

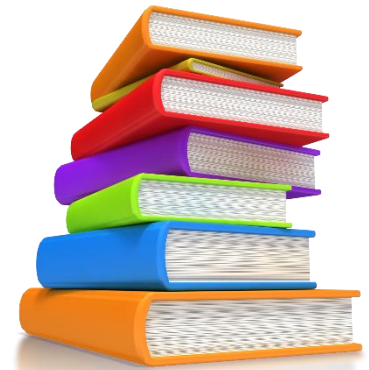
Energy metering and management practices of manufacturing companies

A systematic literature review

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Overview



Introduction



Research method



Results



Discussion



Conclusion

Motivation (bigger picture)

Focus

- Accuracy of cost accounting systems
- Activity-Based Costing (ABC) and energy management
- **Energy costing errors**

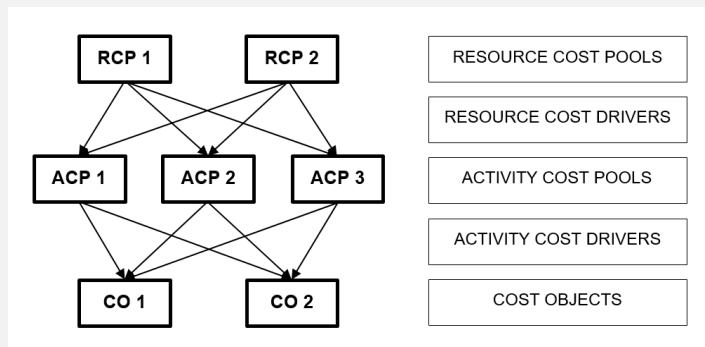
Example

- Information about consumption pattern doesn't capture price variation of energy during the day



Objective

To know under which conditions even coarse methods already provide quite accurate information on energy costs, and under which other conditions more refined methods provide significantly more accurate information.



Introduction of today's paper

- Energy measurement and management practices in manufacturing companies with emphasis on empirical data on a company level
- Energy intensity: energy intensive and non-energy intensive companies
- Size of company: large companies and small and medium sized enterprises (SMEs)
- What does it mean to have correct information about energy consumption for a company?
- Errors in costing systems may cause distortions in decision making
- It provides necessary information for energy management, such as information needed for improving energy efficiency, evaluating the financial benefits and costs of energy efficiency improvement investments, and holding managers accountable for energy efficiency.

Research questions

1. How are companies measuring energy costs and what are their energy management practices?
2. What are the other common characteristics of these companies?
3. How are companies allocating energy costs?
4. What are energy strategies of companies in selected papers?

Included:

- Energy management
- Energy metering
- Empirical data
- Company level

Excluded:

- Statistical analysis
- Theoretical studies
- Technical work
- Sector or industry level

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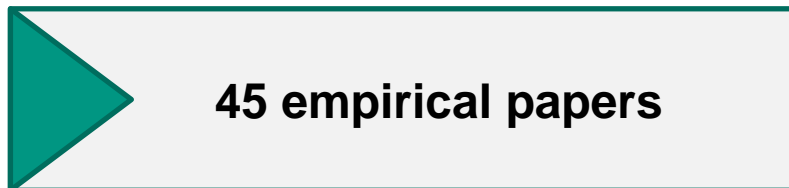
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The research approach

- Systematic literature analysis*
- Search terms included “energy measur*”, “energy management” and “energy metering” in the title, and term “industry” in the title, abstract or keywords of a paper
- Scopus database + Google Scholar
- Backward and forward citation analysis
- Further search with journals and names of authors
- 19 journals in the field of management accounting and energy



45 empirical papers

* following Tranfield, Denyer, and Smart (2003)

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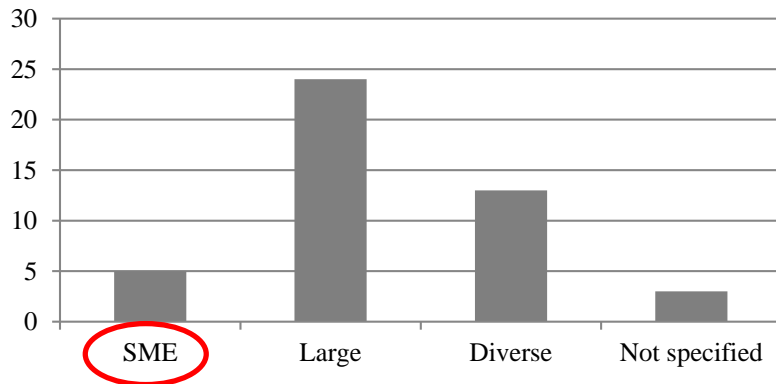
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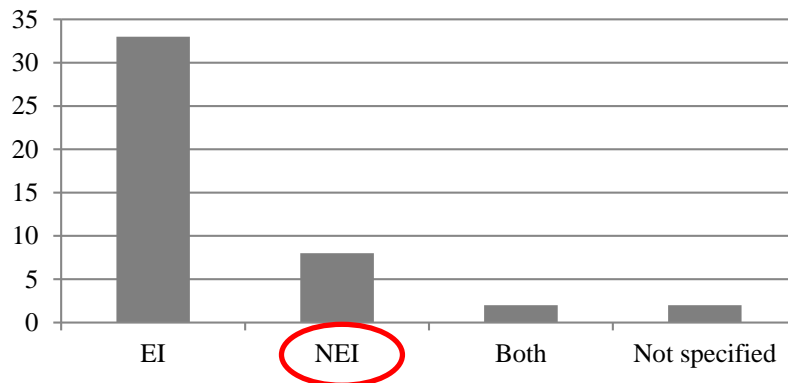
Results

Distribution of the studies by the company size



53% large companies
10% small and medium sized enterprises (SMEs)

Energy intensity levels



73.3% energy intensive companies
17.8% non-energy intensive companies

Results

■ Energy metering

- Non-energy intensive companies mostly meter energy only on facility level and use utility invoices
- Energy intensive companies often use sub-metering on department or production level

■ Allocation of energy costs

- Sub-metering, per product, department, meter square or per number of employees
- 13.3% address allocation of energy costs to departments at all
- Split incentive problem
- Only one paper addresses second stage allocation

■ Energy strategy

- Far less non-energy intensive companies have clearly formulated and long term energy strategies than energy intensive companies

Results

■ Investment criteria

- Strict investment criteria and short payback times are often applied in large companies
- In medium sized enterprises the investment criteria is less formalized

■ Energy audit

- While many energy intensive companies conduct energy audits, in non-energy intensive companies it is not so widely used
- In the few examples of non-energy intensive companies doing energy audit, we can see that the results in terms of savings are notable

To sum up

Focus:

73.3% of the papers focus on metering and energy management practices in energy intensive companies.

Only 17.8% of the papers focus on non-energy intensive companies.

Characteristics:

Non-energy intensive companies monitor and measure energy usage to a small extent.

Energy intensive companies do it precisely and in much more detail.

Allocation:

13.3% of the papers reviewed address allocation of energy costs to departments.

Only one paper addresses second stage allocation.

Strategy:

Far less non-energy intensive companies have clearly formulated and long term energy strategies than energy intensive companies.

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Discussion

- Is it worth investing in energy metering and energy efficiency improvements in non-energy intensive companies?
- Non-energy intensive companies monitor and measure energy usage to a small extent, and even when the energy audits are made, they rarely lead to investments in energy conservations, because it is considered to be more profitable to do nothing.
- Why don't they pay more attention to energy efficiency?
- They don't have a dedicated person for energy issues, small energy saving potential or underestimating potential, they perceive energy as part of overhead costs that cannot be managed, etc.
- Split incentive problem - department managers could be less motivated to save energy if department's costs are allocated based on imprecise measures (as per square meter or per number of employees), instead on actual energy consumption.

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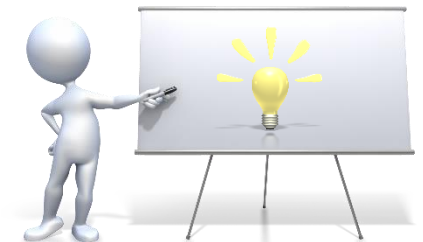
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Conclusion

- Under-researched area
- Room for more detailed case studies
- Literature focuses on energy intensive and large companies
- Measurement methods vary from inefficient measurement methods to detailed sub-metering in real time
- Cost saving potential is left unexploited



What do you think of it?



BACKUP

Keywords

- With manufacturing
- 636 papers = 580 articles + 56 reviews

((TITLE (energy measur*) OR TITLE (energy management) OR TITLE (energy metering) AND (TITLE-ABS-KEY (industry) OR TITLE-ABS-KEY (manufacturing)) AND DOCTYPE (ar OR re) AND PUBYEAR > 1994) AND (LIMIT-TO (LANGUAGE, "English"))

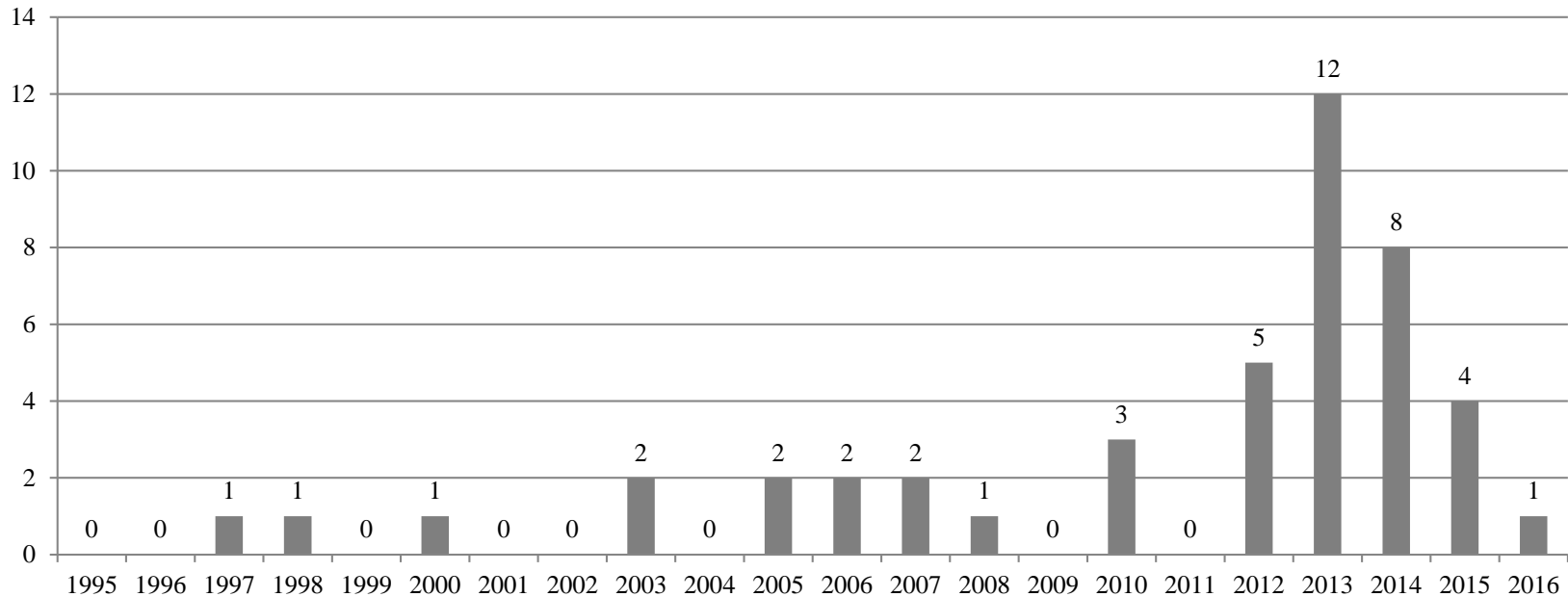
- Without manufacturing
- 565 papers = 511 articles + 54 reviews

((TITLE (energy measur*) OR TITLE (energy management) OR TITLE (energy metering) AND TITLE-ABS-KEY (industry)) AND DOCTYPE (ar OR re) AND PUBYEAR > 1994) AND (LIMIT-TO (LANGUAGE , "English"))

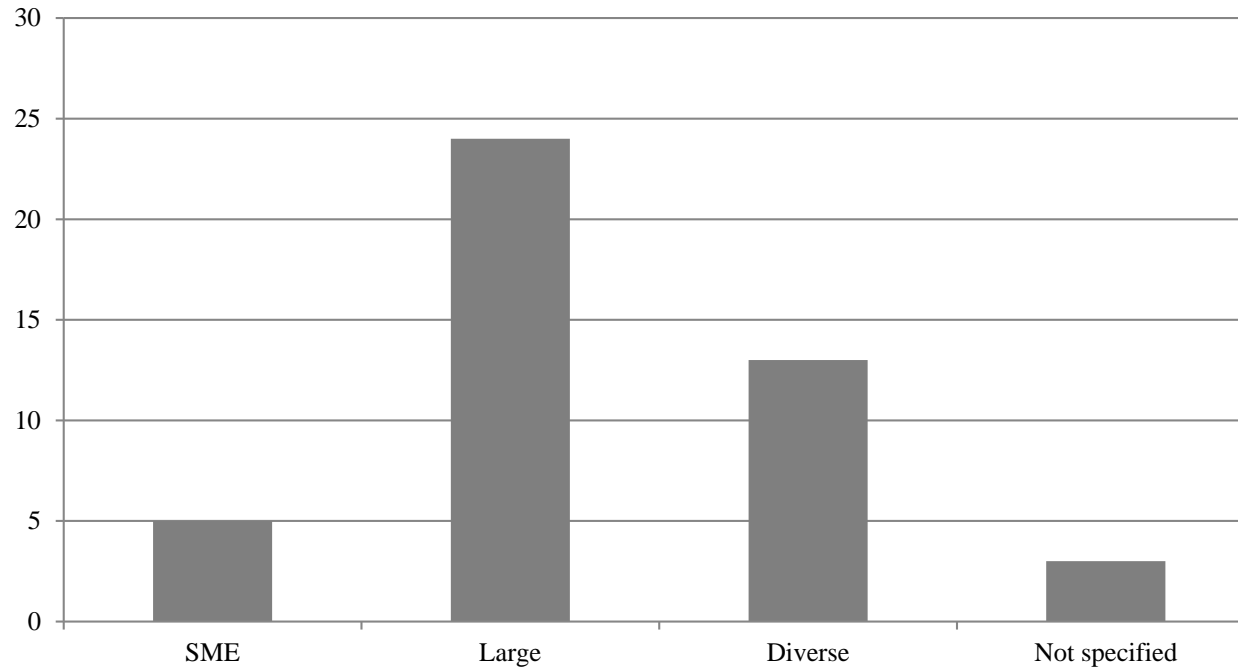
List of journals

Journal	
Applied Energy	7
Applied Thermal Engineering	1
Chemical Engineering and Processing: Process Intensification	1
Energy	5
Energy Conversion and Management	2
Energy Efficiency	2
Energy Engineering	2
Energy Policy	2
Energy Procedia	2
International Energy Journal	1
International Journal of Energy Research	1
International Journal of Scientific & Technology Research	1
Journal of Cleaner Production	10
Journal of Environmental Economics and Management	1
Management Accounting Research	1
Procedia CIRP	1
Production and Operations Management	1
Strategic Planning for Energy and the Environment	3
Sustainable Energy Technologies and Assessments	1
Sum	45

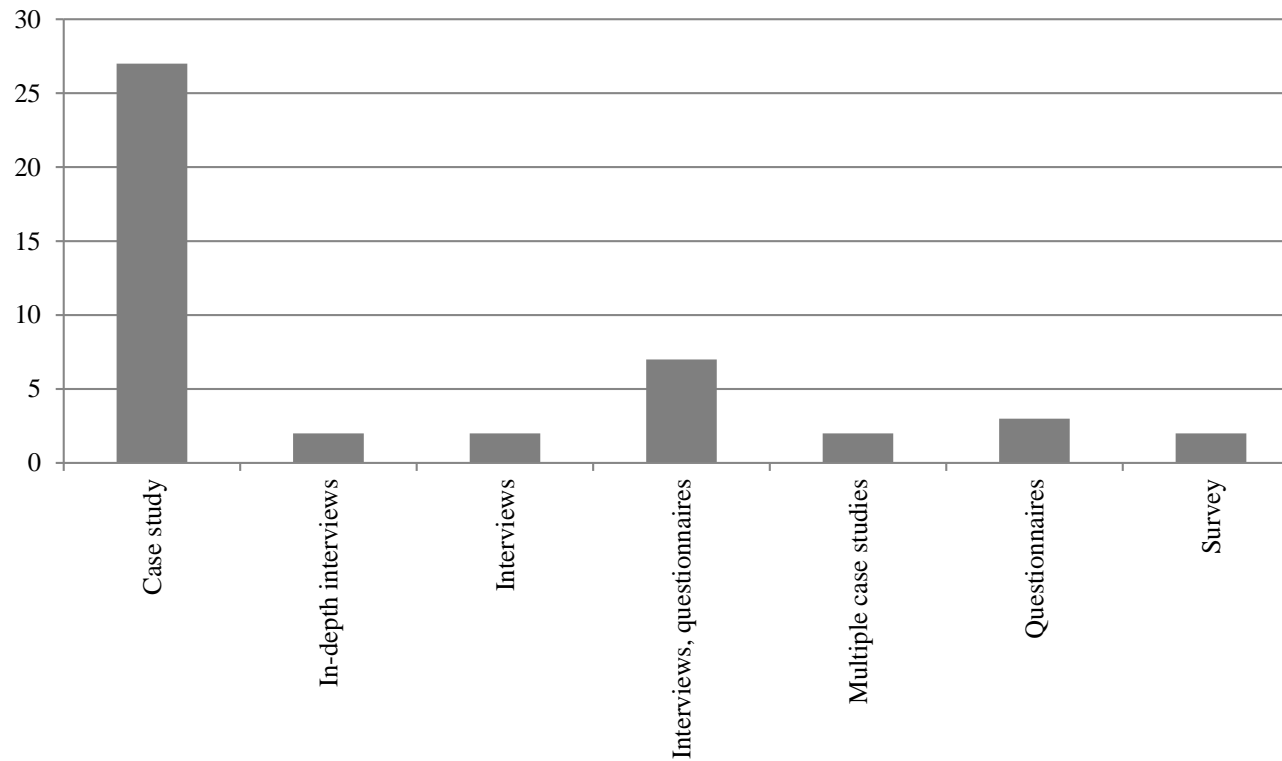
Year of publication



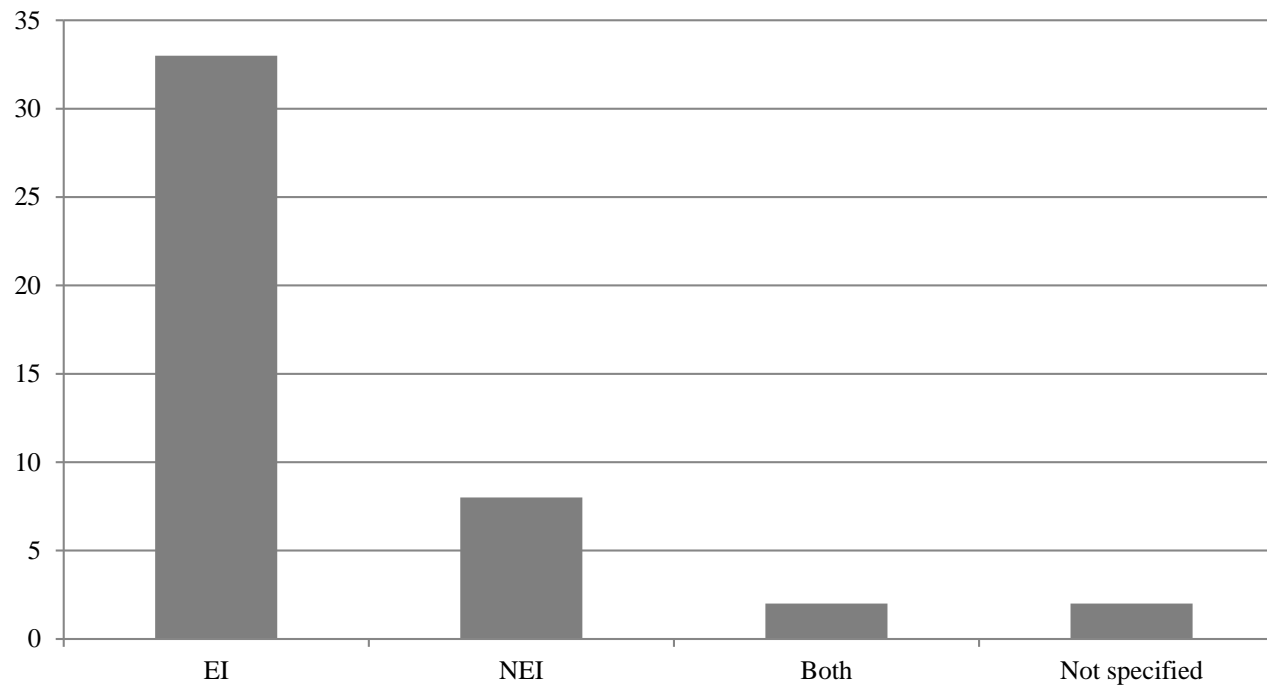
Distribution of the studies by the company size



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Energy intensity levels



Industry sector focus

