Assignment of the Energy Requirement of the Retail Trade to Products

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Abstract
The indirect energy requirement of a product can be significantly affected by the energy requirement of the retail trade. In previous studies this was generally assigned on a financial basis (twice the price results in twice the energy requirement); the financial accounting method. But the energy requirement of the retail trade can also be assigned on a physical basis (twice the amount product (e.g. kg, m^3) results in twice the energy requirement); the physical accounting method. To get an idea of the error made with these methods a detailed energy analysis has been made for two retail branches: clothes shops and shoe shops.
Both methods may give serious errors, 5 to 15 % of the total indirect energy requirement for clothes and shoes if they have a price level deviation from the average price. Unfortunately, neither the physical or the financial accounting method can be indicated as the preferred method.

Introduction

In a previous study we found that the indirect energy requirement of a product can be significantly affected by the energy requirement of the retail trade; for some products the share of the retail trade in the total indirect energy requirement is more than 25%. This energy requirement of the retail trade, calculated according to the method of hybrid energy analysis ([Engelenburg et al., 1994], [Wilting et al., 1994], is generally assigned on a financial basis. This means that if the price of the product doubles, the energy requirement accounted to the retail trade doubles also. This 'financial' way of assigning the energy requirement of the retail trade may result in an overestimation of the energy requirement of the retail trade for more expensive products and in an underestimation for cheaper products in a certain product category.
The energy requirement of the retail trade can also be assigned on a physical basis. In that case the energy requirement of the retail trade is assigned per item, kg or m^3 product and is not affected by the price of the product. This 'physical' accounting method may result in an under-estimation of the energy

requirement of the retail trade for the more expensive products. It may be plausible that more expensive products in a certain product category, with the same weight and size, require more attention of the retailer and more space in the shop.

In this report we give an estimation of the error made by assigning the energy requirement of the retail trade either on a financial and a physical basis. To get an idea of the error made by assigning the energy requirement of the retail trade on a financial basis, we have chosen for a detailed energy analysis of two retail branches: clothes shops and shoe shops.

Clothes

We start with a calculation of the relative energy requirement of the retail trade per item and per financial unit. Next we discuss the error made by assigning the energy requirement of the outer clothing retail trade branch on either a financial and a physical basis.
In this section we assume that both direct and indirect energy requirement of clothes shops are proportional to the area of the shop.

Veldhuizen [1992] gives figures for several types of outer clothing shops; shops with mainly men's clothes, mainly woman's clothes and a mixed collection, all three split up in shops with a low to mid and a mid to high price level[1]. These six shop-types cover 95% of the shops investigated by Veldhuizen [1992]. For the subsequent calculations only a breakdown has been made into shops with a low to mid and a mid to high price level. Veldhuizen [1992] gives also price ranges of ten different articles for clothing (five woman's and five men's clothes) for shops with a low to mid and mid to high price level (see Table 1).

[1] Chain stores like "C&A" and "Peek en Cloppenburg" are examples of shops with a low to mid price level.

	Price level low-mid (Dfl)	mid-high (Dfl)
Ladies		
jackets/blazers	100-250	200-700
dresses	150-400	250-700
skirts	90-200	150-400
blouses	70-150	100-350
haberdashery	70-200	125-500

	Price level low-mid (Dfl)	mid-high (Dfl)
Gentlemen		
jackets/blazers	200-400	300-700
costumes	400-700	600-1100
trousers	99-200	130-350
shirts	49-100	70-150
haberdashery	80-225	130-450

The relative price-difference between the shops with a low to mid and mid to high price level can be derived from these price level ranges.
We calculated a price difference compared to the average price level, by taking an average of the price differences, taking into account the market share, of the ten articles. We took into account that the average price level for the ten articles lies at about one third from the bottom of the given price level ranges [Veldhuizen, 1996]. The results are given in Table 2.

	Price-level low to mid	Price-level average	Price level mid to high
Market share	44%	-	56%
Annual sales per m^2 (Dfl.)	4800	5940	6831
Relative price per item	0.56	1.00	1.35
Relative number of items sold per m^2	1.45	1.00	0.85
Relative energy requirement per item	0.87	1.00	1.10
Relative energy requirement per Dfl.	1.17	1.00	0.87

Table 2 also shows the annual sales per square metre floor for the shops with a low to mid, average and mid to high price level[2]. The relative quantity of sold items per m^2 is calculated by dividing the annual sales per m^2 by the relative price. Also the relative energy requirement per item is calculated by dividing the energy requirement per m^2 (see [3]) by the relative sold items per

[2] Derived from [Veldhuizen, 1992] by weighing the sales per square metre floor by the market share of the shops.

[3] The annual energy costs per square metre for the men's and woman's clothing shops are

m^2. Finally, the relative energy requirement per financial unit is calculated by dividing the relative energy requirement per item by the relative price.
The relative energy requirement calculated this way shows that if the price rises with a factor 1.8, the energy requirement of the retail trade rises with a factor 1.2.

Figure 1 shows the relation between price level and energy requirement, according to the three accounting methods. First: the financial accounting method according to the method of hybrid energy analysis. Second: the physical accounting method which assumes an equal energy requirement per physical unit. Third: the results of the more detailed analysis presented in this report.

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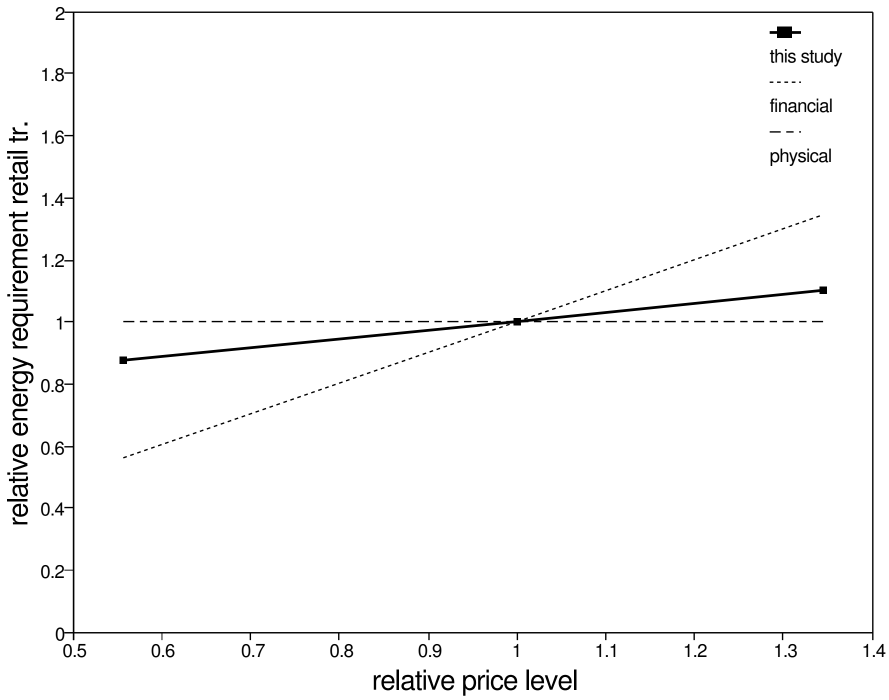
respectively 42 and 41 Dfl/m^2 [CRR, 1993]. The costs per GigaJoule primary energy for the retail trade are 14.31 Dfl/GJ, [Wilting et al., 1995]. The annual direct energy requirement is than 2.9 GJ/m^2.
We assumed an equal energy requirement per square metre for all shops. We also assumed that a rise of the direct energy requirement includes an equal relative rise of the indirect energy requirement (more space results in larger buildings and more use of other materials).



Compared with the most accurate alternative accounting method of the energy requirement of the retail trade, the financial accounting method gives an overestimation for the expensive clothes and an underestimation for the cheaper clothes. The physical accounting method gives an underestimation of the expensive clothes and an overestimation of the cheaper clothes.

We may ask how these deviations caused by the financial accounting method influences the results of the calculations.
Twelve energy analyses according to the method of hybrid energy analysis ([Engelenburg et al., 1994], [Wilting et al., 1994]) made by de Paauw and Perrels [1993] for clothing articles show that between 11 and 24%, with an average of 16%, of the indirect energy requirement for these products is attributed to the retail trade. The systematical error made in the calculation of the indirect energy requirement of clothes by using the financial accounting method is 6% too low for the low to mid price level shops and 4% too high for the mid to high price level shops. The systematical error made in the calculation of the energy requirement by using the physical accounting method is about 2% too high for the low price level shops
and 2% too low for the high price level shops.

Shoes

We start with a calculation of the relative energy requirement of the retail trade per item and per financial unit. Next we discuss the error made by assigning the energy requirement of the shoe retail trade branch on either a financial and a physical basis. We assume that both direct and indirect energy requirement of shoe shops are proportional to the area of the shop.

Table 3 shows average price levels for the shop types, which is set at one third of the price level ranges according to Veldhuizen [1996] for three price level categories. Table 4 shows the relative energy requirement per item and per Dfl. for the different shops and price levels shown in table 3, calculated in the same way as for clothes [Veldhuizen, 1993][4].

	Price ranges from	to	Average price	Price level related to average

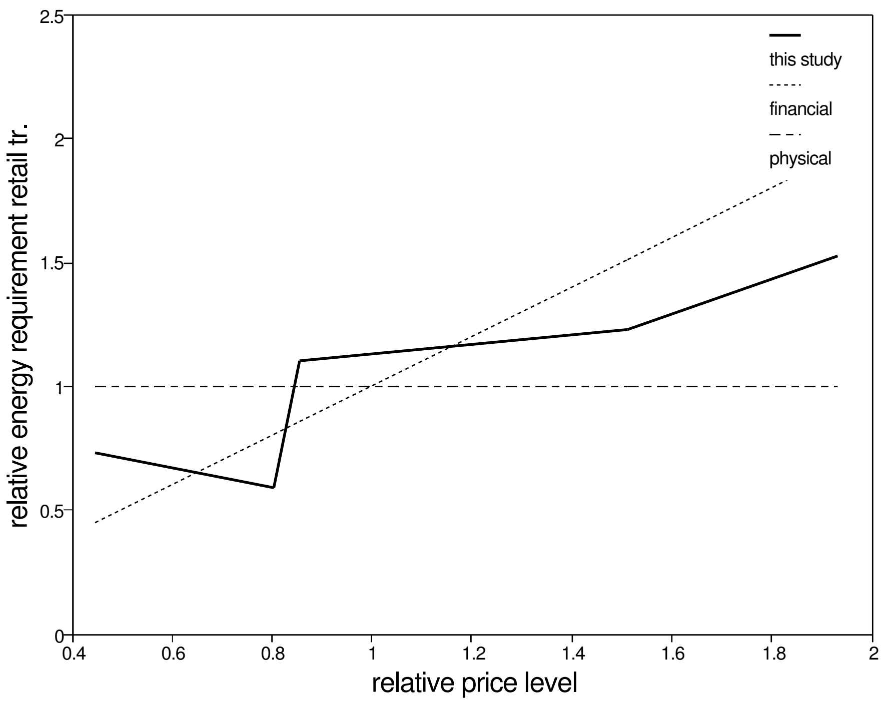
[4] The annual energy costs per square metre for shoe shops are 47 Dfl/m^2 [CRR, 1993]. The costs per GigaJoule primary energy for the retail trade are 14.3 Dfl/GJ, [Wilting et al., 1995]. The annual direct energy requirement is than 3.3 GJ/m^2.

	(Dfl)	(Dfl)	(Dfl)	
low price level				
chain store, discount	10	150	57	0.45
mid price level				
chain, non-discount	59	189	102	0.80
independent classic and fashion low to mid	69	189	109	0.86
high price level				
classic-fashion midhigh to high	89	399	192	1.51
exclusive/orthopaedic	119	499	246	1.93

The relative energy requirement calculated this way shows that shoes from discount chain stores require per pair as much energy for the retail trade as shoes from stores with a mid price level. A pair of shoes from stores with a high price level (1.9 times the average price) requires 1.5 times the average energy requirement for the retail trade.

Shop type	discount chain	non-disc. chain	cl.&fash. indep.	cl.&fash. indep.	excl. indep.
Price level	low	mid	mid	high	high
Market share	26%	16%	25%	22%	11%
Annual sales per m^2 (Dfl.)	4000	8900	5091	8083	8290
Rel. price per item	0.45	0.80	0.86	1.51	1.93
Rel. number of items sold per m^2	1.24	1.53	0.82	0.74	0.59
Rel. energy requirement per item	0.73	0.59	1.10	1.23	1.53
Rel. energy requirement per Dfl.	1.45	0.65	1.14	0.72	0.70

Figure 2 shows the relation between price level and energy requirement, according to three methods of accounting the energy requirement of the shoe retail trade, similar to Figure 1.



Compared with the most accurate alternative accounting method, the financial accounting method gives an overestimation for the expensive shoes and an underestimation for the cheaper shoes. The physical accounting method gives an underestimation for the expensive shoes and a an overestimation for the cheaper shoes.

We may ask how these deviations caused by the financial accounting method influences the results of the calculations.
Five energy analyses according to the method of hybrid energy analysis ([Engelenburg et al., 1994], [Wilting et al., 1994]) made by de Paauw and Perrels [1993] for shoes, show that between 30 and 36%, with an average of 33%, of the indirect energy requirement is attributed to the retail trade. The systematical error made in the calculation of the energy requirement by using the method of hybrid energy analysis is for the low price level shops 7% too low and for the high price level shops 14% too high. The systematical error made in the calculation of the energy requirement by using the physical accounting method is for the low price level shops 11% too high and and for the high price level shops 17% too low.

Discussion

For the calculation in this study of the energy requirement of the retail trade we assumed that both direct and indirect energy requirement of the retail trade are proportional to the area of the shop. It is well conceivable that more expensive shops requires relatively more energy for lighting and heating per square metre than the space of the cheaper shops. The energy requirement of the retail then trade will be higher for more expensive products and lower for cheaper products of the same kind than estimated here.

For the calculation in this study we also assumed that a rise of the direct energy requirement results in a relative equal rise of the indirect energy requirement. About 60% of the energy requirement of the retail trade is indirect [Wilting, 1992]. If a rise of the direct energy requirement does not result in a rise of the indirect energy requirement, the dependency on price of the in alternative way calculated energy requirement of the retail trade will be reduced to one third. However, it is not likely that there is no relation between the indirect energy requirement for the retail trade and the price level. E.g. in most cases more shop-area requires a larger building and more expensive products require more advertisement.

No sufficient data have been found for other retail trade branches. The relations found between price-level and energy requirement of the clothing- and shoe retail trade can differ per kind of retail trade.

Conclusion

Both financial- and physical accounting methods of the energy requirement of the retail trade give serious errors for products which have a price level deviation from the average price. For clothes and shoes the systematical error can be about 5 to 15% of the total indirect energy requirement. Unfortunately, neither the physical or the financial accounting method can be indicated as preferred method.

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