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Energy Conservation and Electricity Sector Liberalisation: towards a Green and Competitive Electricity Supply?

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7. Waste and Electricity

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An important problem in the present reorganisation and liberalisation of infrastructure networks in many countries is what regulatory regimes can provide incentives for demand management and reduction in a future situation. In this paper, the present situation in the Dutch waste and electricity sectors is analysed. It is concluded that a quantity-based tariff system and the entwined interests of organisations are key impediments to effective demand management in these two sectors. A hypothetical intervention is proposed which aims to remove these two fundamental drawbacks. Some likely consequences of the suggested intervention are discussed.

In many countries, infrastructure networks have entered into a process of rapid change. The aim of the current reorganisation of sectors such as electricity or water supply and waste disposal generally is to improve economic efficiency by liberalising these traditionally monopoly-based sectors (Wright, 1994). However, it is also increasingly realised by many national authorities that a reduction of demand for the functions provided by infrastructure networks would be desirable for environmental reasons. Hence, new regulatory regimes have to be found which seek to combine the expected merits of liberalisation with incentives for demand management. Since the experiences with these new organisational frameworks vary between countries and even between sectors, cross-country and cross-sectoral comparisons can provide a useful contribution to the international debate about what regulatory regimes perform best.

In this paper, the demand management perspective is taken as a starting point for analysing the Dutch waste and electricity sectors.

After a brief introduction to the method of analysis used, we describe the situation in both sectors and analyse what fundamental constraints to reduction initiatives can be found in both sectors. Finally we propose a hypothetical intervention that aims at removing the fundamental constraints found and discuss some of its likely consequences.

Method of Analysis

There are many ways to analyse the relationship between the organisation of infrastructure networks and demand reduction by organisations within these networks. In particular the current restructuring of the electricity sector has received much theoretical attention in this respect (Hirst, 1994; Intorcio, 1995; Sioshansi, 1994). Also, many studies have been published which focus on actual changes in regulatory regimes in one country (Collier, 1995; Hvelplund, 1995; Surrey, 1996) or which compare regimes in two or more countries (Bakken and Lucas, 1994; Walz, 1994).

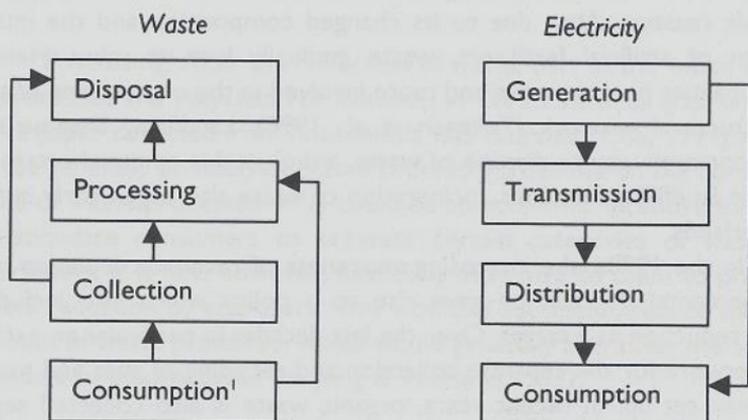
However, the number of cross-sectoral studies in this debate seems far less abundant (e.g. Guy and Marvin, 1996). As far as we know, no generally applicable framework for such a cross-sectoral comparison has been developed, so, before analysing the Dutch waste and electricity sectors, we will give a brief outline of the methodology used in this paper.

Both waste and electricity sector can be regarded as a chain of 'functions'. We will distinguish four functions in the waste sector and four in the electricity sector (Figure 7.1).

In the waste sector, consumers of goods produce discards. In this way, they are 'generators' of waste. Discarded materials and products are collected and either processed or disposed of directly. After processing, part of the former waste is reintroduced into the product life-cycle as a useful product or material; the rest still has to be disposed of. In the electricity sector, electricity is generated, transmitted, distributed and finally consumed by end-users. An important alternative is the direct generation of electricity by end-users, in particular by so-called *cogeneration* (CHP) plants of industrial end-users.

Each of the functions distinguished can be carried out by an organisation whose only task it is to perform this particular function. In this case, the organisations are called *unbundled*. However, in practice it is

quite common that organisations perform more than one function in the chain. This is often referred to as *vertical integration*.



¹ Consumers produce discards and 'generate' waste

Figure 7.1 Functions in the Waste and Electricity Sector

We will first analyse organisations performing a certain function separately, as if they were unbundled. Our key question is: is it economically attractive to organisations in the existing situation to stimulate demand reduction initiatives? We will then turn to the consequences of the actually existing, partly integrated situation.

The Dutch Waste and Electricity Sectors

In this section, after a short historical outline, the present situation in the Dutch waste and electricity sectors is described. First of all, we look at the functions in the waste sector: disposal; processing; collection; and consumption. Secondly, we turn to the electricity sector and focus on generation, transmission, distribution and consumption. Finally, we look at the vertical integration of these functions in both sectors.

The Waste Sector

The first attempts at a systematic collection of waste in the Netherlands were private initiatives in the middle of the nineteenth century. Municipalities granted concessions to these pioneering waste

entrepreneurs who started with household waste collection. This waste had an economic value: it was almost purely organic and could in part be sold to farmers. At the beginning of this century it was realised by authorities that waste collection was of vital interest to citizens for hygienic reasons. Also, due to its changed composition and the introduction of artificial fertilisers, waste gradually lost its value. Hence, municipalities became more and more involved in the organisation of this infrastructural network (Tellegen *et al.*, 1996). Landfilling became the most common way to dispose of waste, although due to the shortage of suitable landfilling locations, incineration of waste also began early in the Netherlands.

In the 1970s, the increasing awareness of resource depletion and environmental degradation gave rise to a policy which also included waste reduction as a target. Over the last decades in particular an extensive network for the separate collection and recycling of glass and paper has been set up. In recent years, organic waste is also collected separately.

However, all recycling and waste reduction initiatives so far have not resulted in a significant reduction of the quantity of household waste sent for final disposal: in 1985 3.830.000 tonnes of waste had to be disposed of, in 1994 still 3.730.000 tonnes were sent for final disposal (RIVM, 1995).

Disposal; Most waste in the Netherlands is still landfilled. However, incineration of waste now plays an important role in the final disposal of household waste in particular. In 1995, 35% of all household waste was incinerated, almost as much as the percentage landfilled (41%). A quarter (24%) of household waste was composted (RIVM *et al.*, 1996). Tariffs for the final disposal of waste are set by the number of units to be disposed of (Epema Committee, 1996). As a result of this financial mechanism, none of the organisations involved in final disposal of waste gets an incentive to reduce waste production from an economic point of view. This holds in particular for waste incinerators, which do have very high investment costs and correspondingly long write-off periods.

In fact, rather than stimulate demand reduction, incinerators have a financial interest in attracting waste. In particular, competition for waste from industry and commerce between incinerators in the Netherlands presently occurs which results in shipments of waste from one Province to another. A newly built incinerator in the province of Gelderland, for instance, with a capacity of 240 000 tonnes was expecting to incinerate only 70-80 000 tonnes in 1996 and tried to get waste from the

Northern Provinces. It even tried to get contracts for waste from Germany (Wester, 1996). Only an intervention of the Ministry of the Environment finally prevented the import of German waste (Huisman, 1996).

Processing; After the collection of waste, part of the waste stream is processed and recycled. For instance, in 1993 76% of all glass and 66% of all paper collected from households was recycled (CBS, 1994). Profits of the generally privately operated processors, depend on the number of units of waste processed. This could be an economic incentive for them to stimulate consumers to separate certain categories of waste for processing. It is not, however, financially attractive to them to promote waste reduction by end-users. This would, if successful, reduce the total amount of waste produced, which would generally also affect the amount of waste to be processed (de Jong & Wolsink, 1997).

Collection; Waste collection from captive customers, generally households and small-scale enterprises, is the responsibility of municipalities. Tariffs for waste collection from captive customers are flat, i.e. not dependent on the quantity of waste produced. They are also cost-plus based, which means that collectors can reimburse their costs and make a certain, regulatory approved, profit per unit of waste. Since, in this case, there is no direct link between the total quantity of waste collected and profitability, economic efficiency considerations do not necessarily provide incentives to the operators of captive waste collection to increase the amount of waste collected. It could be argued that, for economic reasons, they would have a stimulus to reduce the quantity of waste collected, since their profits are not dependent on this quantity whereas their costs are. However, this is only partly true since, as a result of the existing monopoly, they can reimburse their costs by charging higher tariffs to their captive customers. The collection of waste from non-captive customers, on the other hand, is mostly privately operated and profits of private investors depend on the volume of waste collected. In order to increase profits, these collectors would be stimulated by the financial mechanism to collect more waste.

Consumption; Tariffs for captive waste collection are non-quantity based. Hence, in theory these consumers do not have an economic incentive to reduce their waste production. Despite the fact that recycling rates in the Netherlands - in particular of glass and paper - are already high, experiments with quantity-based tariffs for households

show that the quantity of waste sent for final disposal can still be reduced significantly. In 1994, it was estimated on the basis of the preliminary data of several pilot projects that a reduction of 50-70% in household waste sent for final disposal could be obtained as a result of providing new possibilities for separate collection, in particular of organic waste, in combination with quantity-based tariffs (IPH, 1994). More recent figures are less optimistic, but nevertheless show a range of 15-60% waste reduction (IPH, 1995). Non-captive consumers, which are generally larger enterprises and industry, already pay per unit.

The Electricity Sector

In the nineteenth century, some private companies in the Netherlands started with electricity supply on a very limited scale. Similar to the waste sector, municipalities took over the initiative as soon as the importance of this infrastructure network for the public was realised. Many local and regional networks developed, which in the 1950s were connected to form one national grid (Tellegen *et al.*, 1996). Over the last decades a continuous process of reorganisation took place in Dutch electricity supply, of which the most important features were the ever increasing scales of organisations as a result of mergers, the formal unbundling of generation and distribution in 1989, and the present gradual liberalisation of the market.

Demand management became a policy item in 1973, when the first comprehensive energy policy plan was published. In recent years, distribution companies became the main actors responsible for these demand reduction activities. Despite some undoubted successes, electricity demand in the Netherlands continues to rise. Over the last 10 years, electricity demand via the national grid has risen from under 60 TWh/annum in 1986 to almost 80 TWh in 1996 (Sep, 1997).

Generation; Like incinerators in the waste sector, electricity generators do have high investment costs which require full operation of built generation capacity. For instance, UNA, one of the four Dutch generation companies, invested 356 million Dutch guilders in 1995 to build just three new plants (UNA, 1996).

In recent years, the four electricity generating companies in the Netherlands have made large efforts to reduce emissions. An improvement of conversion efficiency, which is also in their own economic interest, has contributed to emission reduction as well. Nevertheless generators still have an interest in selling more electricity, since their receipts are based on the number of kWh actually supplied to distri-

bution utilities. In the past, this was of less importance since, due to the monopoly situation (from which only very large consumers were excluded), all costs could easily be passed on to the distributors who, in turn, charged the captive consumers. However, since the 1980s the pressure on the net profit of the generation companies is growing, in particular due to the boom of combined heat and power installations owned by industrial end-users - even more so, since the coming liberalisation of the European electricity market requires a higher solvency of generators than so far. A reduction of this pressure can be obtained on the one hand by reducing costs, on the other hand by trying to increase sales. Of the four central power producers in the Netherlands, UNA was the only company that managed to increase electricity sales in 1995. It was also this company that saw the net result increasing by the highest percentage: 22% (UNA *et al.*, 1996).

Transmission; The organisation responsible for operating the transmission network acts as an intermediary between power production and the supply of electricity to end-users and is also responsible for power production planning. The tariff system for transmission is complicated, but in essence the operator buys electricity from the four generation companies and sells it to distributors, adding its own operational and transmission costs. In this way, the profits of transmission are directly linked to the number of units transmitted. This relationship is even more evident as the transmission organisation in the Netherlands is also responsible for power production planning.

In fact, the Dutch transmission organisation is involved in stimulating electricity demand, although this is motivated for environmental reasons. In the Electricity Plan 1997-2006 it is noted that: 'Energy conservation policy is directed at efficient application of electric energy, which comprises both electricity conservation *and energy conservation directed application of electricity*' (Sep, 1996, p.15: italics added). The introduction of electric cars, for instance, which is promoted by this organisation, would lead to reduced CO₂ emissions but increased electricity demand, according to a study initiated by this organisation (Sep, 1994).

Distribution; Distribution tariffs for both captive and non-captive consumers are unit-based. Hence, distributors would not find it economically attractive to stimulate electricity demand reduction. The fact that they are nevertheless presently involved in demand reduction activities seems to contradict this thesis. It has to be noted, however, that

these activities are financed externally, predominantly by a levy charged to captive consumers on top of the ordinary electricity tariffs. Also, these activities up to now have resulted at best in a reduced growth of electricity demand, rather than in a reduction of demand. They thus hardly interfere with the economic activities of distribution utilities.

The duality in the tasks of distribution companies, stimulating on the one hand electricity conservation and on the other hand gaining profits from selling exactly this commodity, is, for instance, illustrated in the documents of the distribution company EDON. The Environmental Action Plan of this company states that: 'Environmental policy has been for some years a priority of EDON. The company acknowledges its responsibility for the environment and stimulates energy conservation and a 'cleaner' energy-use since three years with selected measures' (EDON, 1994, p.3). On the other hand, the Economic Account over the same year says: 'Compared to 1993, an improved result of 11.9 million Dutch guilders has been obtained. The higher gross margin on electricity due to *increasing sales* as well as lower cost prices, and stabilised personnel and amortisation costs, contributed in particular to this *positive development*' (EDON, 1995, p.15: italics added).

Consumption; Captive as well as non-captive consumers are charged per unit. Hence, it would be financially attractive to them to try to limit their demand for electricity. In recognition of the price responsibility of consumers, since 1996 a unit-based tax is charged on top of the normal tariffs with the explicit aim of reducing demand. Nevertheless, short-term price-elasticity of electricity demand appears low. In a study carried out some years ago it was estimated that household electricity demand would decrease by only 12% if electricity tariffs were doubled (SEO, 1992).

Vertical Integration in the Waste and Electricity Sector

Due to high investment costs, in particular for incinerators and generators, a guaranteed income is important for the waste and electricity sectors. As a result, they have an interest in a constant, or preferably increasing, waste stream and electricity demand. If they are organisationally linked to, or integrated with, organisations performing other functions in the chain, it can be anticipated that they will use their influence to guard this interest.

In both sectors, such an integrated situation presently exists. In the waste sector, incinerators are operated by municipalities, who are also responsible for waste collection. Funds for new incineration capacity are

raised by municipalities together with private bodies. In the long run, therefore, municipalities are substantially involved in carrying the financial risk of operating incinerators.

On the other hand, municipalities are involved in regulation, notably in setting tariffs for the collection of captive waste. As a result of this position, municipalities can pass on costs associated with the incineration and collection of captive waste to households. Or, as one employee of the municipality of Amsterdam noted when interviewed about waste reduction: 'The principal result of a reduced waste production in one year would be a rise in incineration tariffs in the following year' (de Jong & Wolsink, 1993, p.29). Since waste reduction initiatives, which could be financially attractive to municipalities as collectors, are not attractive to those same municipalities as the organisations carrying the financial risk of incineration plant, any waste reduction initiatives on financial grounds are likely to be nipped in the bud.

In the electricity sector, distribution and generation of electricity were legally unbundled in 1989. Nevertheless close links via ownership still exist; municipalities and provinces own distributors, distributors own generators, and the generators jointly own the transmission organisation. These links will even be tightened in future, as the most recent plans suggest. The four generators will merge to one generation company, with shares completely in the hands of distributors (EZ, 1996).

The recent developments concerning the growth of highly efficient, 'environmentally friendly' CHP capacity illustrate the pressure generators can exert on the system due to their links with other functions in the electricity chain. After the unbundling of distribution and generation, a competition between these two functions arose in which the distribution companies stimulated industrial end-users to install CHP plants. These were interesting to distributors for environmental as well as economic reasons. On one hand, these plants contributed substantially to the CO₂ emission reduction goals distributors had set in their environmental action plans. On the other hand, electricity from cogeneration plants proved to be, in many cases, cheaper than electricity from central generation companies.

However, in 1994 due to the unexpected overwhelming success of CHP, an overcapacity of generation capacity was anticipated by the planning organisation. Although alternative solutions would have been possible, for instance a quicker phasing out of central capacity, it was decided, in an agreement between the planning organisation, central power producers and distributors, to cut back the growth in CHP

capacity, leaving central power production largely untouched. Apparently, the four large-scale power producers managed to bring about this agreement in their favour, despite the remaining interests of distributors as well as industrial end-users in CHP. It is doubtful whether this agreement would have been brought about without the links of central generators to the planning organisation (Slingerland, 1997).

A Hypothetical Intervention

Although the waste and electricity sector certainly differ in many respects, in the previous sections we have argued that they are equal in at least two ways which, in our view, represent fundamental drawbacks to demand-reduction initiatives.

Firstly, for almost all actors, costs and income are related to the quantity of waste and electricity that is handled by them. In Table 7.1 this is worked out in some detail.

Table 7.1 Basis of Income and Costs for Actors in the Dutch Waste and Electricity Sector

	Waste sector		Electricity sector		
	<i>non-captives</i>	<i>captives</i>	<i>non-captives</i>	<i>captives</i>	
Incinerators					Generators
<i>income</i>	quantity	quantity	quantity	quantity	<i>income</i>
<i>costs</i>	quantity	quantity	quantity	quantity	<i>costs</i>
Processors					Transmission
<i>income</i>	quantity	quantity	quantity	quantity	<i>income</i>
<i>costs</i>	quantity	quantity	quantity	quantity	<i>costs</i>
Collectors					Distributors
<i>income</i>	quantity	<i>non-quantity</i>	quantity	quantity	<i>income</i>
<i>costs</i>	quantity	quantity	quantity	quantity	<i>costs</i>
Consumers					Consumers
<i>costs</i>	quantity	<i>non-quantity</i>	quantity	quantity	<i>costs</i>

We have also noticed that, as a result, they do not receive financial incentives for demand reduction initiatives. One notable exception is the

tariff charged by waste collectors to captive consumers. Secondly, we have noted that, the importance of constant waste flow and electricity demand is particularly relevant to incinerators and generators as a result of the high investment costs. In both sectors, the interests of these actors are represented in other functions of the waste and electricity chain due to the entwined ownership and operational relations.

Many regulatory interventions are possible to counteract these two, in our opinion, fundamental drawbacks to reduction initiatives. Also, many regulatory measures aimed at stimulating reduction initiatives in the infrastructure networks we examined have already been taken. However, given the fact that the quantity of waste sent for final disposal has not decreased, and electricity demand continues to increase, one can question if the measures that have been taken in the two sectors we have examined are really effective.

In line with other authors, who suggest that more fundamental changes in regulatory regimes of infrastructure networks are needed to provide incentives for demand reduction (e.g. Verbruggen, 1994), we want to propose such an intervention. It is derived from, and applied to the two infrastructure networks we examined. However, as we limit ourselves to some key general features, we think it is worthwhile considering if it might be applicable to other infrastructure networks as well.

Our analysis suggests that an unbundling of organisations who perform more than one function, and a decoupling of profits of organisations from the quantity of waste or electricity handled, would provide a remedy against the problems found. On one hand, the second part of the suggested intervention seems to contradict economic principles. It is, however, already applied in practice in one part of the waste sector we examined: tariffs for captive-waste collection are non-quantity based, as we have noted. Since the income of waste collectors is not related to the quantity of waste collected, whereas their costs are, in theory they would have a financial incentive to stimulate consumers to reduce the quantity of waste offered for collection and final disposal.

However, a condition for this incentive to hold is a competitive situation. In the present monopoly situation any collectors' costs can be simply reimbursed by a higher tariff charged to captive consumers. Therefore a third element to an intervention would be needed: the introduction of competition. This would also be in line with trends in both sectors that are currently emerging. If collectors, and correspondingly distributors, received a fixed allowance per customer, competition would have to concentrate on reducing costs and increasing service.

Collectors/distributors could reduce their costs by stimulating consumers to reduce waste production and electricity demand.

On the other hand, flat tariffs which would normally result from the fixed allowance to collectors/distributors would not give an incentive to consumers to reduce waste production and electricity demand. To combine a quantity-based charge to consumers with a fixed allowance to collectors/distributors, establishment of an intermediate financial facility would be needed to which consumers pay their bills and from which collectors/distributors receive their allowances. A municipally administered demand management fund could provide such a facility. A condition would be a strict curtailment of municipalities to this task, leaving the remaining functions in the waste and electricity sectors to other organisations in order to prevent a complexity of interests.

Hence, the proposed intervention consists of five elements:

1. Unbundling of functions;
2. Introduction of competition on the collector / distributor level;
3. Fixed allowance, non-quantity based, to collectors/distributors;
4. Quantity-based bill to consumers;
5. Establishment of a municipally administered demand management fund.

In Table 7.2 the tariff system we propose is worked out. In addition, an example for calculation of tariffs in the new system is given in Table 7.3. We want to show, by a largely simplified example, that waste reduction, after the suggested intervention, is financially attractive to collectors and households, though not to incinerators. Profits after intervention, as compared to the existing situation, are shown.

After the proposed regulatory intervention, collectors/distributors would act as an independent buffer between the interests of incinerators/generators and the consumers. As a result of the fixed allowance, it would be in their interest to stimulate consumers to reduce waste production and electricity demand - contrary to the interests of incinerators and generators. The allowance, in our view, would have to be based on the average waste production and electricity demand per consumer. Obviously, this can only work if the differences between consumers are not too large. Hence, customers would have to be divided into categories. Judged from the present situation for captive consumers in the waste sector, households could represent one category. Other categories could be small-scale businesses and various categories of industry, for instance.

Municipalities could be the actors administering the funds to which consumers pay their bills. They would have to sign contracts for their

area for which the collectors/distributors would have to compete. By estimating in advance what the average demand in a municipality for the various categories of consumers in the contract period would be, collectors/distributors could determine against what allowance they would be willing to collect waste or supply electricity. The lower the average estimated, the cheaper the contract they could offer.

Table 7.2 Income and Costs of Actors in Dutch Waste and Electricity Sector after Intervention

	<i>non-captives</i>	<i>captives</i>
Disposers / producers		
<i>income</i>	quantity	quantity
<i>costs</i>	quantity	quantity
Processors / transmission		
<i>income</i>	quantity	quantity
<i>costs</i>	quantity	quantity
Collectors / distributors		
<i>income</i>	<i>non-quantity</i>	<i>non-quantity</i>
<i>costs</i>	quantity	quantity
Consumers		
<i>costs</i>	quantity	quantity

After a contract had been signed, the municipality could determine the tariff charged to customers that was needed in order to maintain the fund from which the allowance to collectors/distributors would be paid. Any surpluses from the fund could be used for additional financing of demand-reduction initiatives.

Although this proposal might seem far-fetched, it should be mentioned that, on a small scale, pilot projects with such demand reduction funds are already being undertaken in the Netherlands. In one southern province, quick-scans for waste reduction possibilities at commercial enterprises are paid from a fund which is financed by the province and other organisations. If the quick-scan reveals economic waste reduction options, its costs (plus a certain amount that is used to refill the fund) have to be paid by the enterprise; otherwise the quick-scan is free of charge (Verspeek *et al.*, 1997).

Table 7.3 Tariff Calculation after Intervention. Example: Households in the Waste Sector

(Dfl)	Situation 1 12.5 kg waste/week per household	Situation 2 10 kg waste/week per household	
Consumer			
Variable costs	5	4	(-20%)
Profit		+ 1	
Collector			
Income	3	3	(fixed)
Variable costs	2	1.60	(-20%)
Fixed costs	1	1	
Profit		+ 0.40	
Incinerator			
Income	2	1.60	(-20%)
Variable costs	0.65	0.55	(-20%)
Fixed costs	1.35	1.35	
Profit		- 0.30	

Assumptions

- I. Data from IPH (1994, 1995) suggest a waste reduction of 50-70%, respectively 15-60% by quantity based tariffs. Here we assume a waste reduction per household of 2.5 kg / week, or 20%.
- II. In situation 1 (the existing situation), the income of collectors and incinerators is set equal to costs of consumers. Profits of collectors and incinerators in the existing situation are disregarded.
- III. In situation 2 costs of consumers are calculated per kg of waste, income of collectors is fixed.

References

1. In 1993, average waste production per household per week in the Netherlands was 12.5 kg (Cornelissen *et al.*, 1993).
2. In 1993, average fixed charge for household waste production was Dfl. 261 per year (AOO, 1995). This would amount to Dfl 0.40 per kg per week. This amount is taken as costs / kg in situation 2.
3. The average fixed charge for household waste production in 1993 consisted of 60% collection costs and 40% incineration costs (AOO, 1995). Of the Dfl 5 charged to consumers per week in the initial situation, Dfl 3 therefore goes to collectors, Dfl 2 to incinerators.
4. Costs of collectors consist of 33% fixed costs, and 67% variable costs; estimates based on TME (1996).
5. Incinerators have 67% fixed, and 33% variable costs (AOO, 1994).

Discussion and Conclusions

Having introduced and described the suggested intervention, we want to discuss now some of its consequences. Obviously these are quite hard to predict for such a drastic change, but we will try to address three key questions: (1) Does the proposed intervention result in an incentive for demand reduction, i.e. is it effective? (2) is it economically efficient? (3) does it interfere with the reliability of service provided?

Effectiveness; Looking at the actors that have been highlighted, the intervention is meant to give incentives for demand reduction to collectors/distributors and to consumers as a result of the proposed changes in the tariff system. The intervention does not give incentives to incinerators/generators nor to processing/transmission organisations to stimulate demand reduction.

A possible drawback on the consumer level could lie in the price-elasticity of demand. The intervention is based on the supposition that consumers will indeed reduce their waste production if charged by quantity. The experience in this respect in the waste sector is limited to a few pilot projects. In the electricity sector, where tariffs are already based on quantity, short-term price-elasticity of demand appears low. On the other hand, consumers do not so much ask for electricity itself as for the tasks that can be performed with it, such as lighting, using audio-visual equipment, etc. That there are substantial possibilities for efficiency improvement which would reduce electricity demand is suggested by various research projects (e.g. WNF, 1994) and also acknowledged by policy makers (EZ, 1995).

A strong emphasis is put on the activities of collectors/distributors, who have to initiate reduction initiatives out of financial self-interest. If the intervention is to be effective, it is crucial in this respect that their position is strong enough to counteract tendencies against reduction which are likely to come from the incineration/generation level. A strict unbundling, including unbundling of ownership relations, is needed to prevent mixed interests here.

Economic Efficiency; The intention of the intervention is to create incentives for economic efficiency through the introduction of competition at the collector/distributor level. These actors have to compete for contracts to be signed with municipalities who administer the funds. On the other hand, the introduction of an additional financial level between

consumers and collectors/distributors could result in increased bureaucracy which would interfere with economic efficiency.

Paradoxically, economic efficiency is also possibly endangered by the effectiveness of the intervention. If the intervention is effective, and a substantial demand reduction occurs, the income of the fund that is meant to cover the allowances to collectors/distributors might not be sufficient to cover the expenses. In addition, through the introduction of quantity-based tariffs, anti-social behaviour of consumers - such as littering in the waste sector - is stimulated. The control that would be needed to prevent this kind of behaviour also interferes with economic efficiency.

Reliability; The essential point concerning reliability of service in both sectors is whether collectors/distributors would be willing to sign contracts with municipalities that for some reason (e.g. high average consumption, low allowance offered) appear less attractive to them. This problem is shared with all competitive systems where an equilibrium between supply and demand has to be found in the market. An obligation for municipalities to assure a reliable waste collection and electricity supply would help to increase reliability, although it cannot be ruled out that, in some cases, reliability would be endangered. On the other hand, the extent to which a service is reliable will also be an aspect of competition - selecting those collectors/distributors who offer the right balance between price and reliability.

Summarising, the main advantages of the proposed intervention, in our view, are the financial incentives to collectors/distributors and to consumers for demand reduction, as well as the incentives for economic efficiency by the introduction of competition at the collector / distributor level. Major disadvantages are the likely increased bureaucracy and the possible anti-social behaviour of consumers. Another disadvantage could be the reduced reliability of the system which would result from the introduction of competition. Obviously, further research is necessary to work out in detail the consequences of the hypothetical intervention proposed here. Nevertheless, given the limited effects of regulatory regimes aiming to stimulate reduction initiatives so far, we think it is useful to carry the debate about the role of demand reduction in infrastructure networks along less conventional lines.

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