Transitions in waste treatment as a driver for product life extension

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Abstract: Increasing amounts of energy are used for provision of resources. Recycling, refurbishment and reuse practices are recurring elements in visions of the future low carbon and resource efficient society. Visions of improved waste management practices are, however, confronted with the inherent tensions between current incineration practices and options for waste prevention, sorting at source and recycling.

Denmark has for the past 30 years developed and continuously improved waste incineration technology, which combined with use of the energy for district heating, has become an energy efficient waste treatment process. Previously improved treatment of waste was perceived as closely linked to waste incineration technology and widely shielded from the contextualisation of demands for increased reuse, recycling and improved resource efficiency. This regime seems now gradually to become somewhat destabilised due to increased EU demands for waste recycling, and new opportunities for pursuing strategies of increased product lifetime appear. Swapping and local repair initiatives can be seen as examples of such opportunities. These initiatives link nicely to e.g. policy visions of circular economy that emphasise prolonged product life and stresses the importance of avoiding down cycling of products and material streams. The destabilisation of the old incineration regime thus opens up for new opportunities with both new policies and potentially new social practices.

This paper describes a number of the above-mentioned refurbishment and reuse initiatives and analyses how they engage with the dominant waste treatment regimes. We investigate how these initiatives may take advantage of the ambiguities and tensions, which appear in the break-up of the old regime. In doing this we conceptualise refurbishment and swap initiatives as mediators that generate transformative change by displacing the boundaries and interdependencies within and among the established socio-material order of waste management.

Introduction

Repair, refurbishment and reuse of old products that would otherwise have been lost as waste are important elements in the strategies of the circular economy model, which aims to prolong the life of products and loss of materials. Therefore it is important to investigate strategies to support various reuse strategies. Reuse requires that used products are either swapped, repaired and/or resold before they enter the waste stream or that they are identified and separated after collection in the waste stream. Products are considered waste when they are collected with the household waste or delivered to the public waste management facility. Accordingly preparing products for reuse must be a common element of waste treatment and increased product reuse depends on the setup of the existing waste management system. At European level there are big differences with regards to how waste is collected and treated. In Denmark waste from the construction industry has a very high level of recycling. Wooden elements are recycled as wood fibers or through incineration with heat recovery. Non-organic and non-metallic elements (gravels, cement plaster, pottery, tiles, etc.) are widely recycled as stable construction filler. Other organic material (plastics) is also incinerated with heat recovery. Some Danish cities have the recent years developed material recycling of household plastic waste, although with big problems in

achieving a high level of material recycling. The vast majority of the reused waste originates from the construction industry. Regarding household waste, separate collection systems for glass and paper are in function, but a large developed material recycling of household plastic waste, although with big problems in achieving a high level of material recycling. The vast majority of the reused waste originates from the construction industry. Regarding household waste, separate collection systems for glass and paper are in function, but a large fraction is still incinerated together with the rest of the household waste. As a result about 50% of many metals are lost in the incineration slag. Statistically Denmark is in the mid-range (Figure 1) when it comes to reuse, but at the same time the European country with the highest share of waste incineration.

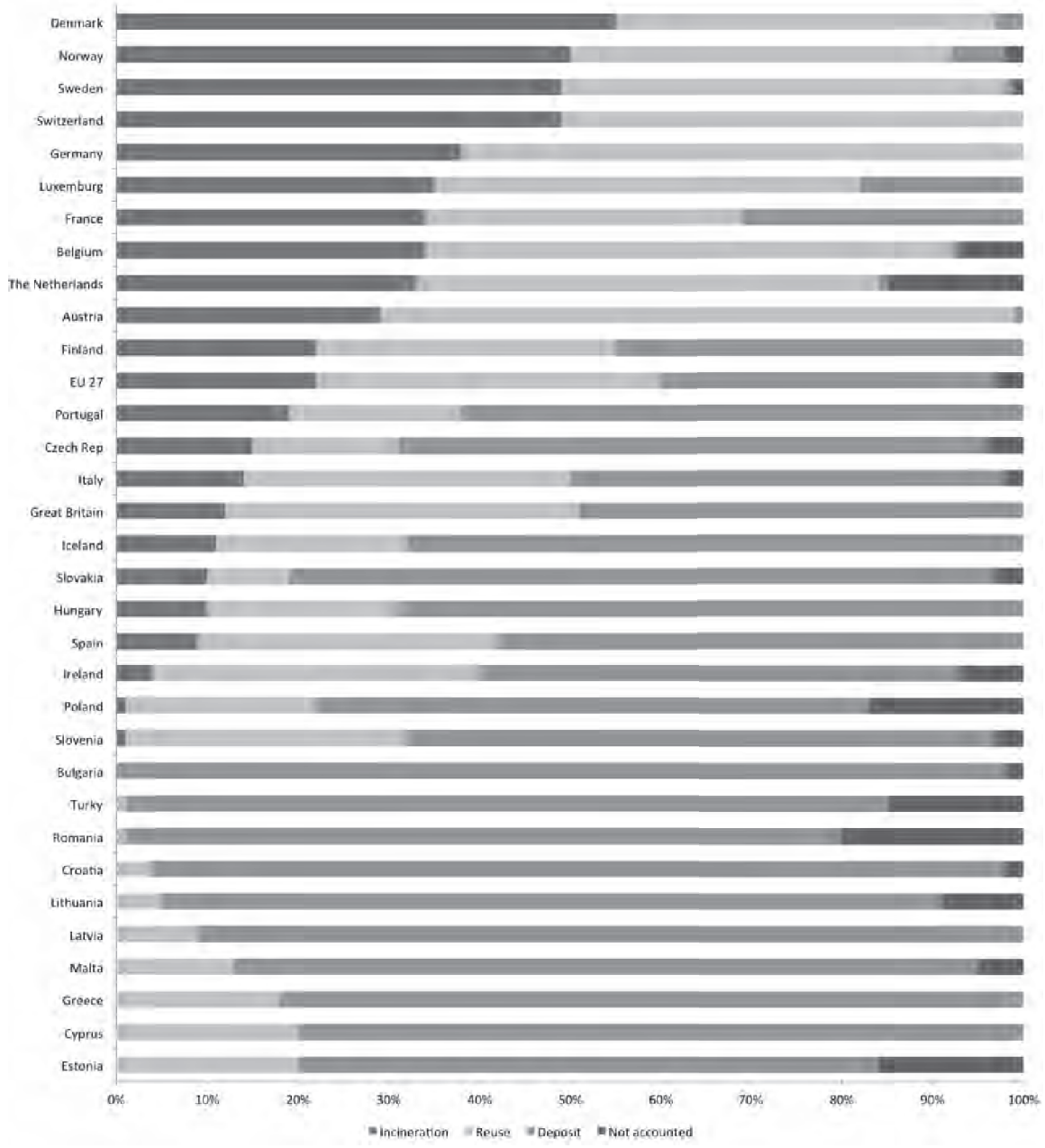

Figure 1. Treatment methods of publicly collected waste in EU 2010. There are big differences with regards to the proportions of recycling, incineration and disposal. Source: Based on data from Danmark uden affald, Regeringen 2014.

This paper investigates how the Danish waste management system is motivated to implement new reuse initiatives under influence of demands of increased product recycling such as the EU target of recycling 50% of the 'dry' household waste (glass, metal, paper etc.) by 2020. The response is identified as changes in specific processes such as swap sheds and repair workshops but also as changes in market structure, user behaviour and regulation. Preparing waste/products for reuse is accordingly conceptualized as a question of transforming the waste management system. Our analytical approach is to understand these systemic changes as elements in sustainable innovation and we use the framework of transition theory to describe the waste management system as an established socio-technical regime.

The paper proceeds with a brief introduction to the concept of socio-technical regimes. This is followed by five brief examples of interaction between reuse initiatives and the existing waste management regimes. The empirical material for this section consists of personal communication and public documents and still needs to be further developed. Finally the paper returns to the question of the challenges of introducing prolonged product life through reuse with multiple owners as a waste treatment alternative to incineration or crude material recycling.

The regime concept

The theoretical argument draws on the idea that industrial activities tend to become institutionalized in regimes whose development is characterized by path dependencies. The path dependent development of regimes implies that specific concerns such as environmental performance are only likely to develop to a point where core regime interdependencies and power structures are not compromised (Geels, 2003; Jørgensen et al., 2007). It is then argued that more and dedicated regime independent development processes may help incumbent regimes to evolve more efficiently by illuminating the possibility of radical alternatives.

The idea of the regime concept as it was originally outlined by Nilson and Wither (1982) is that the problem solving activities of engineer communities over time are likely to develop dominant problem framings and search heuristics, which may on the one may increase efficiency by giving direction to the activities of the community but which on the other hand may also render it blind to alternative problem framings and search heuristics (Kemp et al., 2001). During the past decades this notion of regimes has been gradually expanded along two dimensions. First the concept is no longer limited to the practices of engineer communities. The concept is thus increasing used to explain the direction of broader industrial and societal development processes. Secondly the concept is no longer concerned only with problem framing and search heuristics but has rather been developed to include the broader socio-technical interdependencies and reciprocities underlying established societal practices (Kemp, 2007). Waste management is an example of such interdependencies as it is interrelated to a diverse set of consumption practices, collection systems and infrastructure, market dynamics and waste treatment technologies.

In terms of agency the regime concept implies that everyday practices as well as more deliberate strategic development activities tend to be shaped and conditioned by the prevailing interdependencies and reciprocities characterizing the regime (Berkhout, Smith & Stirling, 2003). Regimes are thus characterized by a set of stabilizing mechanisms which also give direction to development processes such as (i) interdependencies between technologies, regulation and standards (ii) power structures, identities and interests implicit to the division of work division and formally represented by the development of professional interests organizations (iii) cognitive structures and frames which guide the perception of problems and solutions. The current Danish waste management regime is accordingly characterized by the interdependencies between incineration, public ownership of district heating infrastructures versus private ownership of waste as a result of the recent liberalization in the waste sector. Cognitive framings of waste reuse are weakly interlinked and experimental compared to the heavily institutionalized setup of the incineration regime. Because regimes work to focus attention and align a variety of socio-technical structures in a working configuration regimes may be highly productive and innovative for certain purposes at certain periods. In the Danish case the abolition of atomic power has spurred the development of highly efficient coal fired CHP power plants (also for international

export). These combined heat and power plants are however, also highly efficient in utilizing the calorific value of the waste content. Hence most recycling alternatives appear inefficient within the current system setup: Using organic waste for biogas, sorting out plastics and wooden elements from the incinerated fraction will require increased use of coal as compensation.

Embedded actors may find it both unattractive and difficult to develop strategic visions, which do not reify existing regime logics and interdependencies and they may find it even more difficult to mobilize the socio-technical resources, which it takes to materialize regime independent visions of development. In this sense the development and transformation of regimes are argued to be characterized by so-called path dependencies. However, because regimes are structured and because their development path is organized towards addressing certain ends at the expense of others they may be highly counter-productive in addressing alternative ends. Regime specific development paths oriented towards optimizing productivity or user comfort may e.g. be difficult to reconcile with environmental concerns.

In real life regimes and the development path which they define are however less monolithic than indicated above. Development paths are accordingly likely to be characterized by a complex of ends and interests which may be partly contradictory. As much as certain development path characterises a regime, this gives direction to change such a path according to the outcome of a complex of compromises and trade-offs. This entails that dominant development paths to a certain degree will be capable of absorbing new concerns even though the implication of addressing these concerns may contradict with the established orientation of the development path. In the incineration regime separate treatment of distinct fractions such as paper recycling have been gradually accepted.

However, the realization of these concerns should not compromise core regime interdependencies or the core power structures. A more radical shift in the direction of development such as composting of organic household waste thus entails a break from the prevailing development path and the prevailing regime structure, which this path reflects. The organization of such a regime independent development process is recognized to be characterized by high levels of uncertainty as it is not supported by existing institutional arrangements and existing problem solving strategies.

Interactions between reuse initiatives and the waste management regime

If extended product life is to be achieved through new waste management practices, this will require new understandings of when we are managing waste, or managing materials or managing products.

The implementation of the WEEE directive has supported the development of new networks for collecting and treating electronics waste (Lauridsen & Jørgensen, 2010). These are however, all based on massive down cycling through collection, separation and shredding. The EU commission at the time described WEEE as an opportunity for industry to innovate new products, designed for improved disassembly and waste treatment (European Commission, 2002; Hume, Grimes, Jackson & Boyce, 2002). In effect WEEE has supported the expansion of the metal shredding and recycling industry, which has also been supported by the general increase in the price of metals. A fraction of electronic products are reused when they are exported to 3rd world countries. Many of these products are subject to subsequent poor waste handling. The extent of this export is unknown; some estimates are more than 30% (Nordbrand, 2009).

The following section describes how the current Danish waste management regime functions today. We present four examples of the systems responses to new initiatives: (I) A public debate on the need to expand the capacity of the key incineration plant of Copenhagen. (II) The previous organizations of collection of used clothes. (III) The Consumers Councils wishing to extend the guarantee period of larger consumer goods. (IV) The response of the Federation of Danish Industries to the recent spreading of swap sheds and emerging repair facilities at public waste collection sites.

(I) In 2012 it was decided to rebuild and increase the capacity of Amagerforbrændingen, one of the two combined heat and power incineration plants, that burns the waste of Copenhagen and surrounding municipalities.

The decision sparked a public controversy on the waste management system and the impact of increased incineration capacity on reuse and recycling efforts. NGO groups introduced new technologies for waste separation – especially on the household waste – as an alternative. Although political goals to lower the amounts of incineration of unsorted waste were well established, these goals were never influential on the decision to build new ovens with an increased capacity. An existing network of incinerator manufacturers, engineers working with combined heat and power, and consultants were able to produce a very strong report on the economy of the new facility with reference to existing calculative practices and similar technical solutions. The alternative description of the advantages of new waste sorting and recycling technologies was in comparison based on a lot of assumptions. Faced with the challenge of making a choice that involved 500 million Euro, the board of the incineration plant considered, that there was too much insecurity involved with a new technology path, and hence decided to build a new plant with a capacity which is a linear progression of the increase of waste in recent years.

(II) There are many new initiatives concerning the reuse of clothes. For many years it has been an existing practice of NGO's to collect used clothes in containers placed both in the public space for examples in parking lots near supermarkets but also in the public waste collection centres. Some of these clothes are resold in second-hand shops, but the vast majority is exported for use in the 3rd world. Independent of this a large-scale commercial clothing retail chain has launched an initiative, where the customer is encouraged to take back old, used items for material re-cycling in return for a small gift-certificate offering a 15% discount on one piece of new clothes. Concerning clothes that are actually reused in the Danish context, the Danish Fashion Institute last year launched an annual public 'swapping-market' during the Danish Fashion Week. Other initiatives are organized clothes swapping and clothing-libraries such as Share Your Closet where subscribers contribute to a shared virtual wardrobe. Recently the City of Copenhagen has announced that it has agreed to organize a more comprehensive collection of clothes together with the clothing sector and NGOs. It is still unclear how this system will actually function.

(III) The Danish Consumers Council has repeatedly raised the issue of extending the period of consumer warranty from two to five years on larger consumer goods as for example washing machines. Some consumer-oriented politicians are now in support of this, but the Danish Trade Association has voiced an explicit critique of such initiatives. It will, according to them, only lead to more expensive products because shops will be required to stock large inventories of repair material. Clearly a requirement of a five-year lifetime will be easier for some manufacturers than others, and there will be a change in the set-up of the market. Selling products with a five-year warranty may require not only products with an improved quality and lifetime, but also an organization where there is increased need of competences to service products and maintain customer relationships. These competences are very far from the core business model of the domestic appliance outlets that dominate the market today.

(IV) Swap sheds and repair facilities are now spreading rapidly in Denmark. The most prominent examples are in Næstved, Hjørring and Sønderborg. In Næstved the workers at the public waste collection facility actively engage with the public when they come with reusable items. Before throwing them in the container, the public is asked to reconsider their waste as potentially reusable products and hand them over to the workers, who will take them to the swap shop. The swap shop includes easy repair facilities and a very popular outlet, where recycled products can be bought cheap. The swap shops have a relatively low but rapidly increasing turnover in 2014 (approximately 30.000 €/year), and new swap shops are now opening up at many waste management facilities following the examples of Næstved, Hjørring and Sønderborg. Customer surveys indicate that product swaps may substitute as much as 70% new goods (Johansen, 2014). The initiative in Næstved is locally considered to be both a product reuse and an employment initiative providing jobs to a provincial area, where there is a relatively high rate of unemployment. Interestingly, the most developed examples of waste reuse in Næstved, Hjørring and Sønderborg are all peripheral municipalities on with high unemployment rates.

In February 2015 the Federation of Danish Industries (DI) made a formal complaint about

the legality of swap-sheds, outlets and repair-shops (DI, 2015). DI complains about the public being asked at the waste facility to consider their waste as reusable products. According to DI the public waste collection centres are obliged to let the waste they receive be subject to 'waste treatment' especially concerning the WEEE waste. It is still unclear what impact this complaint will have but it is clear that definitions of waste and waste treatment for reuse and recycling are at stake. Clearly the reuse activities have now reached a level, where they are considered a potential threat by the established materials recycling industry.

Discussion and conclusions

There is a strong current waste manage regime which is dominated by incineration practice. The big incineration plants operate as publicly owned companies, which are technically aligned with systems providing district heat and electric power. All households are obliged to have their waste collected by these companies. There are similarities with regards to how the different fractions are managed but also differences. There is for example a longstanding tradition for the collection and distribution of used clothes by charity organisations. It has never been questioned whether charity organisations such as the Red Cross should be allowed to collect and resell clothes. On the other hand they have also never really challenged the existing institutions such as the market of new clothes.

When The Federation of Danish Industries objects to whether waste facility workers can ask the public to donate their products to reuse, it is also a question of product ownership. Who can decide what should happen to the product once the previous owner leaves it? The WEEE directive stipulates that the electronics industry must set up collection systems for waste electronics. But if products can be reused they are not waste and should accordingly not be left to a collection system, which treats the products as a mixed materials stream and hence applies a number of separation processes to it. What is the legislative implication of the waste hierarchy, and can it support to establish that 'proper waste treatment' can also be product refurbishment and reuse?

Critique of incineration as the dominant type of waste recycling has together with increasing material prices and increased political awareness of the availability of scarce resources (metals) led to an increased focus of waste as material streams. The parallel liberalisation of the waste management has led to the development of new commercial and industrial networks of waste separation, material sorting and material recycling. These networks constitute strong path dependencies in the waste management regime, and they actively try to resist new initiatives of direct product reuse.

Incineration facilities are changing their identity to resource centres and energy providers. Surprisingly, there are also many experiments within these organizations to not only burn the waste but also to improve the separation of materials for recycling and even preparing waste products to be resold and used again. This is most prevalent in the peripheral parts of Denmark, where public reuse initiatives are closely linked to employment policy. Creation of local jobs has a high priority in these municipalities and job creation may function as a shielding niche where experiments with reuse systems can be developed without competing on the regular market of products and materials.

There are strong policies for improved recycling of materials at both national Danish and transnational EU level. While these policies with notions such as material circularity may function to stress the current incineration dominated waste management regime, they do not by themselves provide reconfiguration of the current waste management networks. Rather alternative networks related to employment policy appear to be productive in providing alternative setups that can stimulate reuse of increasing quantities of products.

In order to improve the possibilities of extending product lives, it is necessary to also address the situation where products are discarded and become waste to the consumer. Waste management is a heavily institutionalized field and consumers' behaviours with waste are strongly influenced by deep-rooted practices. Extending product life thus touches upon the interplay of multiple regimes: waste management, heating, electricity, and materials (metals) recycling.

Swap initiatives only have a limited impact as mediators of transformative change when are decoupled from the existing waste management system. However, refurbishment

and swap initiatives as niche initiatives may develop into wider accepted practices if they succeed in linking up with the established waste management system. This interlinking may literally take place by setting up repair workshops at local waste collection facilities. But also social and institutional links are important. Attempts to frame new product reuse initiatives, as elements in employment policies appears to be a promising option for the further development.

Clearly there will be no transformation of the waste system by just demonstrating that many products are still functioning or easily refurbished to become functioning again. As isolated elements refurbishment initiatives are not strong transition mediators today. The current waste management system treats all waste as material stream and is as such not disinterested in products and functional entities. Rather, extended product life by reuse and refurbishment will require new cognitive framings, institutional frameworks and social practices that engage with used products in order to save them from ending up as material streams.

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