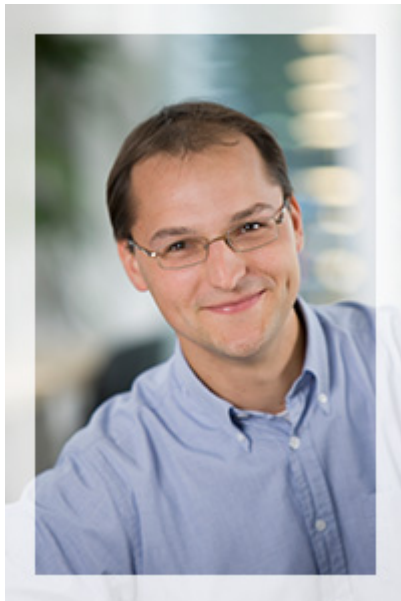


# Multi Sector Model „Energy 2050“

---

Summer School on Modelling in Energy Science  
03.07.2009



Dipl.-Ing. Michael Beer

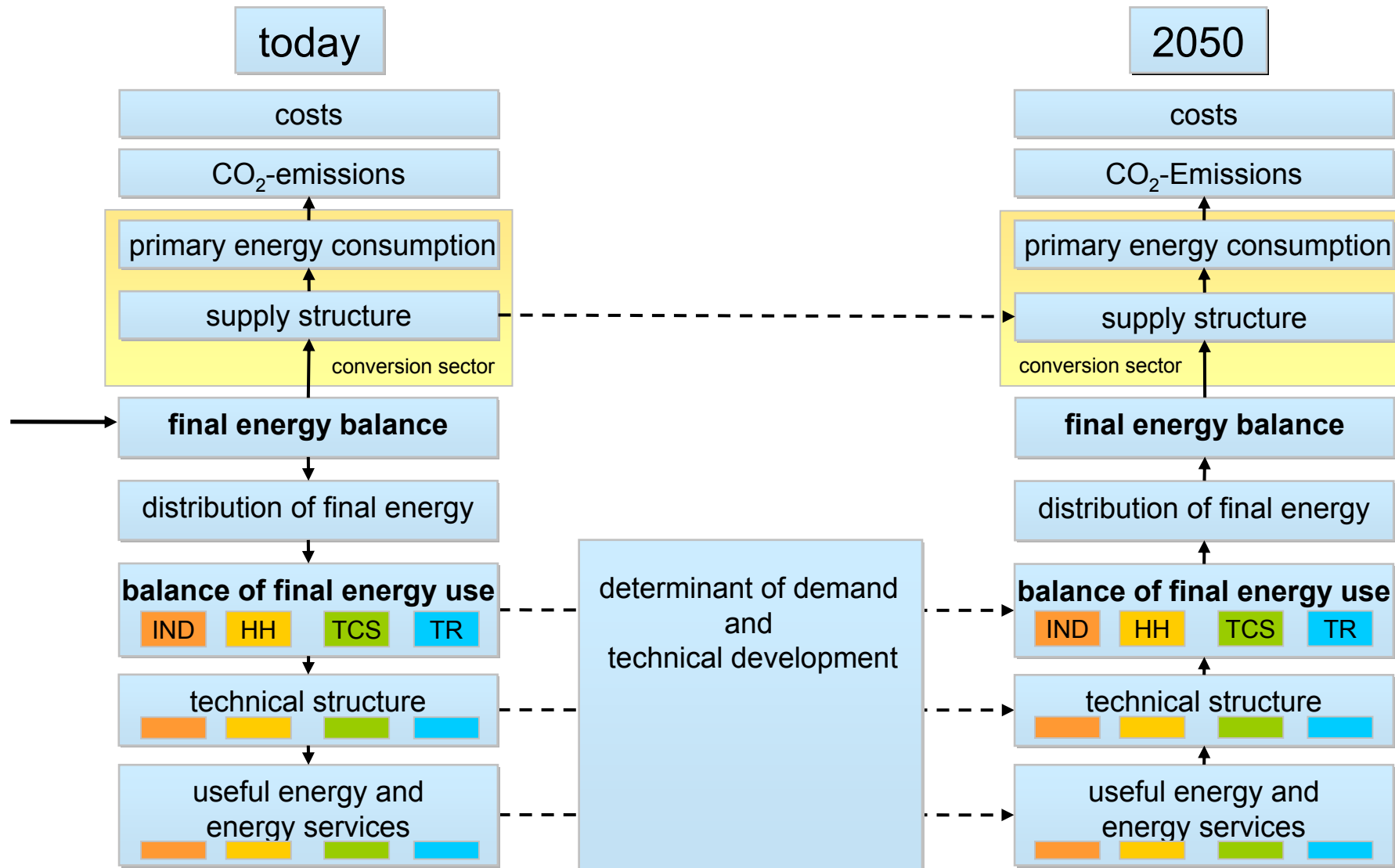
Research Center for Energy Economy  
Am Blütenanger 71  
80995 München  
MBeer@ffe.de

---

## Overview

1. Bottom-up Approach in the Multi Sector Model “Energy 2050”
2. Example: Energy Consumption in Industry
3. Example: Heating Systems in Households
4. Scenarios and Results for “Energy 2050”
5. Summary and Conclusion

# The Project "Energy 2050"



IND: industry  
 HH: households  
 CS: conversion sector  
 TCS: trade, commerce and services  
 TR: transport

# Methodology for Recording the Present Situation in Industry

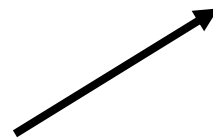
## Sources:

- Statistical Offices
- Organisations
- Working Groups
- FfE-studies
- Further literature

Final energy consumption



Customer generation (electricity and heat from CHP)



Index of production



Production output



Specific energy use for production processes



## Top-Down

final energy consumption of selected industrial sectors



## calibration

validation

determination of basic energy consumption

→ **specific consumption**

→ **overall production**

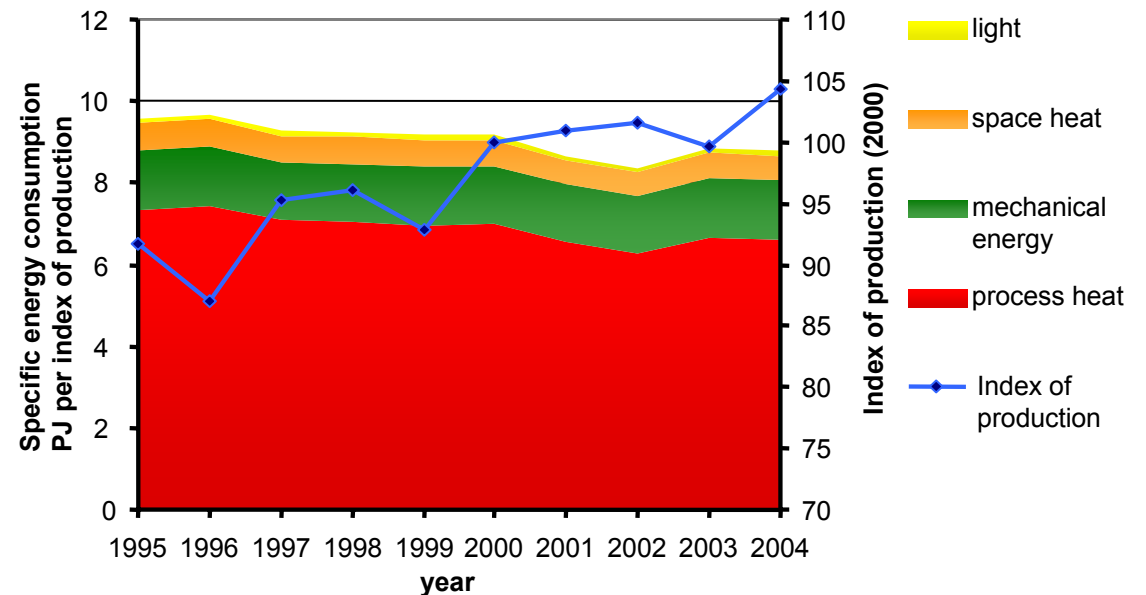
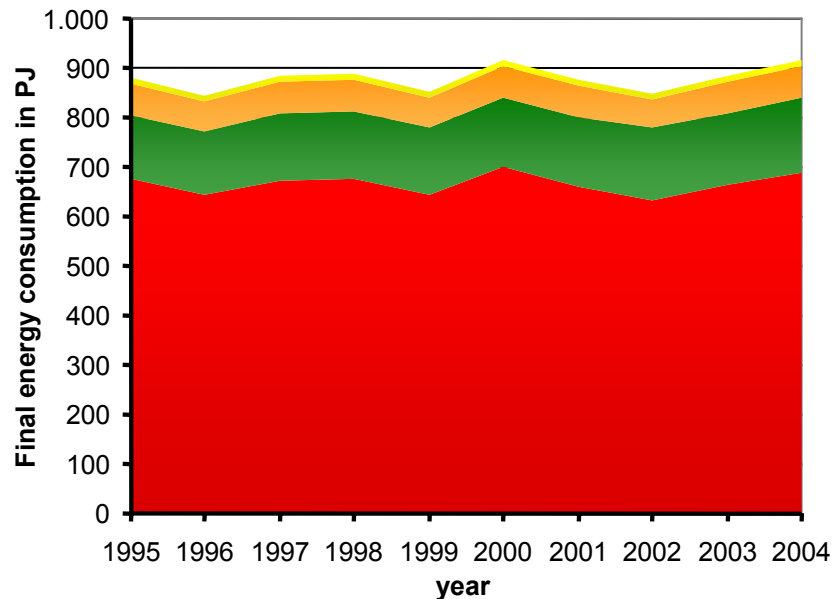


## Bottom-Up

final energy consumption of selected industrial sectors

# Top-Down: Final Energy Consumption in Industrial Sectors

Final energy consumption by mode of energy use: example WZ DE 27: Metal Industry



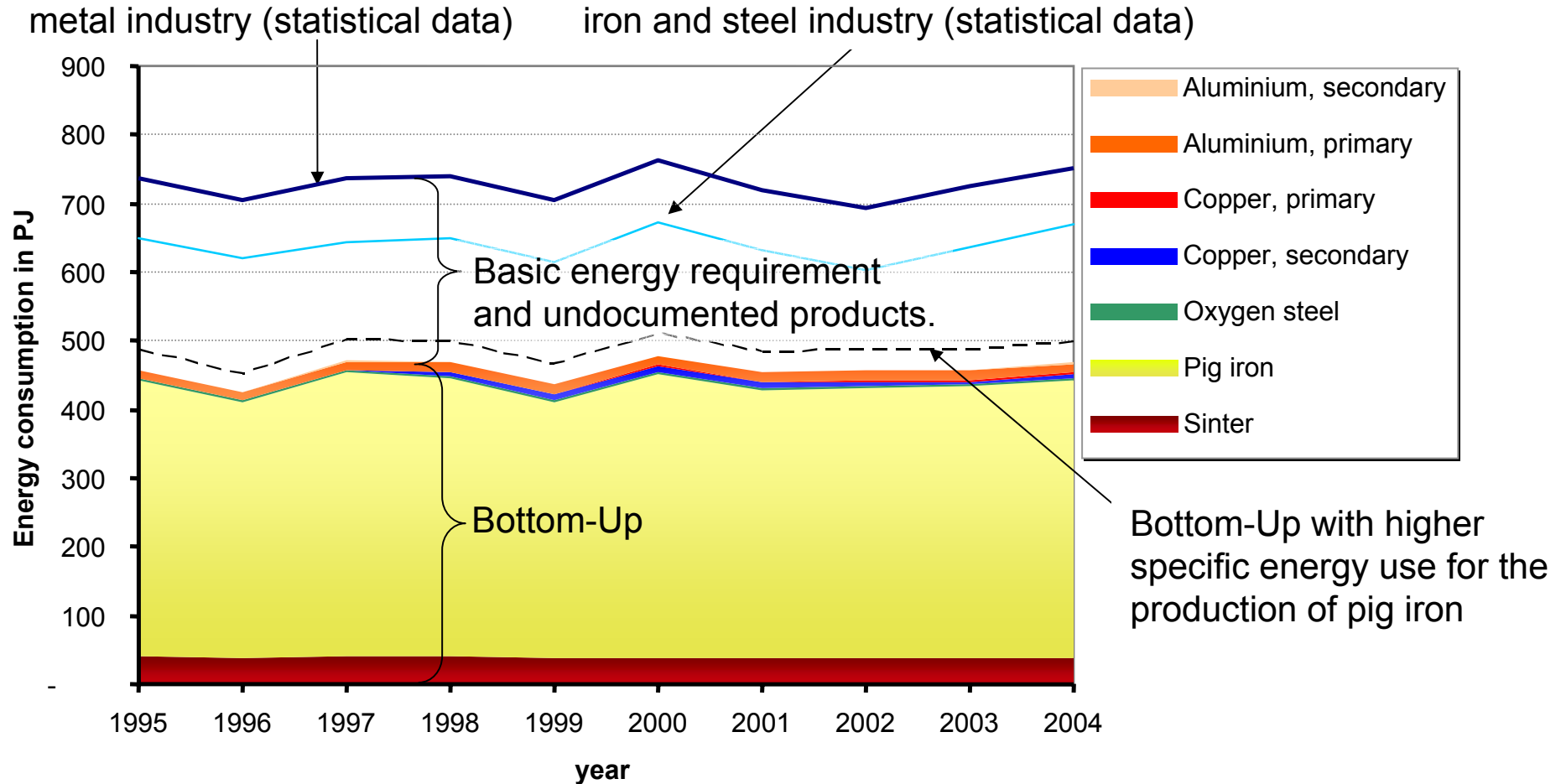
Corrected final energy consumption, taking into account all the sources available and different data collections.

Specific energy consumption including the index of production shows a more even trend.

sources: Stat. Bundesamt Fachreihe 4.1.1, 2004,  
Stat. Jahrbuch der Metallindustrie 2005,  
AG Energiebilanzen 2003 und eigene Berechnungen

# Statistical Comparison: Top-Down ↔ Bottom-Up

example: use of fuel in metal industry



This comparison can be used for validating the specific energy consumption for production processes.

# Methodology for Deriving Future Energy Use

## Production

- Production output
- Index of production

projection

source:  
ifo-institute

source:  
FfE-studies

source:  
organisations

projection

## Specific energy consumption

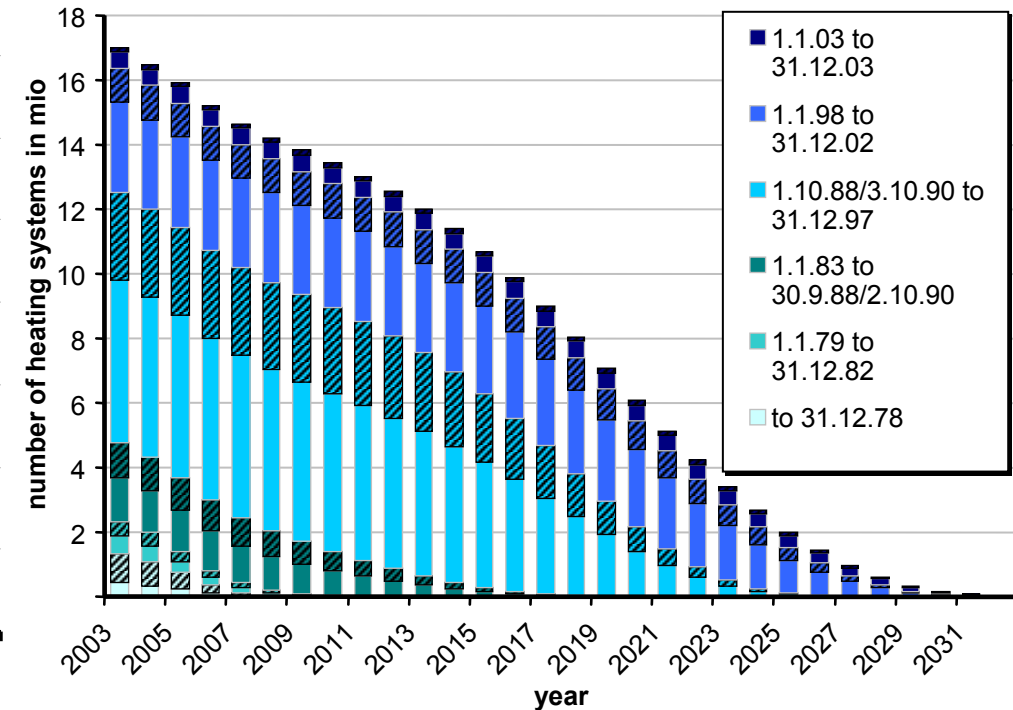
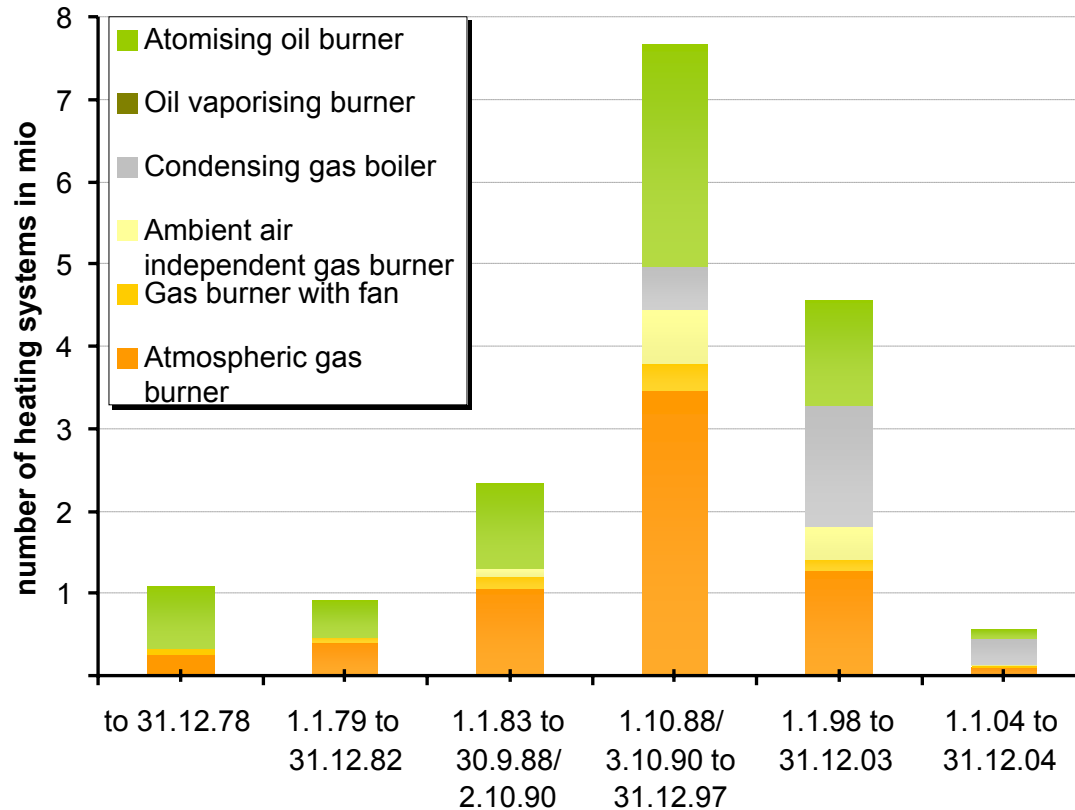
- Substitution of energy carriers
- Increase of efficiency

**Future final energy consumption**  
for different industrial branches<sup>\*)</sup> in mode of

- energy carrier and
- final energy use

<sup>\*)</sup> depending on their level of energy consumption

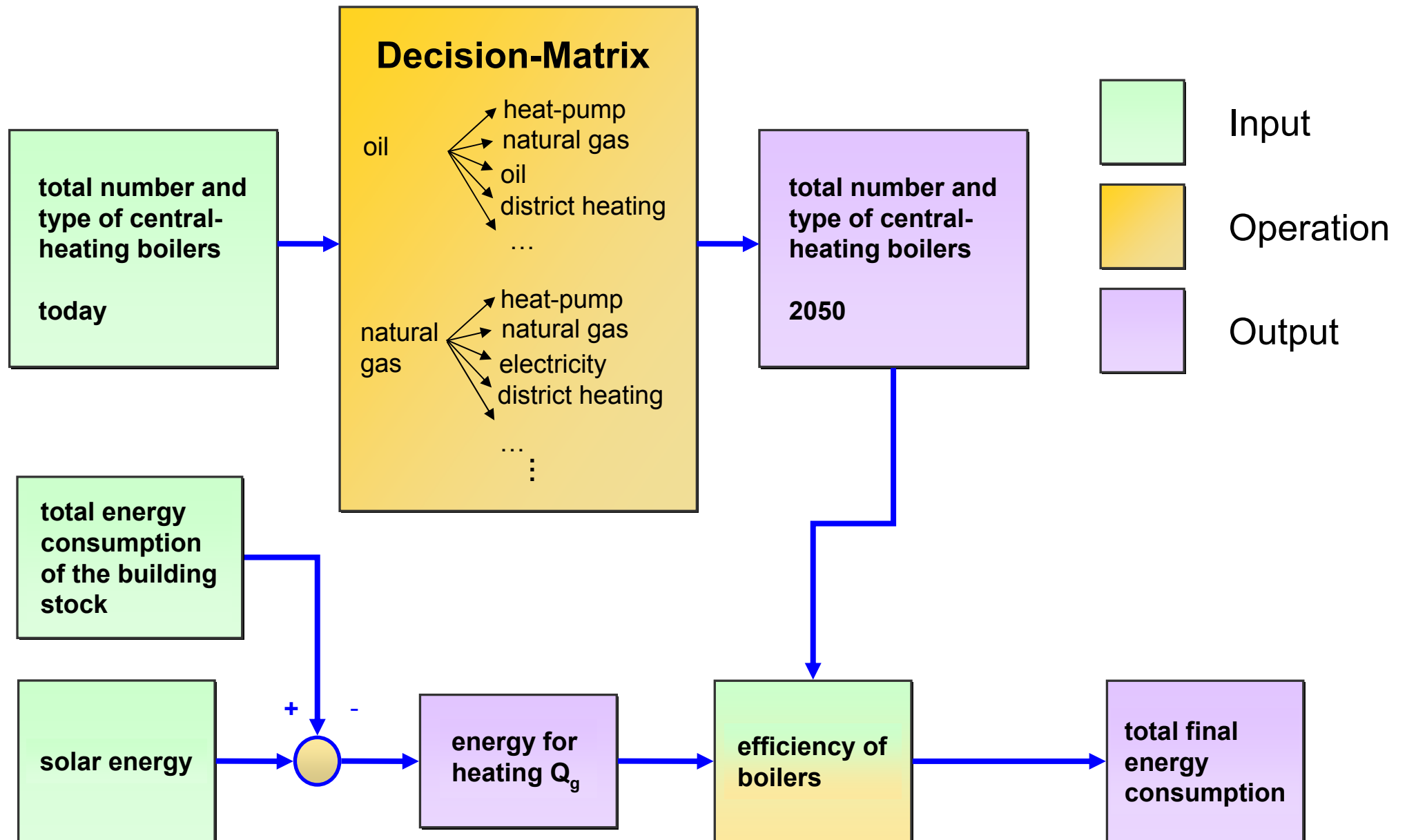
# Closing Down of Heating Systems in Households



- Statistical data of chimney sweepers represents today's situation.
- Probabilistic methods were used to calculate the shutdown time of the boilers.
- All present heating systems will be replaced by 2030.
- All boilers built until 2020 will be shut down by 2050.



# Decision-Matrix as a Method for Forward Projection



# Example for a Decision Matrix

Existing gas boiler	
Alternative	Chance of change
Pellets wood	7 %
Boiler oil	1 %
Boiler natural gas	75 %
Solar heat	0 %
Heat-pump	7 %
Electric heating	0 %
District heating	2 %
Local heat	6 %
Micro CHP	3 %

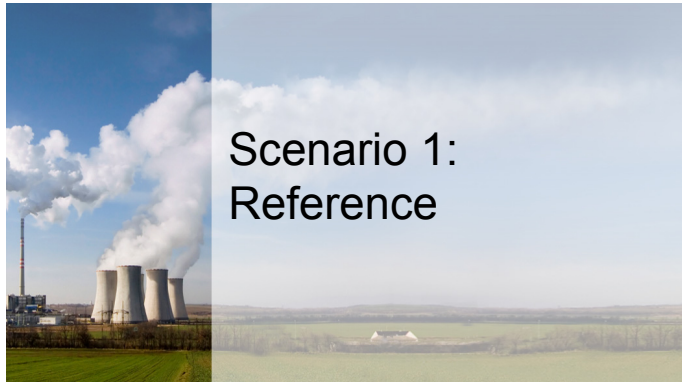


aboutpixel.de / Heizkosten © Andreas Morlok

The decision depends on:

- economic factors
- political conditions
- ecological objectives
- personal attitudes

# Basic Features of the Scenarios



Scenario 1:  
Reference



Scenario 2:  
Higher efficiency



Scenario 3:  
Positive development

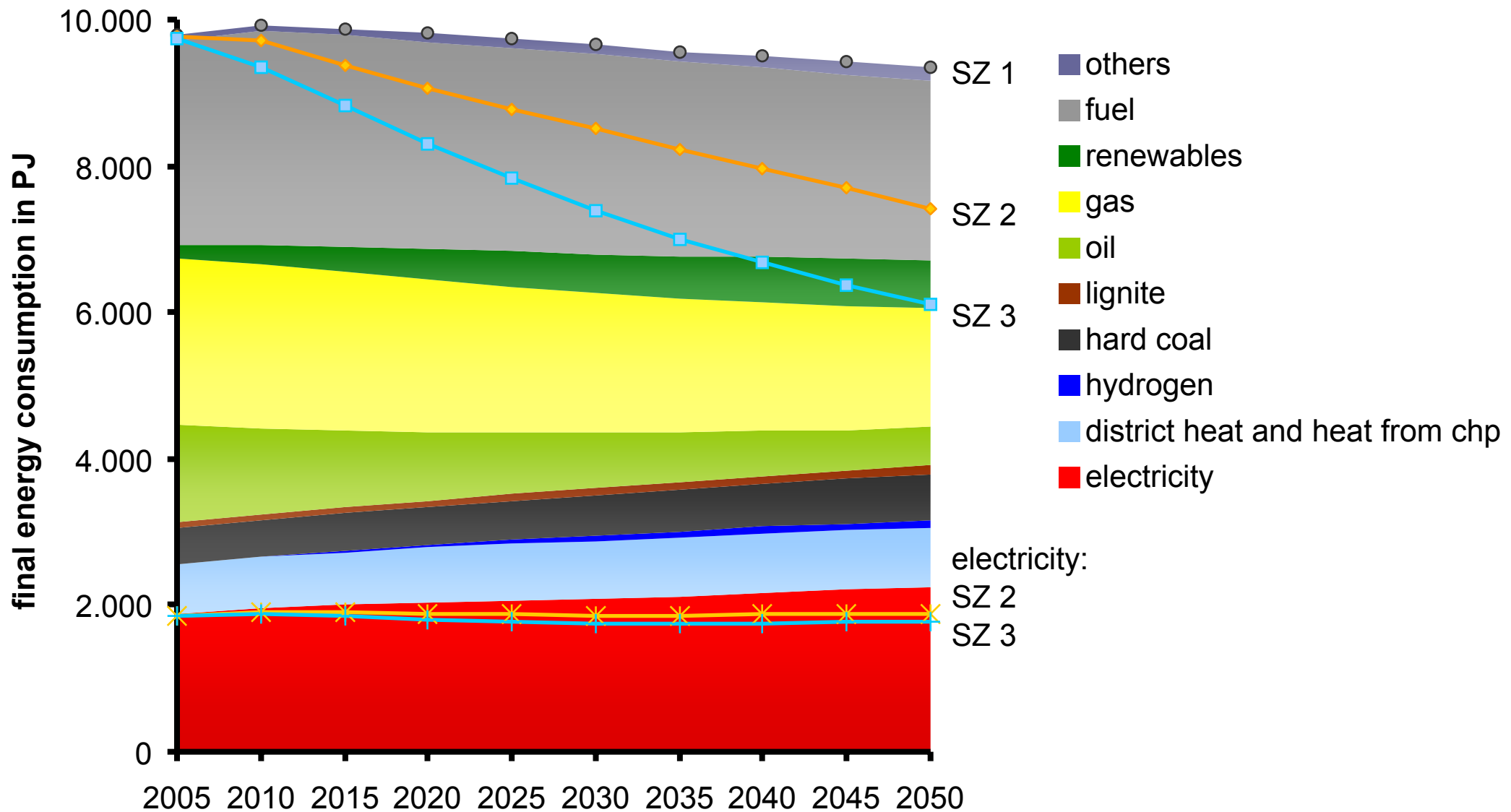
Socio-economic parameters used for forward projection:

- Population development and structure
- Number of employees in trade, commerce and services
- Trend of gross domestic product and indices of production
- Number and structure of residential buildings
- Volume of freight and passenger traffic
- Prices of energy carriers and CO<sub>2</sub>-Certificates

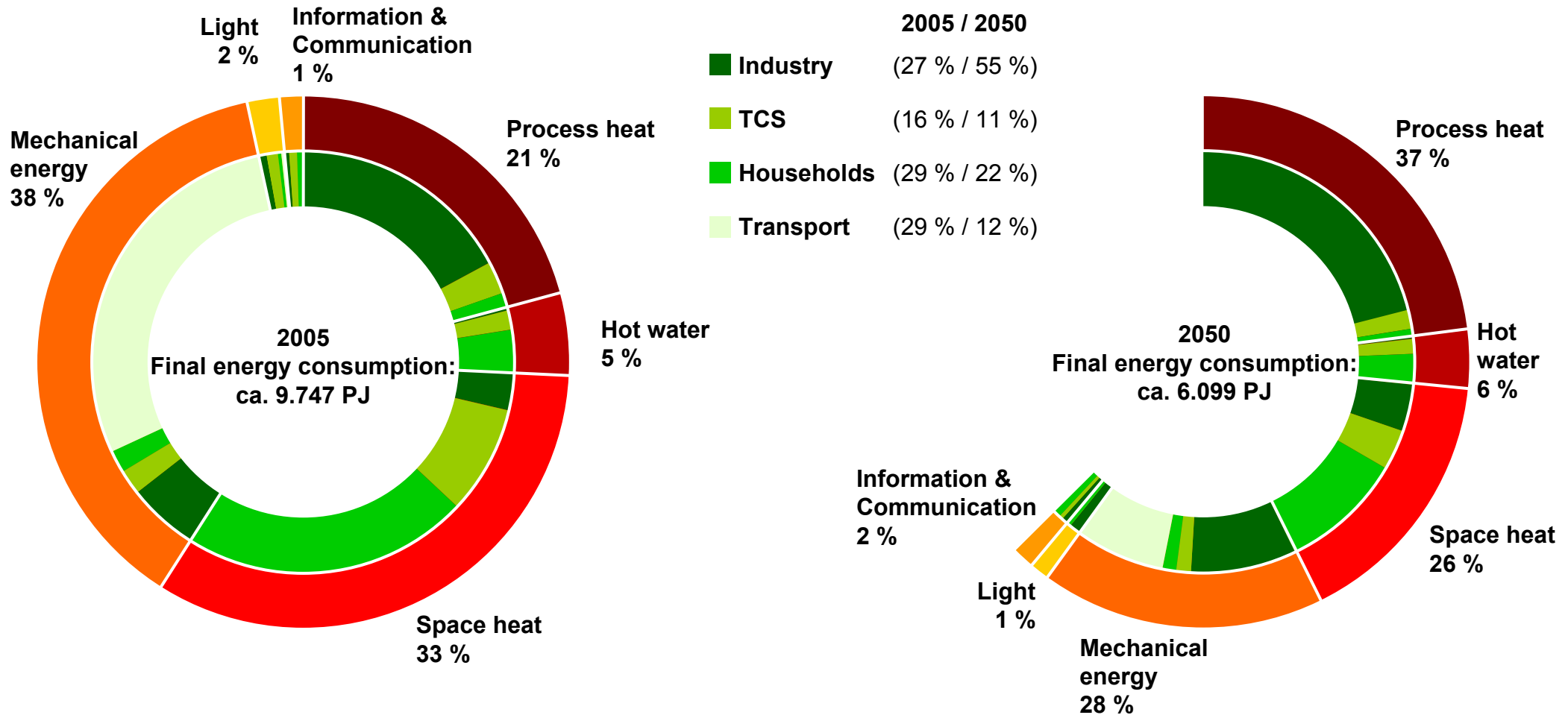
Technical parameters used for forward projection:

- Efficiency of Technologies
- Number of different technologies in the stock
- Specific energy consumption

# Results – Final Energy Consumption



# Scenario 3 – Final Energy Consumption by Mode of Use



- Transport sector: biggest reduction due to changes in consumer behaviour.
- Industry: consumer behaviour has almost no effect on energy consumption.
- The total final energy consumption decreases by 37 % in this scenario.

# Summary and Conclusion

---

- Multiple methods are used for the multi sector model “Energy 2050”.
- A huge amount of information is needed for building up scenarios:
  - Statistical data, objective and quantifiable parameters,
  - but also qualitative parameters and “soft” factors.
- The scale and the quality of the results depends on
  - the detail level of the input data,
  - the models and methods used.
- Households have a big energy saving potential in their heating systems.
- In Trade, Commerce and Services the part of Information and Communication will play an increasing role.
- Industrial energy consumption mainly depends on the economic development.
- In the Transport sector electro mobility helps to increase the efficiency.

---

**Thank you very much for your attention!**

Dipl.-Ing. Michael Beer

Research Center for Energy Economy  
Am Blütenanger 71  
80995 München  
MBeer@ffe.de

Please visit us at: [www.ffe.de](http://www.ffe.de)