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Energy Efficiency Benchmark for Industrial SME

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Introduction

- energy turnaround in Germany until 2020/2050
- goal: reduction of greenhouse gas emission
- energy effiency benchmark for a high level monitoring
- offer results to single industrial small or medium sized enterprises (SME)
- compares energy efficiency and its development over time

Input Data and Indicators

- specific electricity consumption P_{spec}, specific final energy consumption E_{spec}
- gross value added G_i,number of employees N_i,tot. revenue T_i of company i
- different types of energy: cole, fuel oil, natural gas, renewable energies, electricity, distract heat, other energies
- (cumulative energy E_i | fuel F_i | electricity P_i) consumption, carbon dioxide emission D_i of company i

Energy Efficiency Benchmark

- twelve company indicators for company i ($J \in \{E, F, P, D\}$ and $K \in \{G, N, T\}$)

$$I_i^{JK} = J_i / K_i$$

- twelve sector indicators for company i $s(i)$ correspon. industrial sector, $C_{s(i)}$ set of companies

$$S_i^{JK} = \frac{1}{|C_{s(i)}|} \sum_{j \in C_{s(i)}} I_j^{JK}$$

- twelve ratio indicators for company i

$$R_i^{JK} = I_i^{JK} / S_i^{JK}$$

	Greenhouse gas emission (base 1990)	Renewable energies: Gross final energy	Renewable energies: Electricity generation	Reduction energy demand: Primary energy	Reduction energy demand: Building heat	Reduction energy demand: Final energy traffic	Reduction energy demand: Electricity	Nuclear energy
2011 2015 2017 2019								- 41 % - 47 % - 54 % - 60 %
2020	- 40 %	18 %	35 %	- 20 %	- 20 %	- 10 %	- 10 %	
2021 2022								- 80 % - 100 %
2030 2040	- 55 % - 70 %	30 % 45 %	50 % 65 %					
2050	- 80 to -95 %	60 %	80 %	- 50 %	- 80 %	- 40 %	- 25 %	

Fig. 1. Politicial goals of the energy concept 2010/2011 (Source: German Federal Parliament, own calculations)

- company performs better compared to average of the industrial sector

$$I_i^{JK} \leq S_i^{JK}, 0 \leq R_i^{JK} \leq 1$$

- company performs worse then the industrial sector

$$I_i^{JK} > S_i^{JK}, R_i^{JK} > 1$$

- no data means no result

$$R_i^{JK} \text{ undefined, if } S_i^{JK} = 0$$

Suggested Incentive System

- inform industrial, business and trade associations
- reward development by incentives in a financial way
  (C1): the company is on an energy efficiency indicator level which is above average
  (C2): the company has improved its energy efficiency indicators better than the average of its sector
- (C1) motivates further development to hold advance compared to most other companies
- (C1) but production-related & territorial differences influence value
- better: (C2) focuses on the rate of change, it motivates further improvement in a more direct way
- (C2) if improvement takes place faster, this is rewarded, especially for companies who are not at the upper boundary of achievable efficiency

Example Case Study

average energy consumption of iron foundries in Germany (2010)

Energy source	Value in %
cole	38.3
fuel oil	0.0
natural gas	18.4
renewable energies	0.0
electricity	43.0
district heat	0.4
other energies	0.0

- according to Tab. 3, in almost all categories the company is worse compared to the average in the industrial sector

energy consumption of the iron foundry under investigation (2010)

Data item	Value 2010	Unit	Distribution
gross value added	1.359.000	EUR	-
number of employees	32	-	-
total revenue	4.736.000	EUR	-
cole	464	t	44.0 %
fuel oil	0	t	0.0
natural gas	1.935.621	kWh	22.0 %
renewable energies	0	GJ	0.0 %
electricity	2.991.280	kWh	34.0 %
district heat K_μ	0	kWh	0.0 %
other energies K_μ	0	GJ	0.0 %

Values of I_i^{JK} (Tab.1)

Normal.	E_i	F_i	P_i	D_i
G_i	23.28	15.37	2.201.09	2.484.88
N_i	988.83	652.58	93,477.50	105.529.66
T_i	6.68	4.41	631.60	713.04

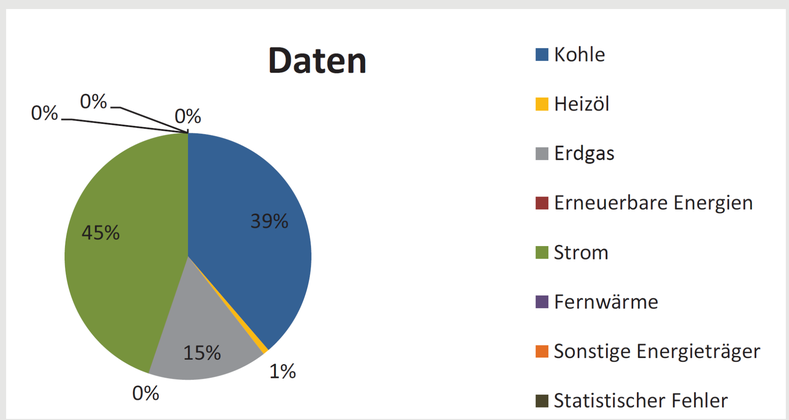
Values of S_i^{JK} (Tab.2)

Normal.	E_i	F_i	P_i	D_i
G_i	15.83	9.03	1.890.86	1.816.34
N_i	825.57	470.91	98.596.27	94.710.28
T_i	5.03	2.87	601.05	577.36

Values of R_i^{JK} (Tab.3)

Normal.	E_i	F_i	P_i	D_i
G_i	1.47	1.70	1.16	1.37
N_i	1.20	1.39	0.95	1.11
T_i	1.33	1.54	1.05	1.23

Implementation



- Prototype web application
- http://www.energieeffizienz-benchmark.de/
- Generate pdf-report

References

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