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THE DEVELOPMENT PROSPECTS FOR THE RECYCLED MATERIALS MARKET IN THE EU

Abstract. The functioning of two markets, one for original materials and another for recycled materials, implies problems caused by the interaction between them. The dominant position of the original materials market may curb the development of the recycled materials markets due to the application of various practices (for instance, price policies) decreasing the competitiveness of producers operating in the recycled materials market. It has to be stressed, though, that for most sectors of the recycled materials market in the EU the concentration rates take lower values, which means a higher degree of market dispersion.

An important issue in the functioning of a recycled materials market is the measurement of its performance. The factor that largely reduces the effectiveness of a market for recycled materials is the unpredictability of their prices. According to observations, neither demand nor supply is flexible in the recycled materials market. The range of changes in the prices of recycled materials is usually larger than in the case of original materials. It can be presumed therefore that the high price volatility of recycled materials „puts a brake” on investments related to reverse logistics.

The functioning of the recycled materials market also depends on the sources of waste. In terms of economy, the most profitable to use in manufacturing is waste generated by the sphere of production, while the post-consumer waste is the least effective.

Key words: secondary market, recycling, wastes.

1. INTRODUCTION

The world's population faces today the challenge of increasing exploitation of natural resources, on one hand, and limited waste disposal capability, on the other. These two trends originate in the expanding needs of the public that expects to have high-tech products embodying state-of-the-art technologies at both home and work. Because innovations bear on economic competitiveness on a micro scale (enterprises) and macro scale (countries or geographical regions), new products appear in the market. Consequently, the world is currently struggling with serious environmental problems: waste and used products that

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have been prematurely removed from the market (Platt B., Hyde J. [1997], pp. 13–38)¹. Another problem haunting the world, including the European Union, is the limited capacity of waste disposal sites (Knemeyer A.M., Ponzurick G.T., Logar M.C., [2002], pp. 455–479)². Recently, Naples and Palermo were paralysed by their problems with municipal waste, which illustrates the magnitude of the problem³.

Therefore, the existing approach to waste must be modified and the possibility of reusing products that have already been withdrawn from the market reconsidered. The reprocessing of used products, including their recycling, is a solution that has been spreading in the global economy. It is particularly popular among developed countries, where waste reprocessing is managed on a systemic basis. This paper attempts to forecast the development prospects for the recycled materials market in the EU and identify major factors influencing its functioning.

2. WASTE PROCESSING

The immediate effect of increasing consumption is the necessity to utilize larger amounts of primary raw materials and energy, which results in the depletion of finite natural resources. Besides the excessive exploitation of resources and insufficient waste disposal capacity, the electrical and electronic equipment contains hazardous substances such as lead, cadmium or hexavalent chromium that pose another environmental risk. As a result, the global ecosystem cannot cope with environmental degradation (Beamon M.B., Fernandes C. [2004], pp. 270–281).

Waste reprocessing offers the following benefits:

1. Economical use of natural resources. Using reprocessed materials as the substitutes for primary natural resources allows reducing the intensity of exploitation of oil deposits, metal ores and minerals.
2. Energy savings. Reprocessed materials and components used to manufacture new products usually involve lower energy consumption than the primary resources used for the same purpose.

¹ It is estimated that 60 million new computers enter the US market every year. At the same time, 12 million computers leave the market, of which less than 10% are recycled and the rest is removed to the waste disposal sites. The situation in the European Union is similar, but the US case was mentioned for the lack of EU data.

² The US Environmental Protection Agency estimates that 29 states have disposal capacity to last for the next 10 years or longer, in 15 states it is 5-10 years and in 6 states less than 5 years.

³ <http://wiadomosci.onet.pl/1981094,12,item.html>. *Kryzys śmieciowy – płoną pojemniki na odpadki.*

3. Clean air and water. Manufacturing goods from reprocessed materials generates less air and water pollutants compared with manufacturing processes based on the primary resources.

4. Lower demand for waste disposal capacity. Waste and components are not discarded, if reprocessed to manufacture new products.

5. Lower financial demands. Manufacturing goods from recycled materials is cheaper compared with the inputs of primary raw materials.

The direct benefits (lower demand for waste disposal capacity and lower manufacturing costs) and indirect benefits (lower external costs of management processes) result from refocused economic policy. Reducing the amounts of generated waste becomes one of the most important issues in industrialized countries and contributes to a gradual replacement of the one-way model of management. Customers expect that enterprises will moderate the negative impacts of their products and processes on the environment (Mohr L.A., Webb D.J., Harris K.E. [2001], pp. 45–72)⁴. Legislation extending producers' responsibility for their products has become a major part of the governments' environmental protection policy. Many countries, especially EU member states, have introduced environmental laws that make producers accountable for the entire lifespan of their products. The obligatory collection and reprocessing of used items applies to many product categories, i.e. electronic equipment in the EU and Japan, end-of-life vehicles in the EU and on Taiwan, waste packaging in Germany. Enterprises see new opportunities in combining an environmentally safe model of management with the potential for profits resulting from cost reduction and entering new market segments. In the last decade, this approach translated itself into a fast increasing volume of the reprocessing business, regarding both the range of activities and the scale of reprocessing.

Waste reprocessing is closely connected with waste generation. Waste volumes generated in particular EU member are very much at variance. A good example is municipal waste. In 2007, an average per capita quantity of waste produced in the EU was 522 kg. This rate was the highest in Denmark (801 kg), Ireland (786 kg) and Cyprus (754 kg), whereas Slovakia (309kg), Poland (322 kg) and Romania (379kg) were at the other end. The main reason for the large discrepancy between municipal waste volumes is the different levels of economic development in particular countries and their socio-economic processes.

⁴ Corporate Social Responsibility has four dimensions – economic, legal, ethical and philanthropic – that require organizations to meet social needs while attaining their own economic goals.

Table 1. Modes of municipal waste management in the European Union in 2007

	Generated municipal waste (kg per capita)	Municipal waste management (%)			
		Discarded	incinerated	recycled	biodegraded
EU average	522	42	20	22	17
Belgium	492	4	34	39	23
Bulgaria	468	100	0	0	0
Czech Rep.	294	84	13	2	1
Denmark	801	5	53	24	17
Germany	564	1	35	46	18
Estonia	536	64	0	34	2
Ireland	786	64	0	34	2
Greece	448	84	0	14	2
Spain	588	60	10	13	17
France	541	34	36	16	14
Italy	550	46	11	11	33
Cyprus	754	87	0	13	0
Latvia	377	86	0	13	1
Lithuania	400	96	0	2	2
Luxembourg	694	25	47	0	28
Hungary	456	77	9	13	1
Malta	652	93	0	2	5
The Netherlands	630	3	38	32	28
Austria	597	13	28	21	38
Poland	322	90	0	6	4
Portugal	472	63	19	8	10
Romania	379	99	0	1	0
Slovenia	441	66	0	34*	n/a
Slovakia	309	82	11	2	5
Finland	507	53	12	26	10
Sweden	518	4	47	37	12
UK	572	57	9	22	12

*The Slovenian recycling data include biodegradation.
Source: Eurostat Newsrelease 31/2009, 9 March 2009.

In addition to the municipal waste volumes and their diversity, it is important for a discussion of the development prospects for the recycling materials market to refer to the modes of waste management (see table 1). Their basic categories are:

- 1) disposal,
- 2) incineration,
- 3) recycling, and
- 4) biodegradation.

The above classification can be used to divide EU member states by their mode of handling municipal waste, which provides grounds for predicting future

changes within municipal waste. The **first group** consists of countries that primarily dispose of their waste, as a result of which large quantities of waste build up, contributing to an even bigger problem in the future (Bulgaria, Romania, Slovakia, Poland, Hungary, Lithuania, Latvia, Cyprus, Greece, the Czech Republic)⁵. The **second group** comprises countries promoting incineration as the main way of dealing with waste (Denmark, France, Luxembourg, the Netherlands, and Sweden)⁶. The **third group** is countries opting for recycling as a waste management method (Belgium, Germany, Estonia, Ireland, Slovenia, and Sweden)⁷. The **last group** is countries where waste undergoes biodegradation, such as Italy and Austria⁸. It follows from the classification that EU member states employ different waste management strategies that reflect the availability of technologies in particular countries.

A comprehensive approach to the waste management problem involves integrated, i.e. systemic, solutions. The leaders in municipal waste management are Belgium, Denmark, the Netherlands, Germany and Sweden that deposit less than 5% of their municipal waste. Essentially, this suggests that the volume of generated waste is not a problem. However, implementing processes that enable the recovery of energy or materials that determine the long-term impact of the waste problem does pose a problem.

A similar analysis to that presented can be conducted for selected flows of waste in the OECD countries (table 2). Waste perceived as a residual effect of economic processes reflects a unique economic profile of a particular national economy.

Because data on some of waste flows are not available, a comprehensive analysis of the generated industrial waste could not be performed. The reason is imperfections in the waste generation monitoring system⁹. However, reports on waste packaging are relatively reliable. They indicate that the models of goods flows in an economy make use of different types of packaging. The primary packaging materials are paper, plastics, metals and glass that have their corresponding systems for handling the flows of waste packaging. It is notable that the existence of different types of packaging materials results in the functioning of many, frequently different waste management solutions (systems).

⁵ Over 75% of waste generated in the countries is deposited at the disposal sites.

⁶ Over 1/3 of municipal waste in the countries is incinerated.

⁷ These countries recycle more than 1/3 of the municipal waste. In the author's opinion, a **thesis** can be put forward that the level of recycling may serve as a measure indicating the degree of utilization of the reverse logistics concept in a given economy. A confirmation can be the total volume of waste deposited at the disposal sites. In countries making practical use of reverse logistics theory, the percentage of deposited waste is lower compared with those applying a classical, linear model of management.

⁸ More than 30% of municipal waste in Austria and Italy undergo biodegradation.

⁹ For many countries, the monitoring of generated waste poses a large problem. Because efficient systems for collecting information about waste are not available, the estimates are frequently used in discussions.

Table 2. Selected flows of waste (in thousand tonnes) in selected OECD countries

Country	Year	Building waste	Dredge	Sewage	Excess	End-of-life vehicles	Worn-out tyres	Electrical and electronic appliances	Mineral and synthetic oils	Waste packaging				
										total	paper	plastics	glass	metals
Austria	2004	28600		264		150	55	120	43	804	408	135	188	36
Belgium	2003	16951		110	116950					1624	593	278	419	141
Czech Rep.	2004	11472	318	178		11	18	22	89	420	204	60	24	12
Denmark	2003	3785		140		150	41			856	502	157	156	41
Finland	2004	20843		160	11	159	37	15	49	451	255	87	68	41
France	2004			964		13000	336	1700	386	12400	4280	1980	3130	710
Germany	2004	178559		3085		459		2099	503	15517	6947	2255	3073	904
Greece	2003	5000		80		30	52	170	85	989	370	300	180	94
Hungary	2004	4239		194		73	8	24	142					
Iceland	2004	17		1	45	45	5		5	65	20	21	9	1
Ireland	2005	14931	239	42		93	34	59		925	326	218	144	74
Italy	2005	46459				1135			220	11951	4315	2100	2117	631
Luxembourg	2004	6806	10	12		13	6	3	5	85	29	10	23	7
The Netherlands	2004	24000		548		283	109	67		3211	1460	549	549	213
Norway	2005	940		103		121	28	169	189	709	379	132	46	35
Poland	2005			1124							96	41	99	7
Portugal	2004			299		177	68		54	1430	520	345	367	106
Slovakia	2004	795	62	568	17	19	7	3	6					
Spain	2004			1012		789	306			7375	3119	1407	1627	492
Sweden	2004	7258	3370	580		476	63	154	104	668	454	29	152	33
Switzerland	2004	11900		205		300	50	78		1177	584	250	318	25
UK	2004	109000	15770	1422		1500	481	1000		10230	3726	1846	2400	833

Source: OECD Environmental Data. Compendium 2006–2008, p. 8.

The systems applied to handle particular flows of industrial waste, including packaging, and of municipal waste determine the scale of waste recycling and form the market for recycled materials.

Factors influencing the functioning of the recycled materials market

The market for recycled materials has been steadily growing in the recent years, in both Europe and worldwide, driven by a range of factors, such as:

1. The implementation of environmental laws, especially the designation of recycling levels to be reached by particular flows of waste in the years to come,
2. Growing enterprises' interest in recycled materials, stimulated by economic benefits arising from the replacement of primary raw materials in technological processes,
3. Technological advancement, allowing mass recycling of waste,
4. The development of flexible manufacturing systems, capable of applying recycled materials,
5. Government initiatives introducing recycling policies and financial instruments (product fees) and taxes (levied on waste disposal sites) that contribute to the internationalization of external the costs.

The above factors decide about the sizes of the recycled materials markets in particular member states. A comprehensive approach to the market's functioning makes us consider both the supply side (i.e. the materials entering the recycling system) and the demand side (the different types of expected outputs). Many EU member states develop their recycling materials markets based on another country's recycling systems¹⁰. Then the problem is external costs of waste recycled in a foreign country.

Many authors emphasize that the recycling levels of potentially recyclable materials are **suboptimal**, both economically and ecologically (OECD, [2004]). This awareness encouraged the governments in many countries to introduce instruments such as state-supported collection systems for municipal waste, obligatory selective collection of waste, indicators defining the content of recycled materials in new products, public procurement, etc. The instruments directly affect the level of recycling, as they help minimize the costs of acquiring waste, while boosting the demand for recycled materials.

A discussion of factors supporting the growth of the recycled materials market should not ignore the relationship between waste handling hierarchy and

¹⁰ In many cases, flows feeding the recycled materials market originate outside. For instance, Germany derives a large part of its recycled materials from the Netherlands. The knowledge of which countries have larger demand for recycled materials can be used as an indication of the location of the waste recycling enterprises, which should be possibly close to their target markets as recommended by location theory.

recycling. In some cases, incineration seems a better approach than disposal that, in turn, may sometimes be superior to recycling (Rasmussen C. et al. [2005]). Therefore, recycling should never be predetermined as an economically optimal solution, when the waste handling hierarchy under consideration. The total social costs of different waste management strategies should not be viewed only in terms of the strategies' environmental implications, but also with respect to the financial costs of actions associated with a given strategy. For some types of waste, the financial costs of a strategy that is friendlier to the environment may involve higher total social costs than a strategy at a lower level of the hierarchy. Therefore, under increasing financial marginal costs of each strategy, the ramifications represented by social costs can be considerable¹¹.

3. THE LINES OF DEVELOPMENT OF THE RECYCLED MATERIALS MARKET IN THE EU

A discussion of the lines of development of the EU market for recycled materials must start with a presentation of the very nature of recycling. Recycling is underpinned by three basic concepts that translate into three distinct waste management systems. These are:

1. *Closed-loop recycling*, where recycled waste (used products) re-enters manufacturing process to make the same type of products. A good example is packaging, particularly PET bottles that are reprocessed to produce new bottles. The development of the closed-loop systems helps reduce the primary material content in a product.

2. *Open-loop recycling*, where used products are utilized to manufacture different items. This approach is illustrated by the reprocessing of PET bottles to produce synthetic fibres or plastic fence elements. However, this approach does not reduce the quantities of primary inputs necessary to produce the bottles. Recycling benefits are therefore associated with lower consumption of non-renewable natural resources, i.e. natural fibres.

3. Energy recovery. Incineration is applied when waste recycling cannot be effectively performed.

The recycled materials markets take shape under the influence of policies dedicated to improving recycling indicators, policies addressing waste-related externalities, policies supporting the replacement of primary raw materials, as well as other factors. All the policies focus on providing functional solutions,

¹¹ For instance, it is more costly to acquire the last 5% of a given waste flow than the initial 5%. A similar regularity concerns recycling. It is more expensive to recycle the last 5% of waste than the first 5%. The presented non-linear relationships involve the problem of rapidly increasing marginal costs.

such as correct separation of the recyclable materials from the hazardous ones, and long-range solutions that promote for instance product designs facilitating future recycling and economically effective recovery of the materials. The implementation of the policies marks a new trend in the EU's socio-economic strategy that emphasizes the sustainability of the economic policy.

The development prospects for the recycled materials market should also refer to the web-based aggregators that provide platforms allowing the buyers and sellers to contact each other (see table 3).

Table 3. Selected websites on recovery services

Company	Company URL
180Commerce	www.180commerce.com
Aucnet	accessible only to firms
Autodag	www.autodag.com
Bigmachines	www.bigmachines.com
Dell	www.dell.com
E-rma	www.e-rma.com
Ebay	www.ebay.com
Fairmarket	www.fairmarket.com
Find-a-part	www.find-a-part.com
Genco	www.e-genco.com
IBM	www.ibm.com
Metalsite	www.metalsite.com
Pharmacy Returns	www.pharmacyreturns.com
QXL	www.qxl.com
ReCellular	access for firms only
Returnlogistics	www.returnlogistics.com
TheReturnExchange	www.thereturnexchange.com
Yantra	www.yantra.com
Viavia	www.viavia.nl

Source: A. Kokkinaki, R. Zuidwijk, Jo van Nunen, R. Dekker, *Information and Communication Technology Enabling Reverse Logistics* [in:] R. Dekker et al., *Reverse Logistics. Quantitative Models for Closed-loop Supply Chains*, Springer-Verlag, Berlin 2004, p. 405.

The elimination of informational externalities existing in the recycled materials market, which is possible owing to solutions based on e-commerce, will determine the future growth potential of the market. Another notable aspect is the increasing importance of logistics operators who have at their disposal effective solutions that allow them to create and manage European and global supply chains.

4. CONCLUSIONS

Trying to identify the development prospects for the recycled materials market in the EU member states is such an extensive and complex task that, as the author believes, only the major determinants of the occurring processes can be captured. A comprehensive approach to the problem of waste allows concluding that the optimal waste management hierarchy is primarily determined by the relative shares of particular waste management strategies and that it varies depending on the type of waste and the member state. Therefore, the implementation of a resource recovery policy in the member involves the adjustment of many partial policies, such as environmental protection policy, taxation policy, and competition policy, so that optimal recycling levels for different types of waste can be ensured. The reforms can be broadly classified as:

1. The introduction of appropriate policy evaluation measures directly affecting the waste-related environmental externalities. Every measure indicating the external impacts of waste and waste management on the natural environment has to adjust the recycling indicators (Porter R. [2002], p. 133). For instance, the recycling of materials can be encouraged by unit fees charged on generated waste as well as tax policy applying to the disposal sites¹².

2. Modifications to the primary materials replacement policy. In many cases, the growth of the recycled materials market depends on the swapping of the primary material inputs for the recycled materials. It is worth noting that the government subsidies favour the use of primary raw materials (for instance ores, chemical paper-pulp, minerals) that compete with recycled inputs. In addition, inappropriately formulated standards applying to both materials and products may restrict the use of recycled materials in place of primary material inputs.

The initiatives launched in support of a model of sustainable economic policy, especially in the EU member states, make it reasonable to believe that the recycled materials market has entered its growth stage, as suggested by the steadily rising levels of recycling of different types of waste.

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¹² The publication uses also the notion of 'logistics of recycling'. See page 164 and next. The same current of reforms includes also the policy of sustainable materials management.

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PERSPEKTYWY ROZWOJU RYNKU MATERIAŁÓW Z ODZYSKU W UE

Funkcjonowanie dwóch rynków, pierwszego obejmującego materiały pochodzące ze źródeł pierwotnych oraz drugiego, związanego z procesami odzysku materiałów pierwotnych, implikuje problemy związane z wzajemnym oddziaływaniem wspomnianych rynków na siebie. Dominująca pozycja rynku pierwotnego może ograniczać rozwój rynków wtórnych (recyklingu), co wiąże się ze stosowaniem różnych praktyk (na przykład w zakresie cen) ograniczających konkurencyjność producentów działających na rynku wtórnym. Jednocześnie należy podkreślić, że w przypadku większości sektorów na rynku wtórnym w UE wartości wskaźników koncentracji przyjmują niższe wartości, co oznacza większy stopień rozproszenia rynku.

Ważnym zagadnieniem łączącym się z funkcjonowaniem rynku wtórnego jest pomiar jego efektywności. Zjawiskiem, które w dużym stopniu determinuje niższą efektywność rynków wtórnych jest nieprzewidywalność cen materiałów pochodzących z odzysku. Wynika to z obserwacji, że zarówno podaż, jak i popyt nie są elastyczne na rynku wtórnym. W większości przypadków zakres zmian cen materiałów z recyklingu jest większy w porównaniu do materiałów na rynku pierwotnym. Można postawić zatem tezę, że wysoka zmienność cen materiałów na rynku wtórnym stanowi czynnik „hamulec” dla inwestycji w zakresie logistyki zwrotnej.

Funkcjonowanie rynku wtórnego zależy również od źródeł pozyskiwania odpadów. Z ekonomicznego punktu widzenia najbardziej opłacalne jest wykorzystywanie w procesach wytwórczych odpadów powstających w sferze produkcji, a najmniej odpadów pokonsumpcyjnych.

Słowa kluczowe: rynek wtórny, recykling, odpady.