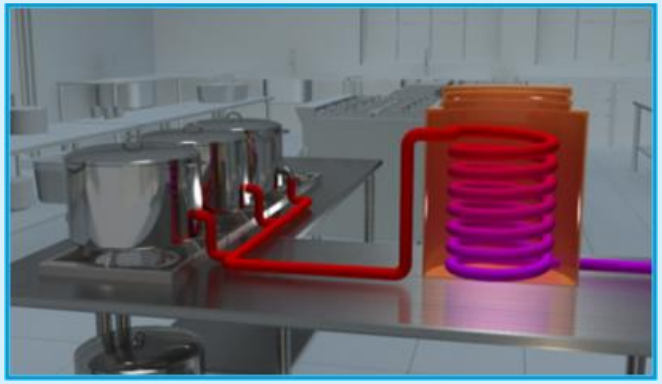
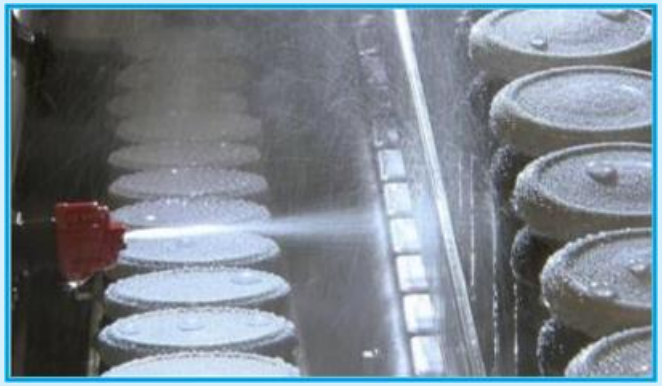
Example of successful RE-measures

Process optimisation: Warming and Cooling



Low-loss pre-heating:
33 % less gas consumption



Efficient cooling:
evaporation cooling instead of water bath:
200.000 l/a less sewage water

ROI: 2 Years

Remarks on (non)investive CP/RE-measures

Worldbank, UNIDO and own experiences demonstrate:

The potential of CP resp. material and energy efficiency measures to reduce environmental impacts like waste and waste water or CO_2 and VOC-emissions are up to an average of 50%.

RE through:

simple organisational or technical CP measures without or with little expenses	**20-35 %**
expenses required (economic efficiency has to be verified)	20-40 %

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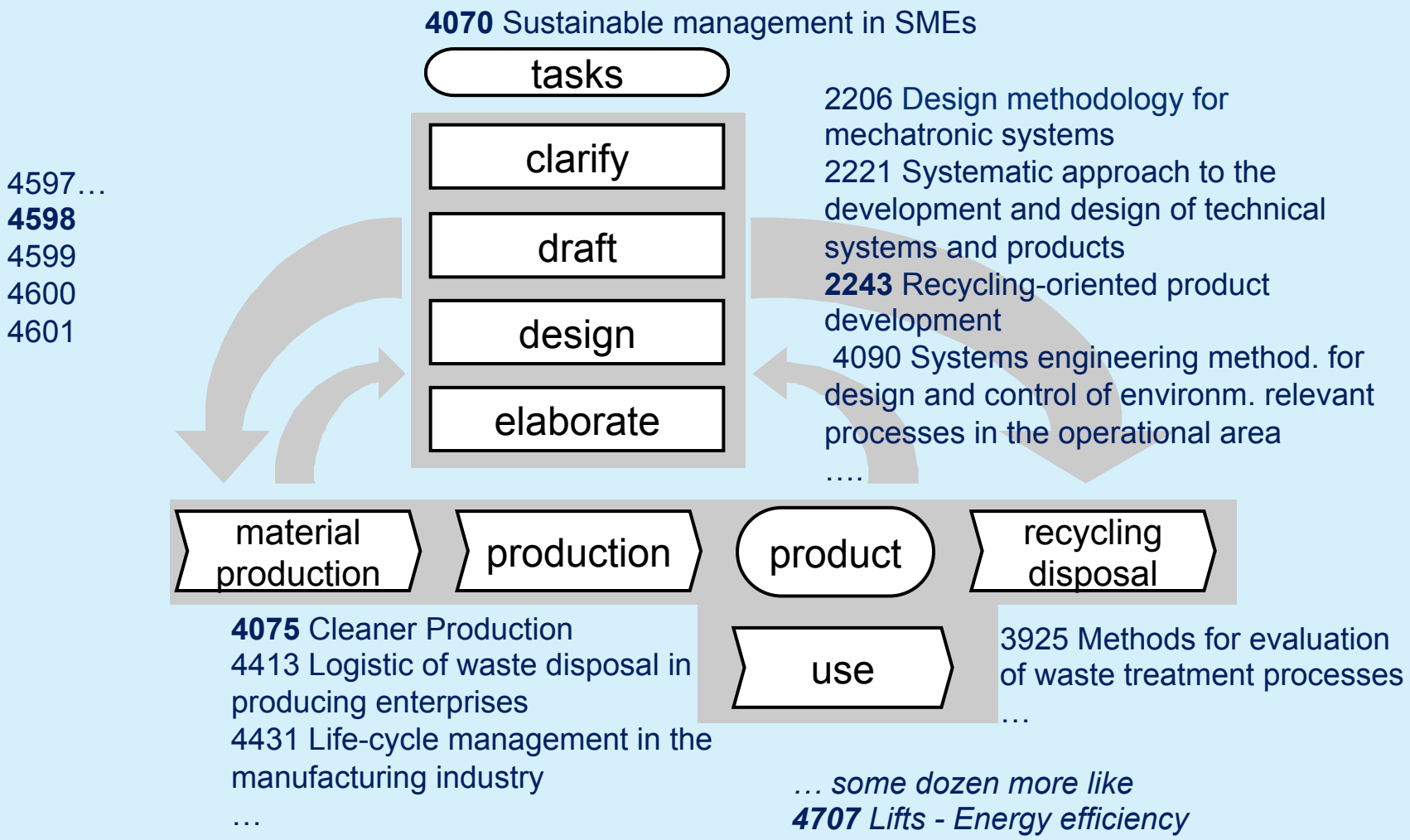
VDI standards relating to RE and CP



Conclusion

VDI 4597 **RE** in combination with VDI 4599-4601 gives an methodological concept on the “state of the art” measuring of *benefit* and *effort*, i.e. *RE*

VDI 4598 **RE in SMEs** gives an structured approach to increase the Resource Efficiency of products and production for SMEs

→ **Every SME can get more Resource Efficient!**
even without RE-calculation and
without running the risk of an improvement for the worse

Target date:
mid of 2014 finished manuscript of VDI 4598 (‘greenprint’)

Discussion: make VDI 4598 available to SMEs free of charge

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Motto „Costs Saving through Environmental Protection “