



IV



Sources of energy in the Dutch Golden Age. The case of Holland

AD VAN DER WOUDE

Solar energy is the most important source of energy in this world. Without it life here is impossible. Through the process of photosynthesis energy from the sun is stored in vegetable and animal products, thus delivering food, clothing and shelter, which in its turn makes the maintenance of human and animal muscular strength possible. That was, is and most probably will remain the most important and certainly the most decisive precondition for human societal existence. Although there are variations in time and place, this solar maintenance energy is relatively evenly distributed across the inhabited world.

But man, that tool-using animal, discovered supplementary ways for energy consumption by making use of wind, water and fuel. All these three rely on the basic solar maintenance energy presented by geological or atmospheric processes. However, this supplementary energy production was and is not evenly distributed across the world. Its use has always been the result of human ingenuity and initiatives combined with natural circumstances that are not equal in time and place. Through the utilisation of *heating energies* (especially important for food preparation, housing and manufacturing processes) as well as *motion energies* (created by wind, water and combustion machines, ships and modern transport facilities) some societies or regions will have taken a temporary lead on others who are devoid of or less equipped with these forms of supplementary energy.

The Dutch economy is said to have been characterised during the early modern period by relatively high energy consumption. A pro caput comparison shows that wind, water and fuel were utilised as energy sources more intensively than elsewhere. Indications for this are the existence of many (for those times) high energy consuming industries in the western and northern provinces of the Dutch Republic, most of all in Holland, but in Friesland, Groningen, Zeeland and Utrecht too.



Examples are the salt and the sugar refineries, breweries, distilleries, potteries, faience, brick, tan, pipe and tile kilns, cotton print industry, madder drying towers, different milling industries, mills for water management, leading inland and sea water transport and the fishing industries. In Holland, in most cases not only the raw materials but also much of the heating energy needed for production had to be imported. The finished products of these energy-consuming industries were an important part of Dutch export goods.

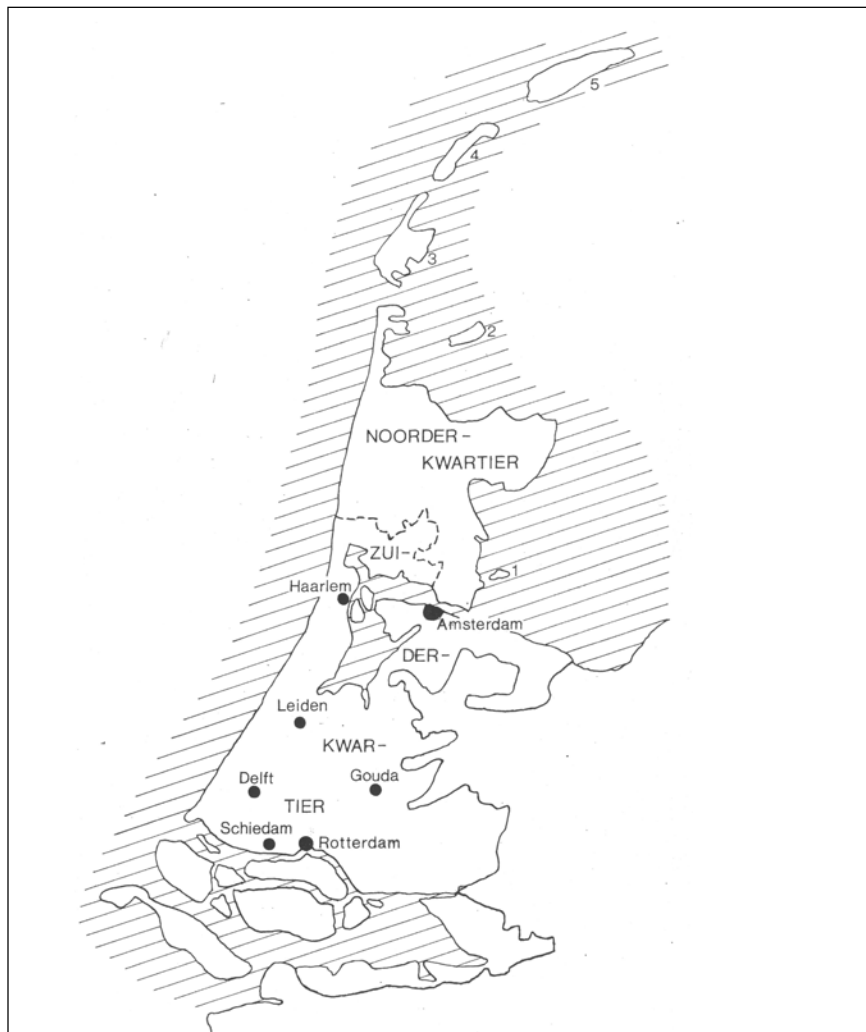
Although a high energy consumption was also found in other provinces of the Dutch Republic, it was the province of Holland with its level of urbanisation of more than sixty percent during the seventeenth and eighteenth centuries that stood out in this respect. During this period sufficient supplementary energy power must have been available in Holland to allow such an enduring high urbanisation level. To obtain an idea of the importance of the energy aspect of the Dutch miracle, we need to gain an insight into the need, the attainability, the import and the consumption of energy in the province of Holland. It is therefore to this part of the Dutch Republic that I concentrate.

Let me start again with the remark that the population of Holland for those times excelled in the use of motion (shipping, windmills) as well as heating energy (peat, coal and firewood). While for most societies during early modern times the use of motion energy was a restricted and marginal phenomenon, this was not the case in Holland. Inland and maritime shipping had played an important role since the Middle Ages. Transport and fishing had a very high labour productivity compared to other European societies. Since the sixteenth century this mobile motion energy became increasingly supplemented with stationary wind motion energy. While during the sixteenth century this by wind mills generated energy became indispensable for the drainage of existing agricultural lands, during the seventeenth century, drainage windmills besides this defensive role, gained an offensive one by making it possible to enlarge the territorial surface of the province by reclaiming large inland water and sea surfaces, reshaping it into fertile and economically organised agricultural areas. A region as large as Holland north of the line Amsterdam-Haarlem gained more than 36.000 ha. of new land between 1540 and 1650 (90% of these even between 1590 and 1640). This increased the existing 108.000 ha. old land of this extended region by one third.¹

Moreover, the use of windmills was not limited to the struggle against the always-menacing water. Especially after the first decades of the seventeenth century, windmills became increasingly utilised for industrial purposes. It is not my task here to depict their development. However, it is important to realise that this form of motion energy contributed much, in any case qualitatively, to the Dutch energy availability. Every important city possessed tens of industrial windmills inside its walls and on its ramparts or in its direct neighbourhood. When, for example, there

1 A.M. van der Woude, 'Het Noorderkwartier', in: A.A.G. *Bijdragen* 16 (1972) 52.

was no further room inside the city of Amsterdam for the building of industrial windmills, the region along the river Zaan (a distance of 15-20 kilometres from Amsterdam) was used for the extra mills and rapidly developed into the area with the most intensive use of stationary motion energy in the pre-industrial world. At its apex, around 1730, the Zaan region had nearly 600 industrial windmills in operation.² A real world miracle, as Napoleon later remarked during a visit. In reality it meant that on both sides of the river, along a length of circa 25 kilometres, there was on average, one industrial windmill every 100 metres.



² *Ibidem*, 318.

With others I want to stress that the study of the energy availability in this first modern economy cannot be concentrated on the use of peat and heating energy alone. Moreover it should always be looked at comparatively. The presence in Holland of more than three sea-going vessels and more than one industrial windmill (and the drainage windmills included more than one and a half) per thousand inhabitants may indeed be considered to be a remarkable phenomenon during the early modern era.

It is, however, not my task here to dwell on this. Let me proceed further to look at the third source of supplementary energy: *heating energy*. In this connection, Dutch peat is always, and rightly, given the most attention. Nevertheless it seems fair to point to the fact that besides peat, also coal, firewood and perhaps even other materials in Holland can have been used as sources of heating energy. Not only could they have played such a role, they surely did so. To obtain an idea of this let us start by looking at the *consumption* of heating energy in Holland during our period. Afterwards we will turn to the *production* of it.

We are fortunate that the Dutch and particularly the Holland fiscal policy had, if not before, in any case since the birth of the Republic given a lot of attention to the taxation possibilities of consumption goods. In the course of time more and more consumables became directly or indirectly objects of taxation. Amongst them we find such important articles as salt, butter, candles, fruit, beers, wines and brandies, soap, some textiles, salted herring, salmon and other fish, oils, pitch and tar, coffee and tea. Then too there were also horses, cattle, arable land, the milling of grain (this means 'bread'), and the selling of slaughter cattle (i.e. meat). Firewood, coal and peat did not escape the taxman's attention either, and in the archives we can find the income of the tax revenues on these consumables after 1650.³ We would, however, be over hasty to assume from this that this fiscal source easily can give us an insight into the volume of used heating energy in Holland.

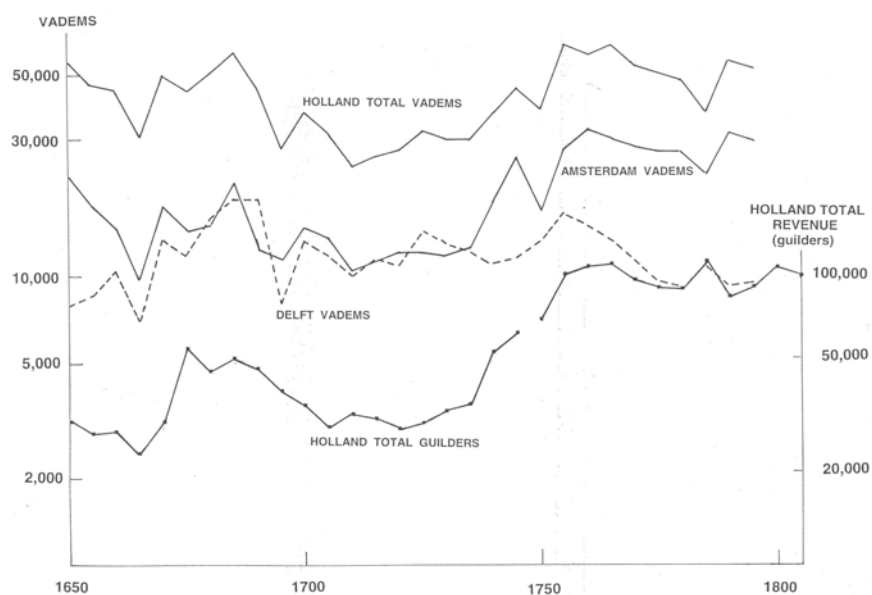
As well as coal, firewood, charcoal and peat, in most cultures dried dung, straw and other crop residues also have a part among biomass fuel. Manure was a highly esteemed product, needed as a fertiliser to keep up the productivity of the arable. It was as such the object of intensive trade, as was also urban household refuse, in many towns a privileged monopoly for orphanages and comparable institutions. In 1679, five years after the hundred percent increase in the tax rate on peat, bakers and others, who could use peat to heat their ovens were explicitly forbidden to burn reed, sawdust, straw, hop and buckwheat husks, wood shavings, or even to store it, on a fine of fl. 200, - (nearly six months salary for a carpenter).⁴ Only pastry-cooks were exempted. Most probably they would have been seriously frus-

3 Nationaal Archief, The Hague, Financier van Holland, nrs. 826-828, Staten van de opbrengst der gemenelandsmiddelen. 3 vols.

4 C. Cau a.o., *Groot plaacet-boeck...van de ... Staten van Hollandt* (9 vols, 1658-1796)

trated in the techniques of their profession without this kind of fuel. However, the prohibition did not work well for by 1680 the bakers of bread were permitted to use that kind of fuel ('Riet, Saeghsel, Mot and Boeckweytdoppen') on condition that they had to pay a tax equal to fifty percent of its value.⁵ As late as 1753 the tax collectors asked for an explicit definition of the word 'Mot'. The answer by the government was that the words used in the tax law had to be interpreted as any fuel other than peat, coal, firewood or faggots.⁶ The fact that this practice was the subject of discussion may indicate that it was applied more frequent than incidentally. Nevertheless it was explicitly limited to bakeries. Not every bakery will have made use of such fuel, nor daily. However, as in Holland the baking of bread was not normally done at home, the occupation of baker showed a high density. About six per thousand inhabitants.⁷ This will have meant about 2.500 to 3.000 bakeries

Figure 1. Revenue of the tax on firewood (in guilders) and a reconstruction of the imported number 'vadems' firewood, 1650-1795 (every fifth year). Semi-logarithmic scale (1 vadem = 400 faggots)



vol. III, 827. Jan de Vries and Ad van der Woude, *The first modern economy* (Cambridge 1997) 610-611.

5 C. Cau a.o., *Groot placaet-boeck*, vol. III, 833.

6 C. Cau a.o., *Groot placaet-boeck*, vol. VIII, 1073.

7 De Vries and Van der Woude, *The first modern economy*, 516-517. Of course it is a just question to ask if the existence of so many (in some cases even specialised) bakeries in

in the province as a whole; a factor that should not be ignored in any examination of the consumption of heating energy.

Another remarkable fact is that there is no mention of the use of charcoal either in bakeries or other industries or home consumption. Charcoal was not taxed. It was not produced in Holland, devoid of forests.⁸ Probably it was also not imported on any large scale. This conclusion may be affirmed by the fact that among the price series published by Posthumus, charcoal only figures in three cases of Utrecht institutions between 1380 and 1580 (and in very incomplete series).⁹ Posthumus will not have found in later periods this fuel in the archives of administrations, which he used, for his price history. Charcoal simply did not play a role.

Firewood and faggots were a different matter. Both were listed as utilised kinds of fuel. There was a separate tax on imported firewood. Its yearly revenues can be followed after 1650 (Figure 1).¹⁰ Before starting any interpretation of the present-ed curve some remarks must be made. These are:

1. Until 1747 taxes on consumables were not collected, but farmed.
2. In 1683, an increase of ten percent on all taxes was introduced. Before 1750, however, this did not hamper the comparability of the income before and after 1683 since the effects could be easily eliminated from the figures.
3. This does not imply that there were no other changes between 1650 and 1750.
4. In 1750, after the tax rebellions of 1747, directed against the tax farmers, the government started to collect these taxes. It continued to do so until 1805, when the whole tax system of the Republic was abolished. The few historians that have worked with these figures believe that the change from farming taxes to collecting by the government itself provoked an increase of roughly twenty percent in tax income (but the costs of collecting were then an expenditure of the government).¹¹

Holland did not bring about a more economic use of energy than a situation in which the making of bread was done at home. The answer is difficult to prove, but I am inclined to give a negative one. Baking bread and so at home in most cases will have been done during the normal daily consumption of heating energy at home and will normally not have demanded a surplus consumption of fuel.

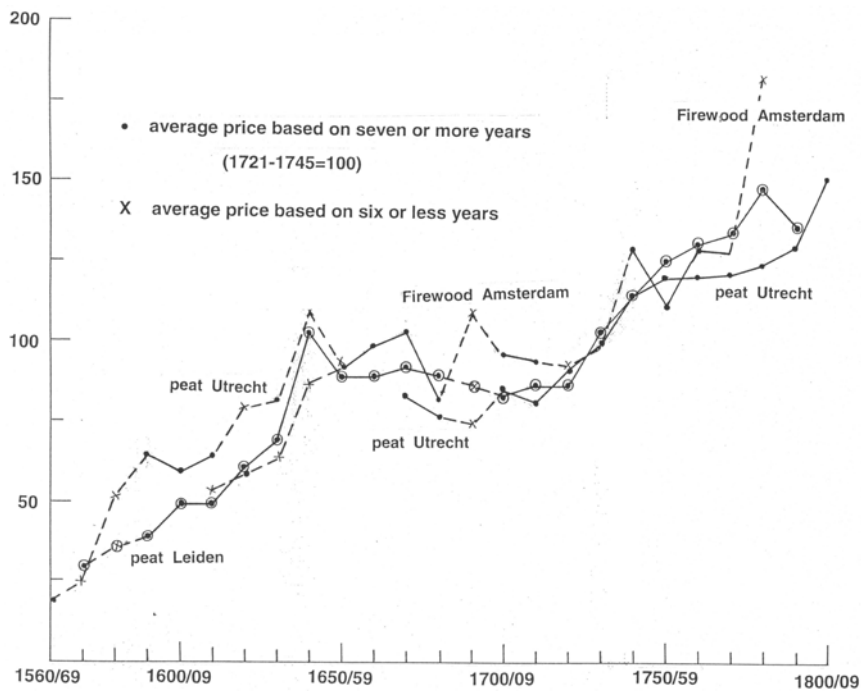
8 In 1801 a charcoal kiln existed in Nederhorst Den Berg, a village south-east of Amsterdam. It was in decay. Formerly it had produced charcoal for the gunpowder mills. (A.M. van der Woude (ed.), 'De Goldberg-enquête in het Departement Texel, 1801', in: *A.A.G. Bijdragen* 18 (1973) 116'.

9 N.W. Posthumus, *Nederlandse prijsgeschiedenis*, II (1964) nr. 4 (96-99), nr. 30 (126-132) and nr. 71 (210-212).

10 Nationaal Archief, Financier van Holland, nrs. 826-828.

11 J.L. van Zanden, 'De economie van Holland in de periode 1650-1805: groei of achteruitgang?', in: *Bijdragen en Mededelingen betreffende de geschiedenis der Nederlanden*, CII (1987) 562-609. A.M. van der Woude, 'De contractiefase van de seculaire trend in het Noorderkwartier nader beschouwd', in: Ad van der Woude, *Leven met geschiedenis* (Amsterdam 2000) 344-345.

Figure 2. *Relative price development of firewood and peat, 1560-1809. Ten yearly averages (1721-1745 = 100)*



5. After 1750, the ten percent increase introduced in 1683 was included in the revenue. This added another ten percent to the figures. Consequently when comparing the figures from before 1748 and after 1750 we have to reckon with an increase of about thirty percent in the bookkeeping.

6. It is important to note that some taxes were raised on volume (quantities) and others on value (prices).

7. Exemption to taxation or special tariffs for certain branches of industry present extra complications for the interpretation of the amount received of tax.

8. Therefore any attempt to reconstruct the level and the development of the consumption of the taxed consumable can never deliver exact figures. It will always be no more than a rough approximation of both.

Turning now towards the curves in figure 1, presenting the received revenue (in Dutch guilders) of the tax on imported firewood in Holland¹² on every fifth year after 1650, and the attempt to convert these money incomes into volumes of im-

12 Nationaal Archief, Financie van Holland, nrs. 826-828.

ported firewood by making use of firewood prices (Figure 2)¹³, we meet the following extra complications.

For reasons unknown the firewood tax was not raised between 1683 and 1747 in the so-called 'Noorderkwartier' administrative area.¹⁴ This area contained about 25% of the population of Holland in 1622 and some of the following decades. In 1795 this share had decreased to nearly 13%. (The absolute population number dropped from about 160.000 people in 1675 to about 100.000 in the period 1750-1800¹⁵). The contribution to the total revenue of the firewood tax, however, amounted to 12,5% during the decades 1650-1680 and only 6% during 1750-1805. This means that the curve of the total firewood tax revenue between 1683 and 1747 - dropping from about 10% to about 6% - is underrepresented compared to the periods before 1683 and after 1749.

However, an important fact can now be established. By dividing the revenues of this tax by the numbers of inhabitants in the cases where they are sufficiently well known, we can reach a fairly good idea of the revenue per head in the two basic administrative areas as well as in Holland in its totality (see Table 1).

Table 1. *Revenue of firewood tax per head of population (in guilders).*

| | ca. 1650 | ca. 1675 | ca. 1750 | 1795 |
|-----------------|----------|----------|----------|-------|
| Noorderkwartier | < 0.029 | 0.029 | 0.054 | 0.060 |
| Zuiderkwartier | < 0.050 | 0.056 | 0.134 | 0.130 |
| Holland, total | < 0.045 | 0.051 | 0.123 | 0.121 |

The revenue per head in the Zuiderkwartier proves to have been about double the amount of that received in the Noorderkwartier! As there is no reason to suppose that the mean domestic consumption of this energy will have been different between the two 'kwartieren', we may conclude that the higher mean use of firewood energy in the Zuiderkwartier per head of population must be explained by its higher use there for industrial purposes. The industrial market must have played an important role in the heating energy extracted from firewood.

We may even presume that the utilisation of imported firewood, as a domestic fuel will have been still (much) lower than the already low figures of Table 1 suggest. The province of Holland and the Republic in general (most actual Dutch forests date from the 19th and even 20th centuries) were fairly devoid of forests. Firewood from lonely trees or shrub would have played only a minor role in the

13 N.W. Posthumus, *Nederlandse prijsgeschiedenis*, II (1964), nr. 328 (753-760).

14 The area north of the line Amsterdam-Haarlem with the exception of the Zaan region and about ten other adjacent south-western villages.

countryside. But we have to realise that more than sixty percent of the population lived in cities. Imported firewood - and only that was taxed - would have been too expensive as a normal domestic fuel. The more so, because the supply in other provinces of the Republic would hardly have been sufficient to meet local demand. It is highly probable that the import of this product was real import from outside the Republic and too expensive for use at home. In this connection I have come across this passage on Norwegian - Dutch commercial and trade relations: '... firewood [was] exported in so far as it could be stored on top of the otherwise fully-laden ships'.¹⁶ More research in foreign port books may perhaps shed more light on the export of firewood to the Republic.

As taxation on firewood was based on value, and as we have an indication of its price development in a published price series¹⁷ from the Amsterdam orphanage (probably baking their own bread!), it is possible to convert the tax revenue into imported quantities (Figure 1). The results, however, of this operation have to be interpreted cautiously. First of all because the figures for before 1750 are based on the farming of taxes. Second we already know that between 1683 and 1747 this tax was not raised in the Noorderkwartier. This implies, as we saw, an underrepresentation of about 8% over these seventy years. Third, there were changes in the tariff (initially the tax was established at the level of one eighth of its price value, but was increased in 1674 to one fourth of it).¹⁸ Fourth - and this is the most disturbing circumstance - there were exemptions from this doubling of the tax level (of course for its biggest industrial consumers). Exemption from this doubling was given to all industries busy in the production of ceramics, porcelain, tiles, bricks, chalk burning, pottery, roof tiles and madder.¹⁹ In 1691 again a change in the tariff was established for the porcelain, faience and tile works. From then on these factories

15 J.G. van Dillen, 'Summiere staat van de in 1622 in de provincie Holland gehouden volkstelling', in: *Economisch-Historisch Jaarboek*, XXI (1940) 167-189.

16 S. Sogner, 'Popular contacts between Norway and the Netherlands in the Early Modern Period', in: J. Roding and L. Heerma van Voss (eds.), *The North Sea and Culture* (Hilversum 1996), 188. Other references can be made to *Samlinger til Stavangers historie*, vol. III (Stavanger 1953), where in an excerpt of a court proceeding of May 23, 1715, can be read that a certain Hans Hoff declared, that the commerce of the burghers mostly consisted of fire wood, lumber, as well as 'stry', hops, steel, iron, tobacco, plumb, etcetera, but that "fire wood, which brings in only a small profit, to his knowledge did not constitute a part of the privileged export commerce of the burghers". Oddleif Hodne wrote in a manuscript entitled *Agder og Nederland ca. 1600-1625. Handel og Kulturkontakt:* 'Also, it seems that every ship, whether Scottish or Dutch, was supposed to load as much firewood as one dared to stack on board' (friendly communications by prof. Sogner).

17 N.W. Posthumus, *Nederlandse prijsgeschiedenis*, II (1964), nr. 328 (753-760).

18 C. Cau a.o., *Groot placaet-boeck*, vol. III, 830 en 841.

19 *Ibidem*, vol. IV, 712.

had to pay 18 stuivers (fl. 0,90) pro taxed unit ('vadem').²⁰ The effect was that for these branches of industry taxation on the basis of value changed into one based on quantity. In 1753 for the faience and tile works, followed in 1764 for the pipe- and pottery factories too, the tariff was lowered to 11 stuivers (fl. 0,55) per vadem.²¹ Given the price level in practice this meant nearly a halving of the tax burden.

By all this and the fact that in spite of the tariff being doubled the tax revenue did not augment between 1669/71 and 1674/76 with 100%, but with 75% (thanks to industrial exemptions, we suppose), and also by making the (incorrect) supposition that the impact of these favoured industries at the doubling in 1674 remained constant till 1800, I introduced the following hypothetical corrections to the reconstruction of the number of vadmens imported firewood:

- 20% increase to correct the difference between tax farming and tax collecting (1650-1745);
- a negative impact of 25% on the revenue between 1675 and 1800 caused by the exemptions for certain branches of industry;
- an increase of 10% regularly dropping to 8% caused by the absence of the Noorderkwartier revenue between 1685 and 1745;
- a decrease of 10% after 1750 to obliterate the influence of the receipt of the ten percent extra taxation to be found in our data for 1750 to 1805 compared to before 1750.

The result of these corrections on the (hypothetical) numbers of imported vadmens are also presented in Figure 1. It shows that between 1650 and 1800 the number of imported vadmens may be put at a level that moved between 50,000 and 25,000. Generally the quantities were higher before 1690 and after 1755. It is important to know that one vadem firewood was declared to be equal to 400 faggots.²² It seems that the importance of this import was much greater than we have ever realised. A volume equal to between 10 and 20 million faggots per year cannot be considered to be unimportant. Per head this meant, it is true, only 12 to 25 faggots. At the domestic level, indeed, this would not have been so important. But for certain industries this was different. It was there that this product had its markets.

²⁰ *Ibidem*, vol. IV, 712 en 750.

²¹ *Ibidem*, vol. VIII, 1092 and vol. IX, 966. For unknown reasons this reduction of the tariff on firewood had no influence on the collected tax revenue in Delft, nor in Gouda. In the district of Delft the yearly totals between 1750 and 1756 (both included) amounted to 13,052, 14,743, 14,571, 14,674, 14,569, 16,341 and 13,256 guilders; between 1761 and 1766 to 12,355, 14,580, 16,423, 12,463, 13,244 and 13,007 guilders. In the district of Gouda between 1750 and 1756 these amounted to 2,235, 2,525, 3,017, 2,926, 3,158, 3,661 and 3,148 guilders; between 1761 and 1766 to 2,671, 2,665, 2,632, 3,285, 3,395 and 3,073 guilders.

²² *Ibidem*, vol. IX, 966.

A glance at the figures of the tax revenues immediately reveals that in Holland the markets for (imported) firewood were found in (the fiscal districts of) Amsterdam and Delft. The combined income of these two lay somewhere between 65% and 75% of the total receipt. And that as well in the period of taxes farming as in that of tax collecting. My hypothetical reconstruction of the number of consumed vadems of firewood seems to point to a greater use of this energy source in Amsterdam than in Delft before 1650. But the Delft earthenware industry, specialising in refined imitations of Chinese porcelain, experienced a real explosion that began in the 1640's to reach its summit between 1670 and 1720. It is exactly in the years between 1650 and 1690 that we see Delft gradually catching up to Amsterdam in the use of firewood, even overtaking it around 1690. Up till 1735 the utilisation of this source of heating energy was probably more or less the same in both cities (formally 'districts'). From then on, however, Amsterdam began a new phase in the use of this source. The quantities of firewood consumed in Amsterdam more than doubled, while its use in Delft - in accordance with the decline of its pottery industry - regularly declined after about 1755.

If we ask ourselves why there was such a high level of firewood heating energy used in Amsterdam, three points perhaps can be made. *First* the fiscal district of Amsterdam contained probably a much greater number of bakeries of bread and cakes and pastries. That can already have made an important difference in the utilisation of this heating energy in absolute numbers. *Second* although Amsterdam had not so many of the Delft kind of refined potteries within its boundaries, an important industry of coarse earthenware was producing there for the Amsterdam sugar refineries. In 1662 it was said to deliver pots with a total value of 50,000 to 60,000 guilders to these refineries. Also later, for example in 1776, we know that such potteries were in operation.²³ *Third*. The explosion in the use of firewood in Amsterdam between 1730 and 1760 (from about 12,000 vadem yearly to between 25,000 and 30,000) can only be explained, however, by the expansion of a new, heating-consuming industry. The only new, energy-intensive industry I can imagine was that of cotton printing. At least 34 were numbered in 1735 but around 1750 they peaked with some eighty printing works. Thereafter this industry that had offered labour opportunities to many thousands and that had become one of Amsterdam leading industries, collapsed rather quickly and by 1780 hardly anything was left. French competition had swept it from the world market.²⁴ But although the use of firewood heating energy in Amsterdam experienced a serious decline between 1760 and 1785, it did not decline to the level before 1730. The enigma of this higher late eighteenth century consumption in Amsterdam remains (see Figure 1). Production (import from where?) as well as consumption are not yet clear.

23 De Vries and Van der Woude, *The first modern economy*, 305.

24 *Ibidem*, 295.

The two remaining fuels for heat energy - coal and peat - also present difficulties if we want to unveil their utilisation. If we look at the taxation on their consumption we find again figures for more than 150 years. The greatest complication, however, is that they were farmed and later on collected as a whole. Separate series of figures for peat and for coal do not exist. This tax was regarded by the government as one and indivisible. Probably both fuels were considered as alternatives and used indiscriminately. The Amsterdam sugar refineries are an example of this.

These refineries were extraordinarily large for that time, often five or six stores high, and can be compared with the factories of the nineteenth century. After 1650 their number increased yearly from about 40 to 100. The Amsterdam government restricted these refineries to two districts, so as to minimise as much as possible the ecological annoyance they caused by the soot and stench emitted from their chimneys. As early as 1614, the city sought to reduce this disamenity by forbidding the use of coal as a heating fuel at the refineries. In 1643 the city relented, allowing the use of coal in the four winter months, but two years later already they returned to total prohibition because of the 'insufferably great sorrow, vexation, and discomfort of the residents'. The persistence of the refiners moved the city fathers once again to allow winter use of coal - and now for six months - beginning in 1655. In 1674 the burgomasters caved in altogether before the refiners' threats of closing down their operations. They received permission for the burning of coal on a year-round basis.²⁵ This story is a clear proof of the interchangeability of coal and peat as a source of heating energy. But also of the competitive advantage of coal over peat in this case. And why should it have been the only one?

Nearly twenty years ago Richard Unger challenged the idea that it was peat and peat alone that allowed the existence of the heating energy intensive industries in Holland.²⁶ He presented convincing evidence about the underestimation of the use of coal. Liège, English and Scottish coal played an important role in the energy supply during the early modern period. During the years which we have been looking at (the period after 1650), the import of British coal surely was the most important. German coal began to gain an influence only in the last decades of the eighteenth century. Next to his observation that English and then Scottish (after 1707 British) coal dominated the Dutch coal market, I like to stress his remark that especially in certain branches of industry coal became the dominant supplier of energy. I have already shown that this was true for sugar refining. But this will also have been true for industries like brewing, distilling, soap boiling, bleaching and

25 *Ibidem*, 329.

26 R.W. Unger, 'Energy sources for the Dutch Golden Age: peat, wind and coal', in: *Research in economic history* (P.J. Uselding, ed.), 9 (1984) 221-253. Ungers' article has to be read as a critical comment on the fundamental publication of the Dutch (Wageningen) soil scientist J.W. de Zeeuw ('Peat and the Dutch Golden Age. The historical meaning of energy-attainability', in: *A.A.G. Bijdragen* 21 (1978) 3-31).

in blacksmithing (in brick- and limemaking perhaps too). However, it is striking that Posthumus in his two volumes on price history could present only one very incomplete series of coal prices.²⁷ He therefore understandably wrote: 'Prices [of coal] can only sporadically be found. This demonstrates the relative scarcity of this product'.²⁸ But Posthumus has taken his information on prices from the Amsterdam Beurs and from the archives of charitable and comparable institutions. And as Unger also rightfully remarked: peat was the favoured source of domestic heating. Coal would have been used for industrial purposes; peat for both industrial and domestic purposes.

To explore this perception more fully it is helpful to construct again a table like Table 1 but this time looking at the revenue per head from the combined coal-peat consumption tax (Table 2).

Table 2. *Revenue of peat-coal tax per head of population (in guilders).*

| | ca. 1650 | ca. 1675 | ca. 1750 | 1795 |
|-----------------|----------|----------|----------|------|
| Noorderkwartier | < 0.52 | 0.66 | 0.96 | 1.12 |
| Zuiderkwartier | < 1.39 | 1.36 | 2.45 | 2.05 |
| Holland, total | < 1.18 | 1.23 | 2.25 | 1.93 |

With the exception of the late eighteenth century, the difference between the per head revenue in the Noorderkwartier and the Zuiderkwartier is even a little bit greater than that observed in Table 1 on the consumption per head of firewood. In the peat-coal case, this revenue per head was in the Zuiderkwartier even *more* than double the amount paid in the Noorderkwartier! This is not such a surprise as industrial plants were more concentrated in the Zuiderkwartier. But isn't it true that we would like to establish the difference especially between industrial and domestic use of both fuels? If we could find a tax district (nearly) without industries and compute the income per head there, then we might have a yardstick for domestic consumption in Holland in general, supposing that the mean household consumption of heating energy in Holland would have had rather equal regional levels.

There is such a case. During the century of tax farming (1650-1747 in our data) there was a taxation district called 'the islands'. It included the five islands of Marken (not so far from Amsterdam) and Wieringen, Texel, Vlieland and Terschelling (up in the very north of the province). The population (in 1622 for all

27 N.W. Posthumus, *Nederlandse prijsgeschiedenis*, II (1964), nr. 215 (503).

28 *Ibidem*, 556.

five together 17,549 inhabitants) occupied itself with agriculture, shipping, fishing and pilotage. Apart from service workshops like (perhaps) a local smithy and bakery, real industry did not exist. If we divide the mean tax revenue on peat and coal for the decade 1650-1659 (i.e. fl. 4,147) by the population in 1650 (estimated at around 20,000) we obtain a result of about fl. 0.20 yearly tax income per head in that decade.²⁹ Table 2 shows a revenue of fl. 1.18 for the whole province. Accepting the foresaid equality in domestic fuel (peat!) consumption, we now dare to conclude that in Holland as a whole around the middle of the seventeenth century a little bit less than 20% of the heating energy was domestic consumption and more than 80% industrial. In the Noorderkwartier, the industrial share would have been between 60 and 65%; in the more urbanised and industrialised Zuiderkwartier even more than 85%. Later on in the century this share would have slightly increased in the Zuiderkwartier, possibly to decline somewhat during the second half of the eighteenth century.

Having now arrived at a reasonably acceptable estimation of the partition of the coal-peat heating energy between the domestic and the industrial use in Holland, it would be even more wonderful if we could also make an acceptable estimation of the division of coal and peat in the industrial heating energy consumption in Holland. Unfortunately available tax sources do not allow a well founded estimation of each share in the industrial eighty percent. If, however, we would know the total volume of coal imported into (and not re-exported from) Holland, we could risk such a reconstruction. Richard Unger tried to produce such a tentative figure for all coal, whatever the region of origin. Making use of an impressive number of references to existing literature and Dutch archival sources, he assembled a lot of separate, in nearly all cases unconnected information on the coal trade from Liège, England and Scotland to the Northern Netherlands, especially Holland. These act, so to say, as little flags on the map of time. But they are not able to produce a series or even a clear indication of the import levels and developments. Nevertheless, Unger dared to jump from these to very general statements and rough figures on the use of coal. The estimations may be more or less correct. Given the quality of the information now available this cannot be either proved or disproved. But let us see where his guesswork brings us.

According to Unger, during the seventeenth century imports of coal from Liège, England and Scotland would normally have been at least 25,000, plus 30,000, plus 10,000, that is 65,000 metric tons per year. During the eighteenth century this would have increased to at least 50,000, plus 100,000, plus 40,000, that is to let us

29 The number of inhabitants of the five islands amounted in 1622 to 18.300 and may be put around 1650 at about 20.000 people. Import of firewood was so incidental and insignificant in this taxation district that this tax was farmed during the fifties for the (most probably) symbolic amount of fl. 4,- each year. Perhaps to the farmer of the peat-coal tax? This implies that a comparable computation for firewood could not be made.

say about 200,000 tons (and, if German coal is included, to 215,000 tons) per year.³⁰ In the same study Unger tried by all kinds of reasoning to reduce the volume of peat used in energy consumption. His argument is not always convincing. On the basis of these very uncertain computations of coal and peat he concluded that in the seventeenth century energy extracted from coal was equal to almost two-fifths of that from peat. By 1800, coal and peat would each have supplied the Dutch economy with fifty percent of its energy demand.³¹ Given the 20% used in domestic energy consumption, in the seventeenth century this would have meant that the industrial heating energy demand would have been met by an energy supply for two-thirds from peat and for one-third from coal, while during the eighteenth century these shares would have been turned round. In the seventeenth century, the source of all energy consumption - domestic and industrial - would have been a little bit more than 70% from peat compared to the 50% level reached in the eighteenth century.

Given Ungers' aim to examine the underestimated role of coal in the Dutch energy supply and his debatable efforts to argue for smaller energy supplies coming from peat,³² it seems wise for the time being to regard the result of these computations based on his rough estimations of coal imports as producing minimum figures and percentages for the use of peat and maximum ones for coal.

Although the tax on peat and coal was raised on volume and not, as in the case of firewood, on value, the revenue figures cannot be translated into trustworthy quantities of fuel, because of the complication that it was a combined revenue from two different objects. We can translate the income into fictive quantities of peat or also fictive quantities of coal. Since we know, however, that both fuels held an important position in the energy market, and also because we do not have a reasonably well founded knowledge neither of each share nor of their developments, such a computation is useless. Nevertheless it might be rewarding to look at the curves in Figure 3, showing the development of this tax revenue in Holland in its totality as well as in the separate taxation districts of Amsterdam, Delft and Haarlem.

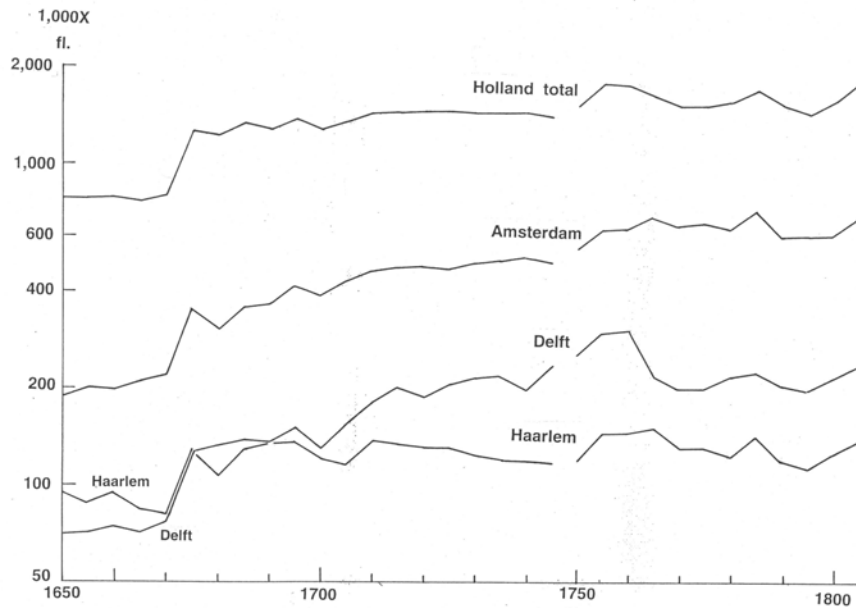
If we ignore the leap in income between 1670 and 1675, caused by the doubling of the tariffs in 1674, we see for the whole of Holland first a thirty-year period between 1650 and 1680 with a more or less constant revenue. This is followed by another thirty-year period with a small irregular, but not really impressive growth between 1680 and 1710. A third period of again thirty years (1710-1740) shows a perfect stationary period. If we look at the development after the passing of the tax revolt and its aftermath, we can see that from 1760 until nearly the end of the 18th

30 R.W. Unger, 'Energy sources', 245-246.

31 Ibidem, 246.

32 M.A.W. Gerding, 'Vier eeuwen turfwinning. De verveningen in Groningen, Friesland, Drenthe en Overijssel tussen 1550 en 1950', in: *A.A.G. Bijdragen* 35 (1995) 329-331.

Figure 3. *The revenue of the combination tax on peat and coal (in guilders). Holland total and the fiscal districts of Amsterdam, Delft and Haarlem, 1650-1805 (every fifth year). Semi-logarithmic scale*



century there is an irregular decline in the tax revenue, dropping from almost 1.8 million guilders around 1760 to little more than 1.4 million guilders in 1795.

Looking at the three curves of the aforesaid taxation districts (and also to that of Leiden, where the tax income is almost the same as that for the Haarlem district, in its level as well as in its development), we see that in Haarlem (and therefore also in Leiden) the revenue declined regularly during the first half of the 18th century and certainly after 1765. Delft had a totally different development. Starting in the third quarter of the 17th century on a clearly lower level than Haarlem (and Leiden), its tax revenue surpassed the Haarlem-Leiden levels already in the last quarter of the century and showed a continuous increase until 1745 (probably even until 1760). Between 1660 and 1745, the revenue from this tax increased in the Delft district by no less than 213%, in the Amsterdam district by 148%, in that of Haarlem by 25% and of Leiden by 11%. The increase in the total figures of Holland was 79%. It is evident that during that century Amsterdam and Delft passed through a period of important increases in the use of peat-coal heating energy consumption. This consumption probably declined even in the Haarlem and Leiden districts, if we take into account the increases in the tax tariffs during this

1660-1745 period. Looking at the 18th century as a whole, we can see not only at first stability and then decline during the second half, but in Delft a much slower growth in the revenue. Between 1705 and 1740 the increase was in Delft still 27%, against 20% in Amsterdam. But between 1740 and 1780 there is only a further increase of 11% in Delft, but one of 23% in Amsterdam. If we take into consideration the change from tax farming to tax collecting, it is probable that in Delft the real tax income even declined, or at any rate remained constant. Just as for the market of firewood, Amsterdam remained the only district with a (in this case modest) growth after 1750.

In certain periods during these 150 years, other districts also had an important share in the revenue of this combination tax. So the revenue for the district Gouda in the fifties and again in the eighties of the 17th century was as great as that for the Amsterdam district. But while in Amsterdam the growth continued, in the Gouda district, first stagnation and then a slow but almost uninterrupted decline set in. Rotterdam, however, started in 1650 on a much lower level but grew constantly in importance to reach the Haarlem-Leiden level after 1715, even surpassing it a little in the forties. After the tax revolt, under the system of tax collection by the government itself, the situation was completely different. Suddenly the tax revenues at Gouda were on a much lower level, while in Rotterdam they had made a great leap upwards. The only reasonable explanation for this is that there was a change in the district boundaries. In 1765 such an administrative measure showed itself again in the sudden creation of a new taxation district, i.e. that of Schiedam (centre of distilling). In Gouda, but now also in Rotterdam, revenues from tax incomes were much lower after that year.³³

The only acceptable way at the moment to overcome these complications is to combine the tax incomes of some districts. As it is fairly certain that territorial changes only took place in the southern part of the province, it seems wise to divide the Zuiderkwartier into two units: one consisting of the taxation districts of Amsterdam, Haarlem and Leiden, and the other of those of Delft, Gouda, Rotterdam and Schiedam. Combined with the administrative unit Noorderkwartier, the tax incomes of these three units cover 99.9% of the total revenue from the peat-coal combination tax.³⁴

33 Nationaal Archief, Financie van Holland, nrs. 826-828. Intensive research into the institutional history of the system of taxation on consumption goods (imposten), of the farming and the collecting of these taxes, the boundaries of the districts and the changes thereof, the sometimes and in some cases revolving system of farming between districts, the absence of taxation on a given product in some places/areas in some periods, and so on, and so on is still lacking, but very wanted.

34 Only totally unimportant contributions from districts like Gorinchem, Schoonhoven and/or Den Briel are lacking.

Figure 4. Share of the Noorderkwartier, Zuiderkwartier-North and Zuiderkwartier-South in the revenue of the combination tax on peat and coal (in %), 1650-1805

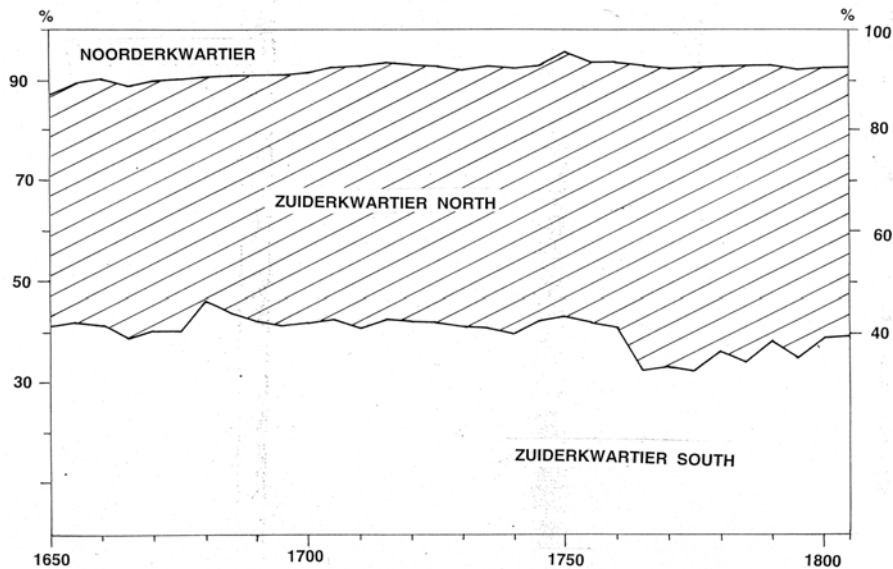


Figure 4 presents (in percentages) the three portions in the total revenue during more than 150 years. We can see how the share of the Noorderkwartier slowly dwindled from more than 10% between 1650 and 1665 to a level of 6.5 to 7% around 1720. Disregarding the irregular situation connected with the change from tax farming to tax collecting, this level remained until the end of the 18th century, during which its share in the total income in Holland always moved between 6.2% (1755) and 7.7% (1795). By combining the information from Table 2 with that of the district of the fives islands we have already seen that around 1650 in the Noorderkwartier roughly 40% of this tax revenue was from domestic use of heating energy. But between the middle of the 17th century and 1730 the Noorderkwartier population declined with some 40%. Because of that the 10% level in the tax share in the years 1650-1665 had declined in 1730 by about 1.5 to 2.0%. As the ten-percent level did decline by 3 to 2.5% between ca. 1650 and 1740 the industrial use of these fuel(s) will probably also have declined in the Noorderkwartier. Salt refining, smoking of herring, local breweries, soap-boiling, whale-oil houses, roperies, smithies, some chemical workshops and more of this kind of enterprise may have also declined in numbers and/or activity.

More interesting, of course, are the developments in the more industrialised Zuiderkwartier. The juxtaposition of its northern taxation districts (Amsterdam, Haarlem, Leiden) against its southern ones (Delft, Gouda, Rotterdam and Schiedam) reveals that it was the northern half (in reality the central part of the province) that enlarged its share first slowly between 1650 and 1760 (from about 48% to about 52%) and then suddenly to between 56% and 60% after the 1760s. We already know that this cannot be attributed to the growth of the use of heating energy in the industries in the Haarlem district (i.e. bleaching) nor in those of Leiden (see Figure 3). It was the growing demand for this energy in Amsterdam that caused the increase in the share of this part of Holland in the total revenue. But we have already seen that. This development automatically brought about a drop in the share of the constructed taxation unit Zuiderkwartier-South. Here Rotterdam and Schiedam more than kept their contribution, but the setback of the brick works in the Gouda district as well as that of its urban potteries and smoking-pipe works, and the decline of Delft's earthenware industries all counteracted these developments.

In the Zuiderkwartier, the negative development in the number of households was not so spectacular as in the Noorderkwartier, although at the local level as in the cities of Haarlem and especially of Leiden not absent. We know that in the Zuiderkwartier as a whole the domestic use of heating energy was little more than 15% of all peat-coal heating energy. But this does not exclude the possibility that in a tax district like Leiden this share may have been double that level, let us say 30%. In such a case, the serious decline of Leiden's population (from about 60,000 around 1680 to about 30,000 in the last decades of the 18th century, i.e. a loss of about 8,000 households) without a compensation by population growth in the surrounding countryside may perhaps be a sufficient explanation for the stagnation and even decline in the demand for heating energy in the Leiden district. But in the Zuiderkwartier as a whole and in most of its tax districts the population development would not have played a decisive role in energy use. It was industrial demand that was decisive for development in energy consumption. Next to the growing industrial demand in the Rotterdam-Schiedam area and the declining industrial demand in the second half of the 18th century in the Delft-Gouda districts, it is the almost constantly growing energy demand in Amsterdam from 1650 up to late in the 18th century that is so striking (Figure 3). But this we have seen several times already.

What I have tried to do is make the best possible interpretation of the revenues of the taxation on the *consumption* of heating fuel, with the aim of gaining a better insight into the consumption itself. It seems right to ask if it is possible to obtain any more insight by looking also at the *production* (and distribution) of the different kinds of fuel. For the present our knowledge is not good enough. For firewood and coal we are dependent on information on the imported volumes of both fuels.

That for firewood is more complete, although far from being exact. Moreover, the imported volumes of firewood, translated into energy equivalents, show that in the quantitative sense it was only a minor product compared to coal and peat. But we also have to realise that in the qualitative sense, firewood played an important role in certain branches of industry. In that way it can be compared with the role played by shipping and windmills. In contrast to the heating energy produced by peat and coal that from these was small too. Nevertheless they played an essential role because they produced a kind of energy (motion energy) that, at that time, could not yet be produced via heating energy. I mean 'before the advent of the steam engine'. We have to look in a similar way at the import of firewood: its importance cannot only be deduced from the quantity of energy it produced.

We have already looked at the import of coal as a substitution for production, discussing the information presented by Unger. In fact, it is impossible at the moment to give reliable figures for the imported quantities from Britain and from the Liège region. This is all still vague guesswork. But perhaps systematic research into portbooks and other sources may in the future produce more hard facts than we now possess. Such a research still seems far away.

But can we produce trustworthy figures on the volume of peat consumption in Holland by looking at produced volumes? We have to acknowledge bluntly that this also is still impossible. The reason for this is simple. At the moment the only relevant publication that could give answers on that kind of questions, is the brilliant study by Gerding on peat production in the Northern (Friesland, Groningen) and Eastern (Drenthe, Overijssel) provinces of the Dutch Republic.³⁵ But that area was not the only one of importance for peat production. Along the actual Dutch-Belgian border peat production was very important during the late Middle Ages and the first half of the 16th century.³⁶ This area was one of the main providers of this fuel for the Flemish-Brabant cities. Another one was, at that time, Holland itself. But because this Brabant area certainly would be exhausted somewhere in the 16th century, entrepreneurs from Antwerp developed a new production area in the 16th century in the region between Wageningen, Veenendaal and Ede, the border area between the provinces of Utrecht and Gelre.³⁷ By the beginning of the 17th century this production area too was nearly exhausted. In combination with the greatly expanding demand for peat after the beginning of the 17th century, this will most probably have been one of the causes why the lifting of peat assumed enormous proportions in the Northern and Eastern provinces from that time on.

35 M.A.W. Gerding, 'Vier eeuwen turfwinning'.

36 K.A.H.W. Leenders, *Verdwenen veenen. Een onderzoek naar de ligging en exploitatie van thans verdwenen veenen in het gebied tussen Antwerpen, Turnhout, Geertruidenberg en Willemstad (1250-1750)* (Wageningen 1989).

37 H. Soly, *Urbanisme en kapitalisme te Antwerpen in de 16e eeuw* (Brussel 1977). T. Stol, *De veenkolonie Veenendaal. Turfwinning en waterstaat in het zuiden van de Gelderse vallei, 1546-1633* (Amsterdam 1990).

However, until late in the 17th or early 18th century, the most important production area of peat remained Holland itself. The huge export of peat from Holland to the cities in the Southern Netherlands came to a standstill at the beginning of the revolt against Spain. But the peat production in Holland and in the border area between Holland and Utrecht continued on an even larger scale. According to Gerding - and his arguments sound reasonable - around the middle of the 17th century about a small 60% of the peat production, measured in surface area and thickness of the peat layer, was situated in Holland itself and an ample 40% in the North-Eastern areas of the Republic.³⁸ It even seems not too daring to suppose that the growing import of British coal during the 18th century acted as a substitution for the declining peat production in Holland, because the volume of peat produced in the North-Eastern region remained more or less the same in the 17th and 18th centuries.³⁹ It is evident that definitive conclusions on peat production and consumption cannot be reached before the results of a study on Holland's own peat production, comparable to Gerding's publication on the North-Eastern provinces, is available.⁴⁰

38 M.A.W. Gerding, 'Vier eeuwen turfwinning', 328.

39 *Ibidem*, 274-275, figures 8.2 and 8.3.

40 As a good start, but only on a regional level may be considered H.J. Kamermans, 'Turfwinning in Holland in de achttiende eeuw: de ontwikkeling van de vervening bij Sluipwijk', in: *NEHA-Jaarboek* 58 (1995) 149-171.