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- Gold Standard -

1999 – 2019: 20 Years
Life Cycle Models and Potential Analysis

Digital Solution
to support and to self-monitor
YOUR Sustainable Development

LCS Life Cycle Simulation GmbH

LIFE CYCLE MODELS
METHODOLOGY AND EXAMPLES

2021 Status short overview

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Life Cycle Models

Holistic approach for costumized software tools

Perspective 7: Product and/or Life Cycle Costing (cost efficiency)

Perspective 6: Personal (qualification; demand)

Perspective 5: Life Cycle Assessment (Resource eff., ISO 14040)

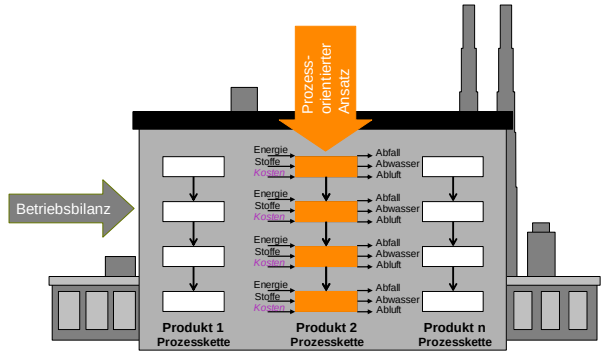
Perspective 4: Material flows (material efficiency)

Perspective 3: Energy flows (energy efficiency, ISO 50001)

Perspective 2: Technical evolution status

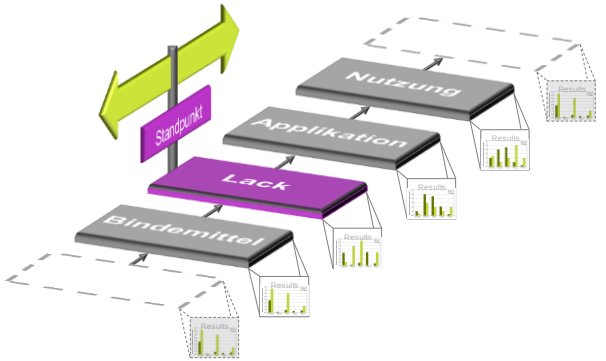
Perspective 1: Technical key performance indicators

Implementation Production



Optimization and technology evaluation

Implementation Life Cycle



Optimization and Added Values

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Example for implementation

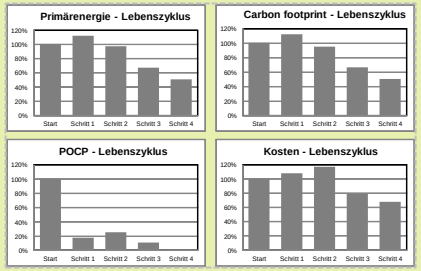
Life Cycle Models

* Customized software tool
* Technology characteristics
* Profitability analysis
* Life Cycle Assessment

Life Cycle Models

Modular principle

Software tool
Life Cycle Model
- Platform Excel©
- Functionalities
- Modular



Economy
- Static (CCM)
- Dynamic (NPV)
- Amortization
- Regions (DE, CN,…)

Technology
- Metal processing
- Composite process.
- Surface technologies
- Joining technologies
- …

Ecology
- Material eco profiles
- Energy eco profiles
- Hot Spots
- Regions (DE, CN, …)

CCM = Cost Comparison Method
NPV = Net Present Value Method

Life Cycle Models

Definitions – example surface technologies

Goal:

- **Life cycle potential analysis (economy and ecology)** of car body **coating concepts**
- Build-up of **flexible Life Cycle Model** to show strengths, weak points and potentials

Functional unit:

- **One OK coated car body** (investigation of a complete production year and conversion to one body)

Comparability:

- The investigated coating concepts fulfill the same technical requirements and therefore these can be compared.

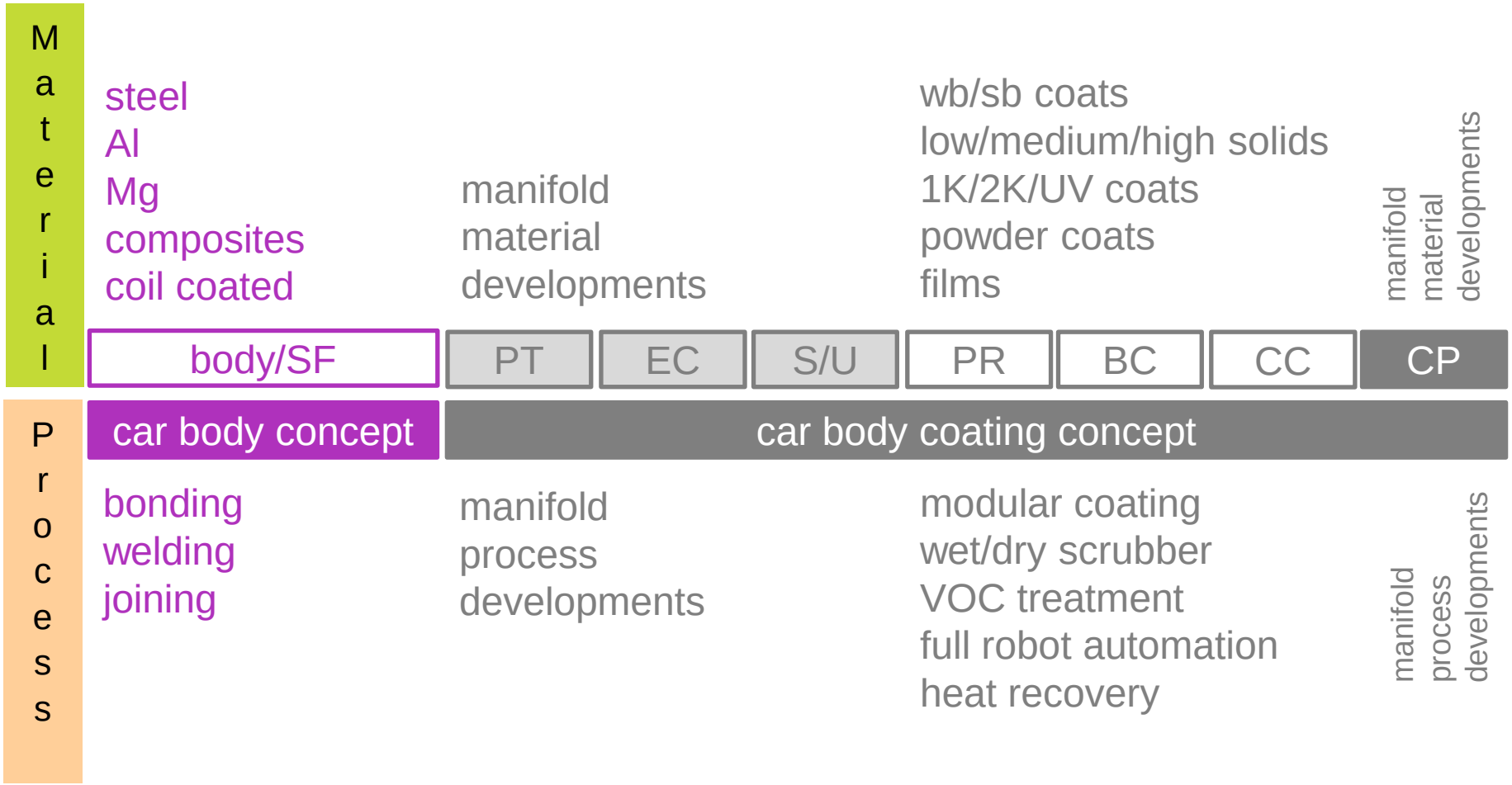
Life Cycle Models

Definition of scope - example surface technologies

- Product definition: car, van, truck, bus, etc.
- Product characteristics: materials (steel, aluminum, composites), weight, surface area, etc.
- Yearly production: units/a, operation time, etc.
- Production site: country, climate, energy supply, prices, etc.
- Production technology: process steps, automatization (robots, manual), periphery (building), etc.
- Repair concepts: multiple runs, repair boxes, etc.
- Logistic concept
- Alternative technologies (processes, materials)
- …

Life Cycle Models

Coating concepts – simplified overview of alternative materials and processes

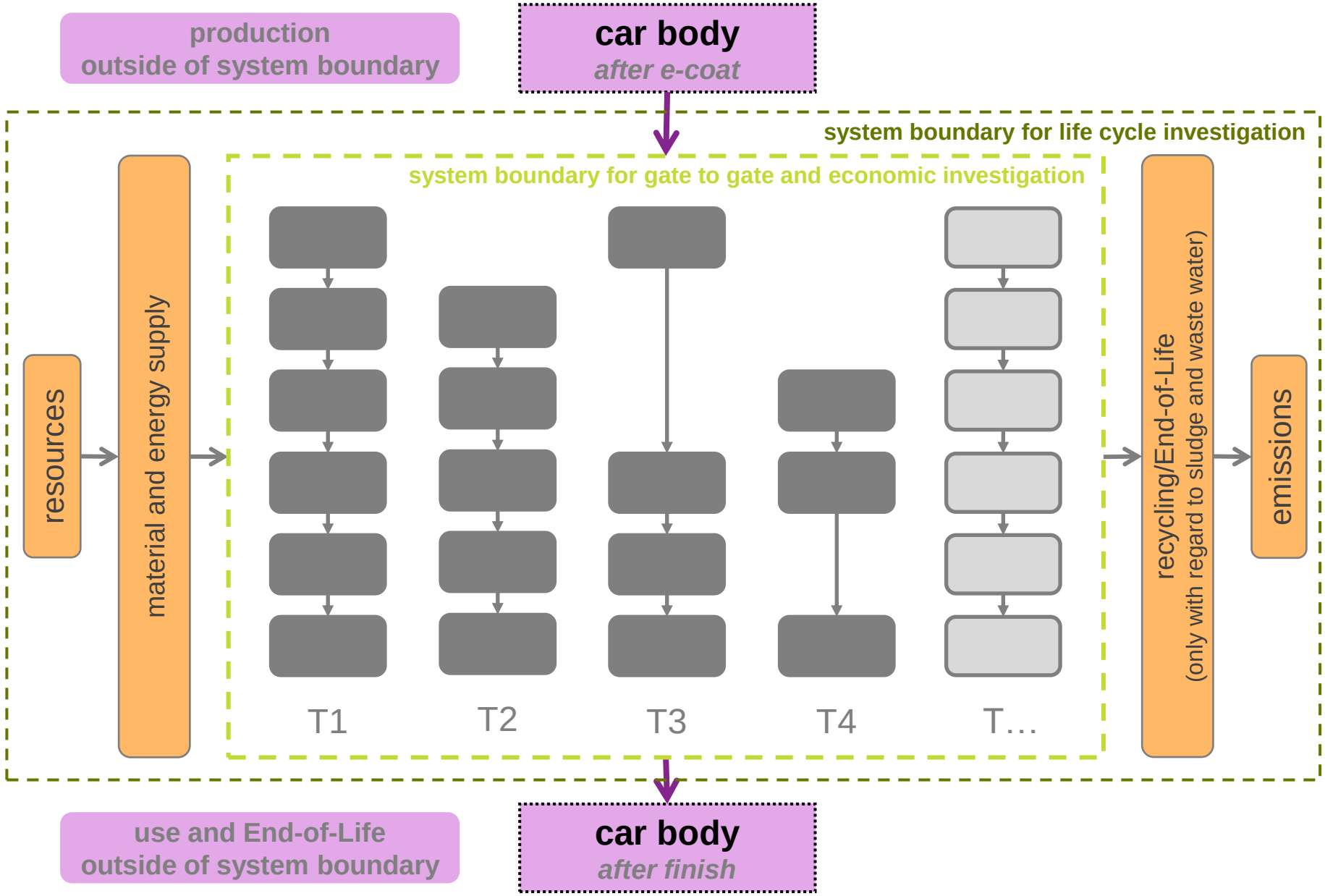


SF: space frame, PT: pretreatment, EC: e-coat, S: seam sealing, U: under body protection, PR: primer, BC: base coat, CC: clear coat, CP: cavity protection

Quality level and design aspects are important!

Life Cycle Models

Definition of system boundaries - example surface technologies



General methodical approach

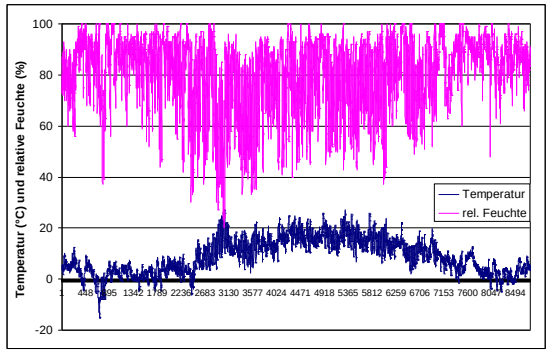
Modeling, Simulation and Calibration

Model
- Input

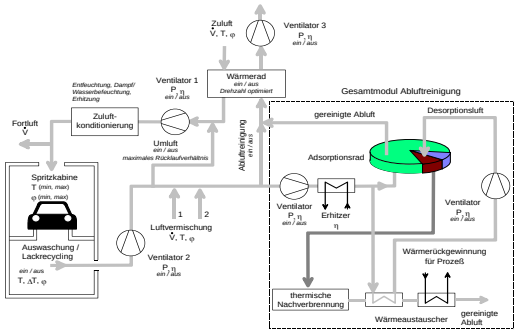
Model
- Processes
- Parameterization

Model
- Results
- Calibration

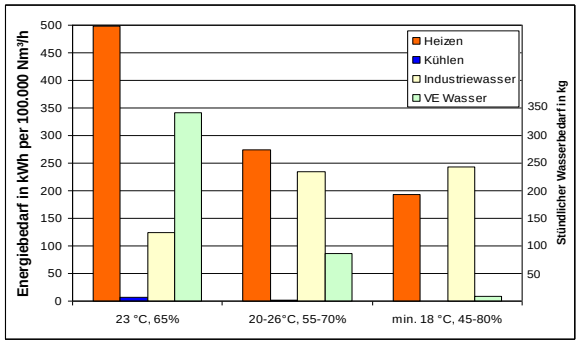
Hourly climatic data of location (e.g. DWD)



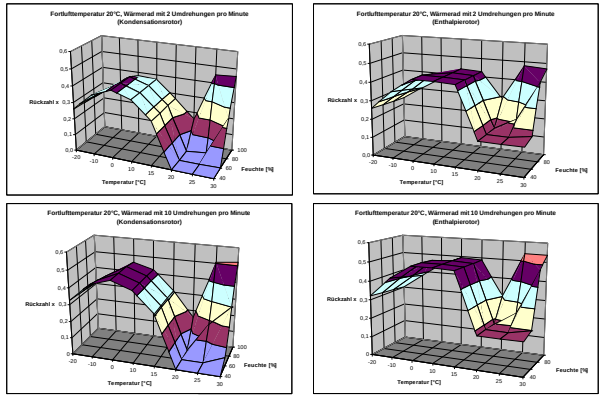
Air conditioning of the spray booth



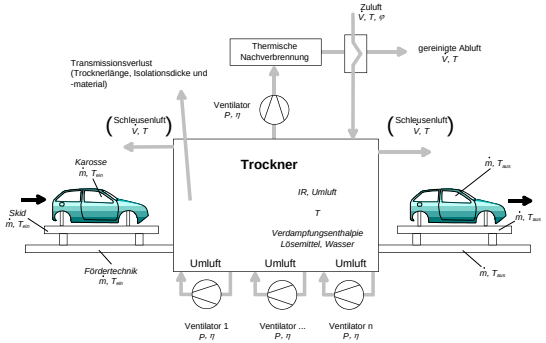
Energy demand of the climate windows



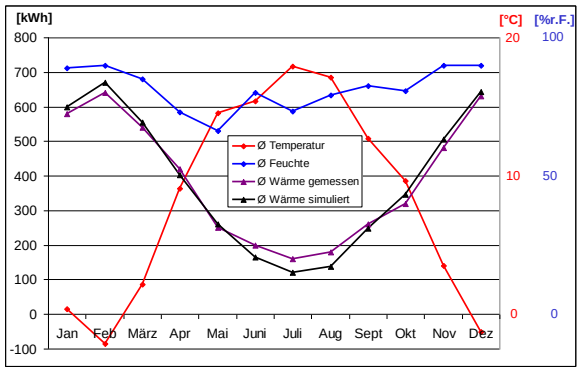
Characteristics of technologies e.g. rotating air-to-air heat exchanger



Heat demand of oven



calibration with measured data



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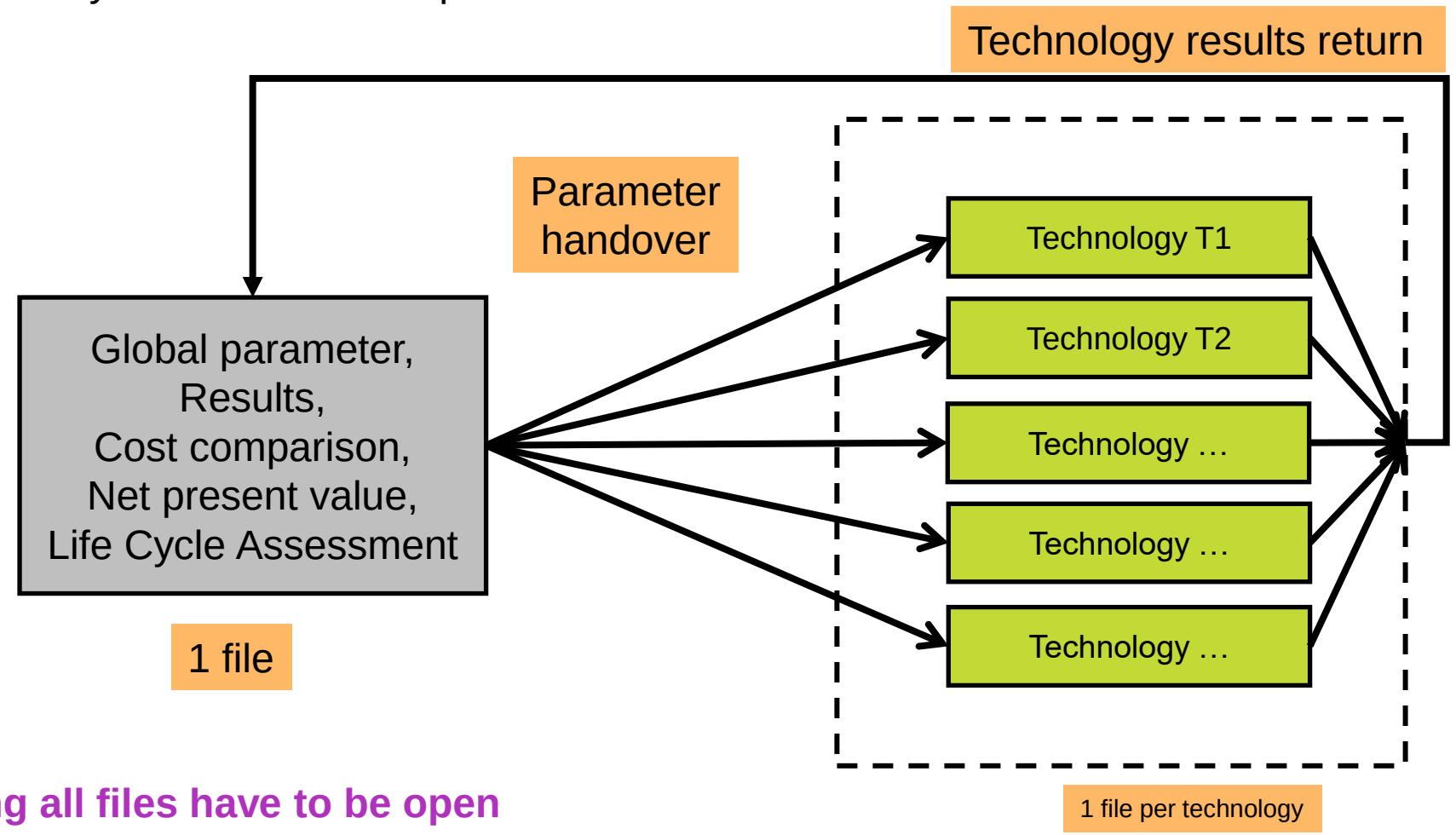
General methodical approach

Overview of the provided model and Excel files and their connection

- Excel-Model for the quantitative analysis of resource and energy flows as well as costs
- Same boundary conditions for all technologies (Country settings, production)
- Sensitivity analysis for all relevant parameters



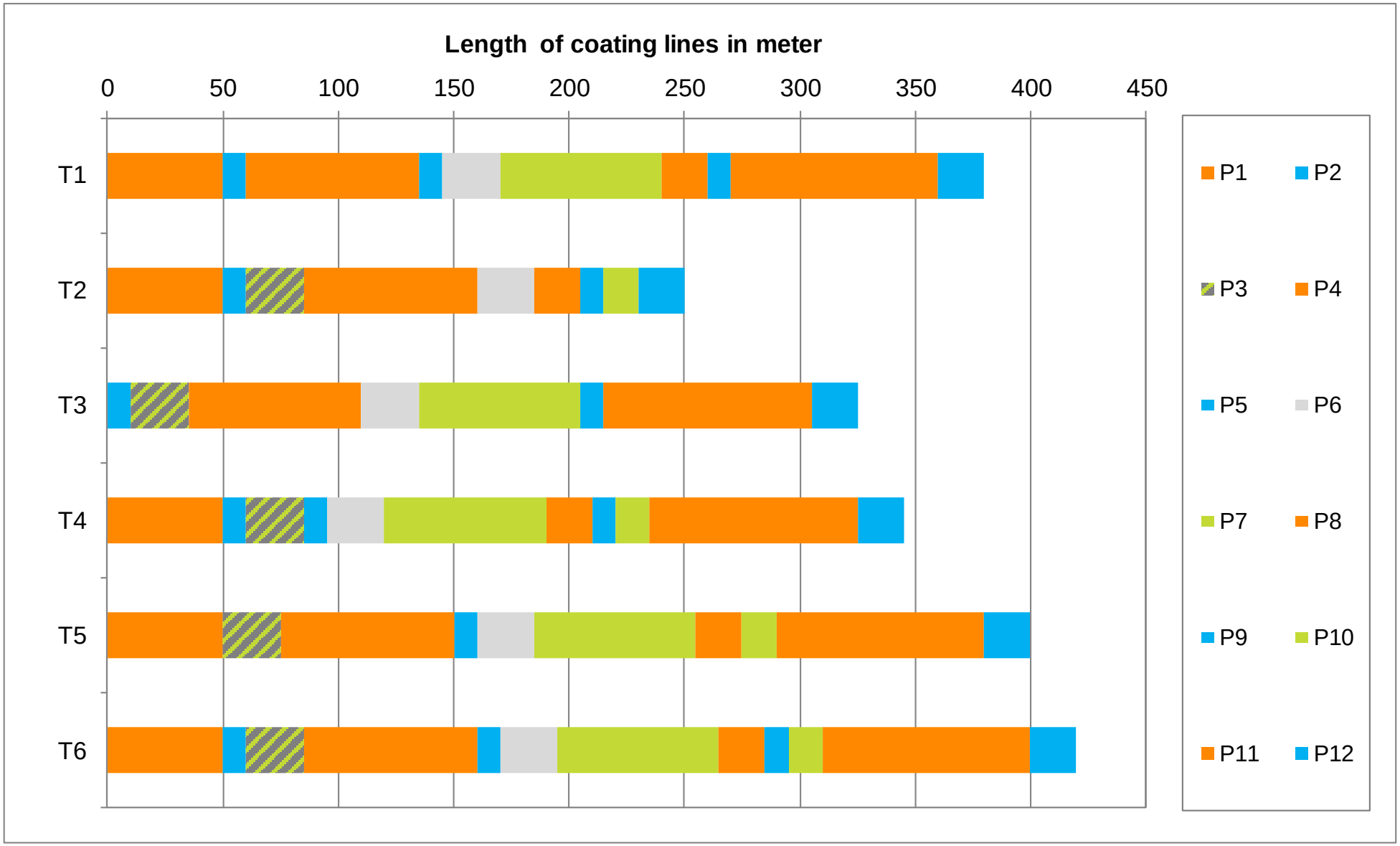
- **For editing all files have to be open**

Technical results

- Energy demand
- Material demand
- Process parameter

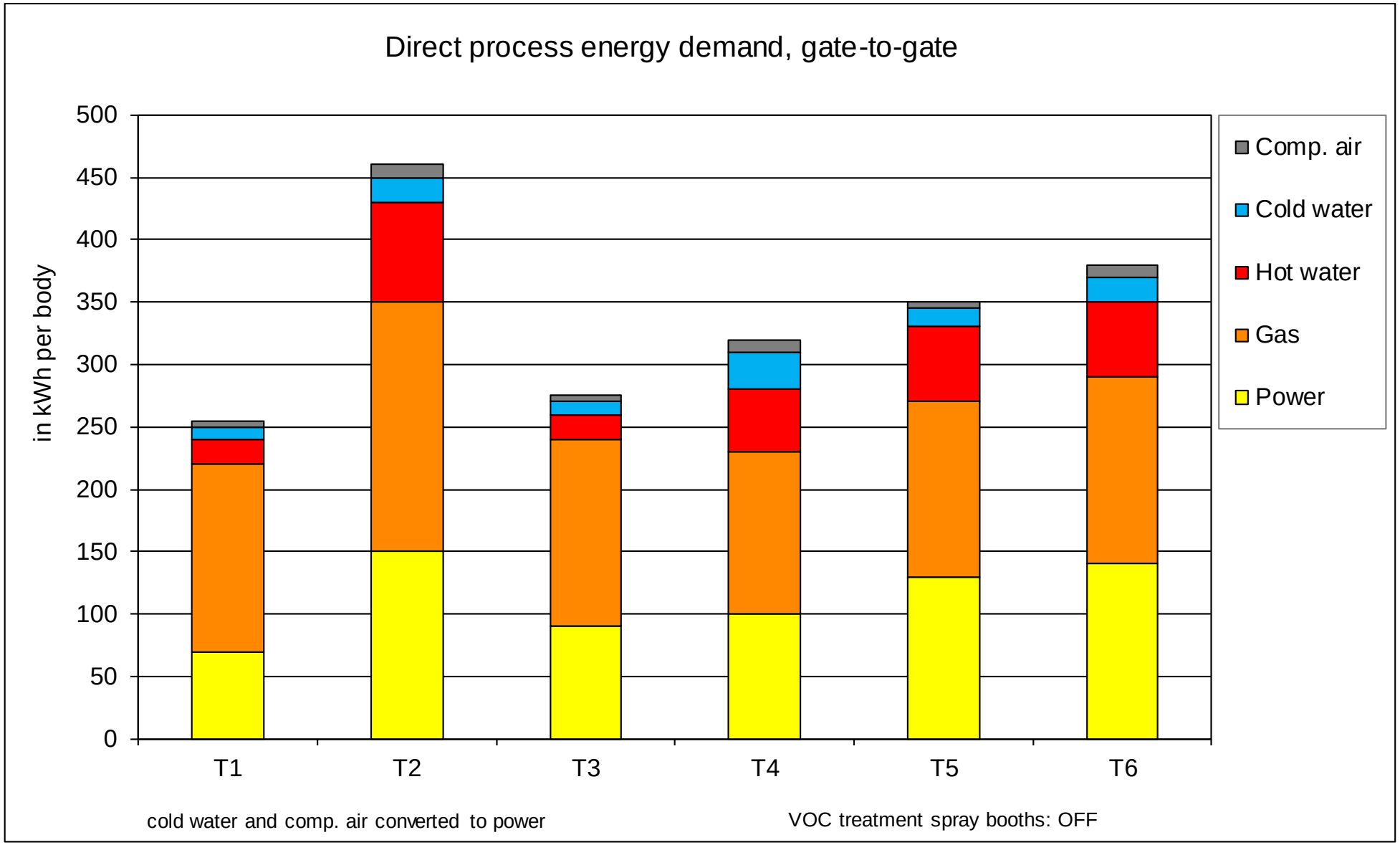
Life Cycle Models

Technical results – lengths of coating lines (only example)



Life Cycle Models

Technical results – energy demand of coating lines (only example)

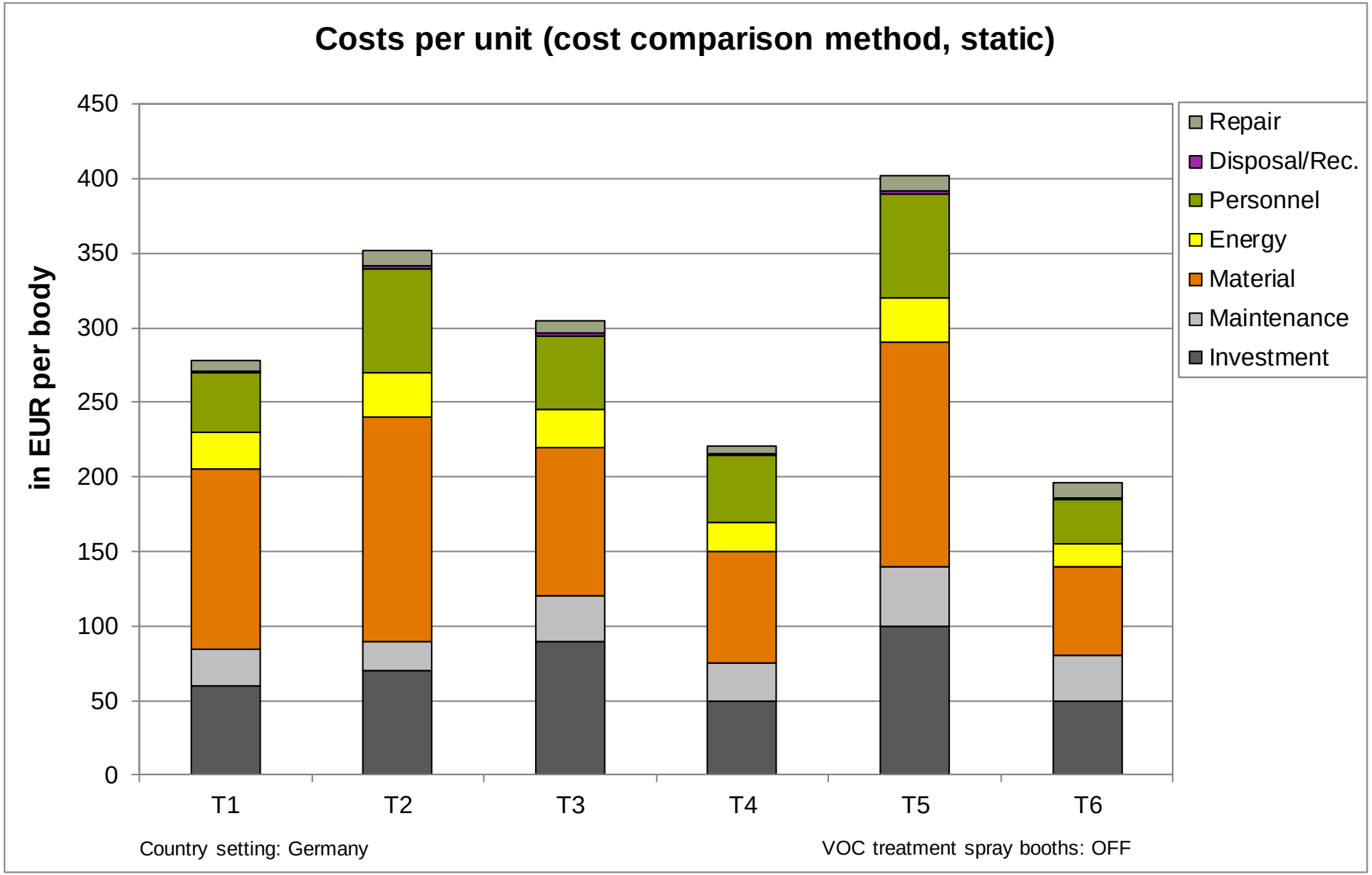


Economic results

- Cost comparison method
- Net present value method

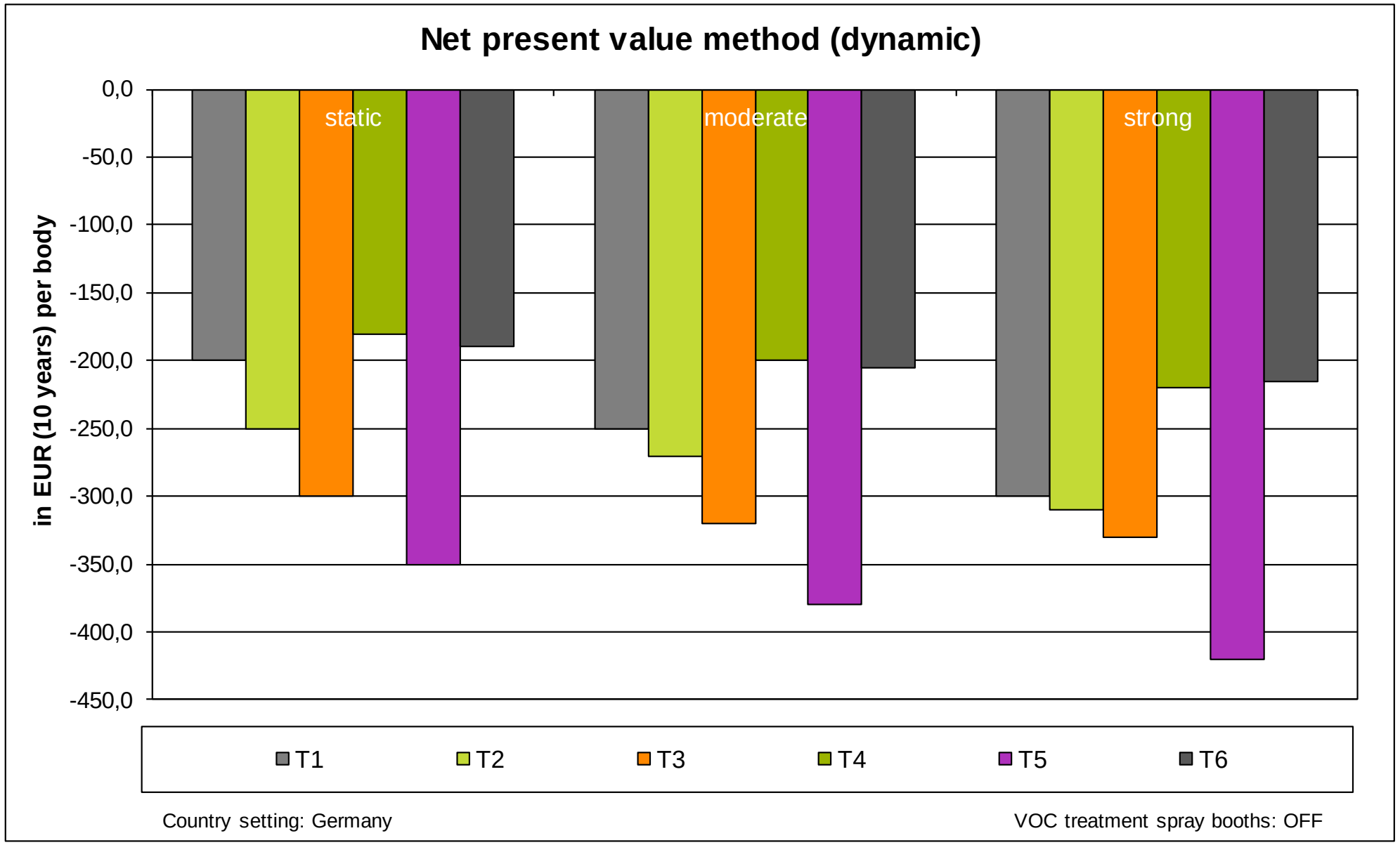
Life Cycle Models

Economic results – (only example)



Life Cycle Models

Economic results – (only example)

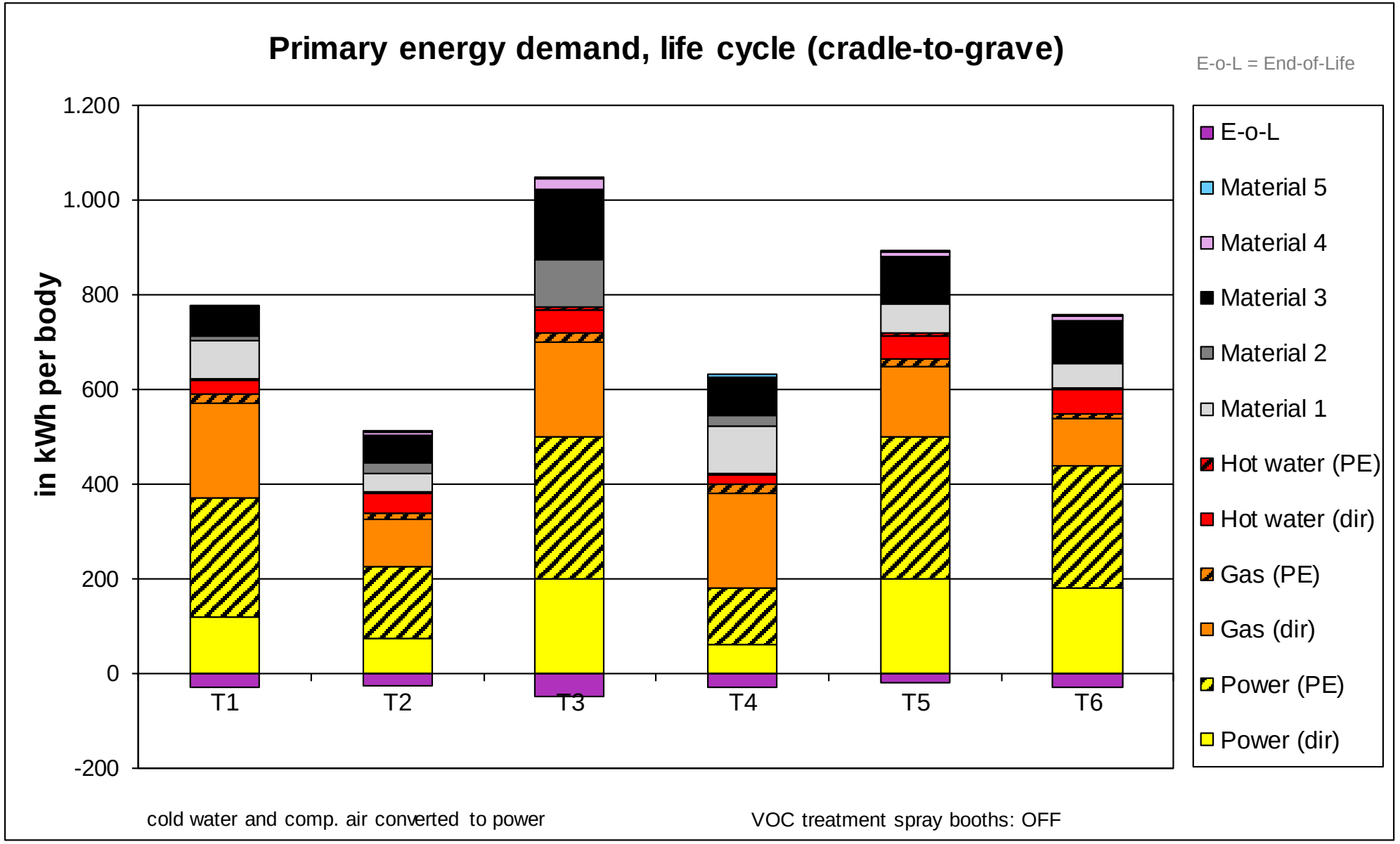


Ecological results (LCA)

- Inventory level
- Impact level
- Normalization
- Visualization

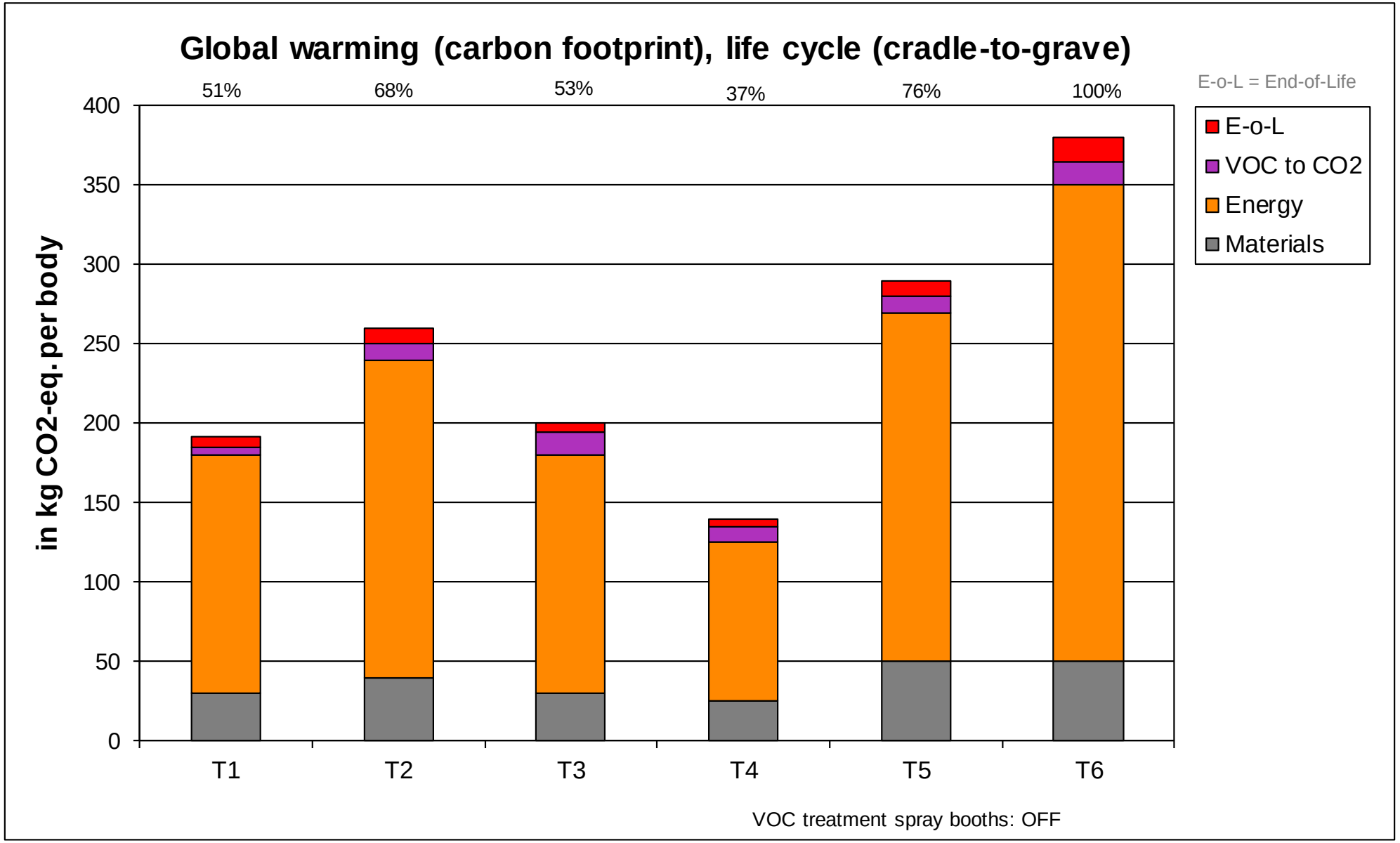
Life Cycle Models

Ecological results – Inventory level (only example)



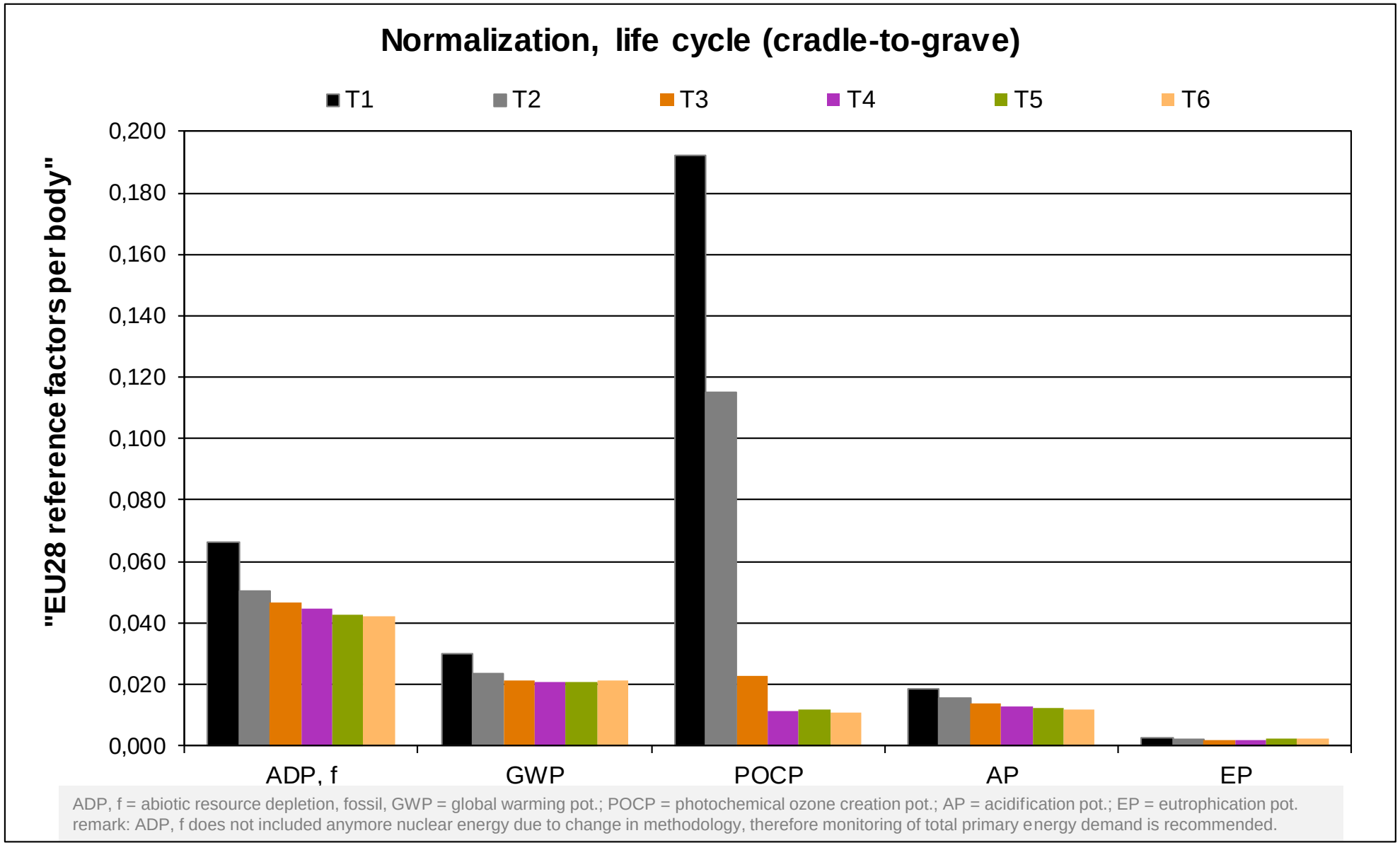
Life Cycle Models

Ecological results – Impact level (only example)



Life Cycle Models

Ecological results – Normalization (only example)



ADP, f = abiotic resource depletion, fossil, GWP = global warming pot.; POCP = photochemical ozone creation pot.; AP = acidification pot.; EP = eutrophication pot.
remark: ADP, f does not included anymore nuclear energy due to change in methodology, therefore monitoring of total primary energy demand is recommended.

Life Cycle Models

Ecological results – Visualization (only example)

Boundary conditions: 20 Mio. car bodies (approx. yearly EU production), 15% renewable energy included

≈ 2,5 Mio. tons crude oil equivalents per year

≈ 45 oil tanker á 56.000 tons net load per year

≈ 6,2 Mio. tons CO_2 equivalents per year

20 Mio. cars drive ≈ 2.600 km at 120g CO_2 per km

≈ 39.000 tons VOCs into exhaust air

≈ 1.500 trucks á 26 tons net load

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