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GREEN ECONOMY PREREQUISITES OF WASTE MANAGEMENT

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Abstract

This article analyses the concepts, the purpose, the evolution and the present state of the waste management and recycling in EU. In view of a green or circular economy, there are several prerequisites for further development of the sector, since the analysis discovers issues of waste management and recycling in Romania compared with some other Member States. There will be also approached and highlighted some aspects regarding the management of the rural municipal waste in Romania. The analysis will lead to some conclusions in regard with chances of the member states to reach the ambitious recycling target of 50% adopted by EU. The revision of the legislative framework has the purpose of waste reduction and therefore sets up an ambitious plan in view of waste management and recycling. This plan consists of some challenging targets to be reached by 2030, such as: the recycling of 65 per cent of municipal waste and of 75 per cent of packaging waste (as common EU targets); reducing landfill to at most 10% of all the waste (binding target). The conclusions reflect recommendations for improving the waste management in Romania and topics of further research.

Key words**:** *waste management, hierarchy, green economy, recycling, member states*

INTRODUCTION

In view of a greener and circular economy, the general trend in European Union is to improve and enhance all activities related to waste management, starting with the quantities of waste generated and ending with the disposal of the waste.
This is an important component in making Member States more resource efficient. The resource-efficiency is a paradigm behind the green (and circular) economy [11].
Indeed, if a country finds ways to extract more value from resources taken from nature, it will generate greater economic returns at lower costs for the environment [20].
In the case of waste, the environmental burden produced by emissions and leftover must be reduced. The best way in achieving this is by changing/adopting measures for waste management according to the waste hierarchy. This should be done by a pro-active plan meant to reduce the waste disposal (especially landfilling). At the same time, there will be an increased activity for the promotion of the green and circular economy prerequisites: preventing, reusing, recycling and recovering waste will support closing the loop and increased resource-efficiency.
In recent years, some central objectives have been included in the environmental policies and strategies, such as: the European Commission's Roadmap on a resource efficient Europe [1]; the EU's Waste Framework Directive [7].
As for the case of Romania, it is important to mention that national efforts to shift up the waste hierarchy have been under way for longer, in large part driven by earlier EU legislation such as the Landfill Directive [6]. Together, these instruments established a range of waste management targets and broader goals for 2020 and beyond.
In the transition to a green economy with a high level of resource efficiency, the EU member states must comply with the Waste Framework Directive (WFD). One of the most significant target is to enable, by 2020,

an increase in the re-use and recycling of some household or similar origin waste materials (paper, metal, plastic and glass), to reach the minimum overall quota of 50% by weight [14].

MATERIALS AND METHODS

The objective of this paper is to draw attention on the necessity to improve the waste management in view of a green and circular economy. The secondary goal is to assess Romania`s position in achieving the 50% goal of waste recycling as well as the situation in other member states in this endeavor.
The methodology used was as follows:
-Analyzing data and information existing on paper and on internet;
-Extracting data from Eurostat database on waste;
-Processing the data extracted, creating tables and synthetic graphs;
-Analyzing and interpreting the processed data, tables and graphs;
-Drawing conclusions.

RESULTS AND DISCUSSIONS

Grounds, policies and dynamics of municipal waste management in the EU

The waste policy has evolved in the European Union in the last 20 years or more, especially due to the strategies dedicated to the sustainable development and transition towards a green economy, namely a low-carbon and resource-efficient economy.
Starting with the EU's Sixth Environment Action Programme (2002- 2012) the waste management has become a priority, with the main goal to ensure that economic growth does not lead to increased waste [2].
Thus a long-term strategy on waste has emerged, namely the Thematic Strategy on Waste Prevention and Recycling (COM 2005/666) resulted in the revision of Waste Framework Directive, as the main document of waste policy in the EU [2, 7].
As a step of transition towards the green and circular economy, the WFD introduces a modern view to waste management, considering waste no more a burden but a valuable resource.
The main innovation in the WFD is its focus on waste prevention and the new targets meant to direct the EU towards becoming a greener, recycling economy. It includes targets for EU Member States to recycle 50% of their municipal waste and 70% of construction waste by 2020.
The WFD 2006/12/EC introduces a five-step waste hierarchy where prevention is the best option, followed by re-use, recycling and other forms of recovery, with the release to the environment (such as landfill disposal) as the least desired solution (Figure 1).
The best methods to be used are, in a hierarchical succession:
(a)Avoidance of producing waste at the source (waste prevention);
(b)Reduction of waste at the source;
(c)Reuse of waste, recycle and recovery.
The least preferred are the methods situated at the bottom of the list: releasing/disposing into environment (landfilling) etc.

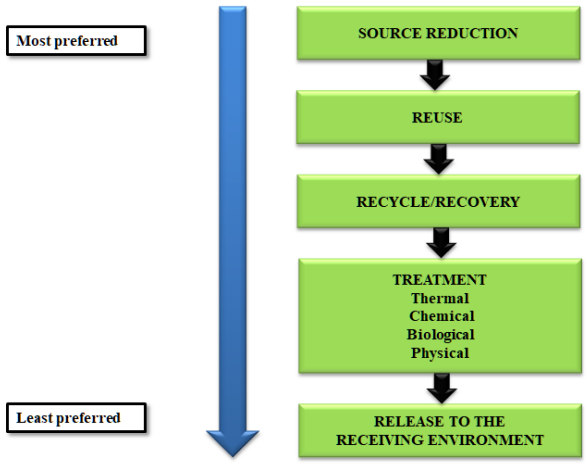


Fig. 1. Hierarchy of waste management practices
Source: [2].

In the following, there will be an analysis of the evolution of the municipal waste produced in the EU and in Romania.
According to the definition of OECD/Eurostat questionnaire, "municipal waste covers household waste and waste similar in nature and composition to household waste" [8].
Municipal waste consists to a large extent of waste generated by population, but may also

include similar wastes generated by small companies and public institutions and collected within the boundary of a municipality. In this paper we are aware that this latter part of municipal waste may vary from member state to member state and from municipality to municipality, depending on the local waste management system [4].

The quantity of generated waste is also estimated for the areas not served by a municipal waste collection system. The total amount of municipal waste generated and recycled yearly is reported to Eurostat by the EU member states [10].

During 1995-2014, the total quantity of municipal waste has increased in EU (28 countries) from 225.8 mil. Tonnes in 1995 to 239.25 mil. Tonnes in 2014, with a peak in 2008 (260 mil. tonnes of waste generated).

In Romania, in the same period, waste generated decreased from 7.75 mil. Tonnes of waste in 1995 to 5.1 tonnes in 2014 (a reduction of 2.27 mil. tonnes of waste in 20 years). The quantity of waste produced by Romania represented, on average, 2.8% of the total quantity generated in EU.

Other big countries like Germany, Italy, France or UK used to generate more waste with no visible trend of decreasing. For instance, during the period analyzed (1995-2014), Germany has reduced the quantity of waste generated from 50,894 mil tonnes to only 50,256 mil tonnes of waste. This reduction is similar, in absolute terms, with that of Romania, which is generating 7 times less waste [5]. For UK and Italy, it is recorded a small increase in the waste generated.

This overall evolution means that not all member states take actions in accordance with the waste hierarchy (reduction at the source).

In the analysis on the quantity of waste reduced during 1995-2014, it may be noticed that 12 countries have diminished their generated waste by 11.11 mil. Tonnes, out of which Germany contributed with 22.3%, Romania with 20.47%, Bulgaria with 17.7% and Poland with 11.6%. (Table 1).

When analyzing the relative quantity of waste generated in EU (waste calculated per capita), it results the diagram in Figure 2.

Table 1. Quantity of municipal waste reduced in the period 1995-2014

	Member State	Mil. Tonnes of waste reduced	Share
1	Germany	-2.480	22.32%
2	Romania	-2.275	20.47%
3	Bulgaria	-1.973	17.76%
4	Poland	-1.291	11.62%
5	Hungary	-1.039	9.35%
6	Spain	-908	8.17%
7	Norway	-586	5.27%
8	Slovenia	-283	2.55%
9	Lithuania	-175	1.57%
10	Estonia	-95	0.85%
11	Iceland	-5	0.04%
12	Latvia	-2	0.02%
	Total	**-11.11**	**100%**

Source: own calculation on Eurostat data [8].

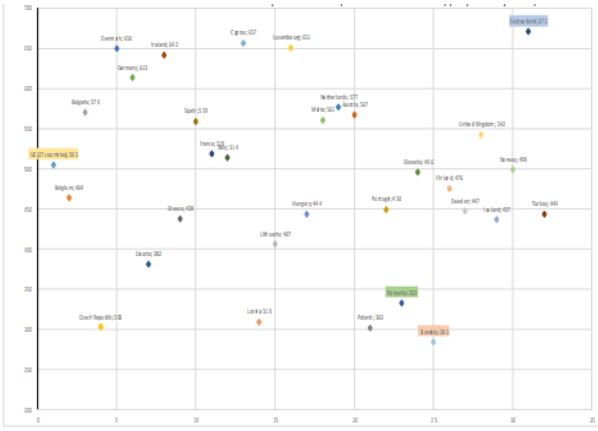


Fig. 2. Waste generated in EU member states (kg/inhabitant/year)
Source: own calculation on Eurostat data [8].

In the picture we could identify three areas. In the lower part there is a group of countries that have a low waste generation per head (less than 350 kg/inhabitant/year), such as: Czech Republic, Latvia, Romania (333 kg waste/inhabitant/year), Poland and Slovakia. In fact, Slovakia is the member state with the lowest value of this indicator (285 kg waste/inhabitant/year).

In the upper end there are European countries that generate large quantities of waste (more than 600 kg. waste/inhabitant/year). The group of heavy generators is comprised of six countries: Germany, Denmark, Cyprus, Luxemburg and Switzerland. On top of this group is Switzerland which has the biggest quantity of waste generated, 671 kg/inhabitant/year.

Between these two areas, there are other countries that generate municipal waste closer to the EU average (505 kg/inhabitant/year).

The data analyzed showed little evidence of increased waste prevention in the case of municipal waste. The prevention measures would create a consistent decreasing trend in waste generation [3].

Despite the fact that the definition of municipal waste is not the same across all EU countries, comparisons made in Figure 2 are relevant due to the fact that they were calculated as an average for 20 years.

Another issue of waste generation and management to be considered in Romania is the management of the municipal waste in the rural areas and localities.

The composition and the features of the rural household waste are different according to their corresponding origins in different types of households, villages, regions, and countries. However, there may be often noticed an issue of waste management that rural areas share: they are poorly or not sufficiently served by professional waste management companies. This is due to some adverse premises for a proper and sustainable development of rural infrastructure (low inhabitants densities, poor socioeconomic conditions, low willingness-to-pay, long distances from urban areas, etc.) [15].

The Romanian environmental protection agencies compute the amounts of municipal waste generated and uncollected by waste operators in rural areas using a waste generation rate of 0.4 kg/inhabitant/day−1, about 150 kg/inhabitant/year, so less than half the national average amount of municipal waste per inhabitant, but the waste management data is not usually available at the commune level [18].

In Romania, the rates of waste collection utility are not detailed at the local administration unit level (cities and communes). Accordingly, in environmental reports the waste statistics are conveyed as aggregate at the county level.

This factor makes it difficult to estimate the flow of uncollected household waste within the communes located in a geographical area.

As highlighted in previous research Romania has still some important socio-economic development gaps between urban and rural areas and this involves also the waste management infrastructure [13].

Although there are some waste management improvements since the EU adhesion (2007), the rural practices of waste dumping still remain a serious environmental threat in Romania, as documented by a recent study [16].

The material recycling of waste and prospects for reaching the 50% target

Since its fast development, industrial economy inevitably involved the production of a large quantity of waste the environment is not capable to naturally assimilate and transform. Therefore, one of the main green economy sectors is considered the waste retrieval and recycling, namely the waste management [21].

In the paper, it should be mentioned that the recycling rate was calculated by dividing recycled tonnage from municipal waste with the total municipal waste arising from municipal generators. The recycling activity includes several techniques as: material recycling, composting and anaerobic digestion, energy recovery.

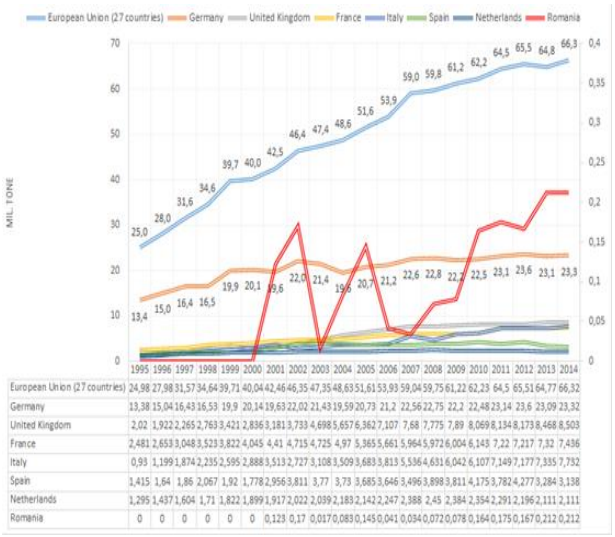
Material recycling is a process based mainly on separation, sorting, cleaning and mechanical treatment. Full recycling includes other activities as bio-digestion, fermentation and energy recovery.

Some authors argue that incineration should be not taken into account in recycling activity. Incineration is inconsistent with reduction, reuse and recycling because it relies on a steady large quantity of mixed waste. It is a superficial solution which does not solve the root of the problem – reducing the waste [17].

Figure 3 showed the clear tendency to increase the recycling quantities, in all EU member states.

At the EU level, during 1995-2014, the recycled waste quantities (material recycling) increased from 25 million tonnes in 1995 to 66, 3 million tonnes in 2014 (an increase of 266%). The biggest recycler in EU is Germany, with 23.3 million tonnes in 2014. Other significant recyclers were the United

Kingdom (8.5 mil. tonnes), France (7.4 mil. tonnes) and Italy (7.7 mil. tonnes).



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
European Union (27 countries)	24,98	27,98	31,57	34,64	39,71	40,04	42,46	46,46	35,47	35,48	63,51	61,53	59,04	59,75	61,22	62,23	64,5	65,51	64,77	66,32
Germany	13,38	15,04	16,43	16,53	19,9	20,14	19,63	22,02	21,43	19,59	20,73	21,2	22,56	22,75	22,2	22,48	23,14	23,6	23,09	23,32
United Kingdom	2,02	1,922	2,265	2,763	3,421	2,836	3,181	3,733	4,698	5,657	6,362	7,107	7,68	7,775	7,89	8,069	8,134	8,173	8,468	8,503
France	2,481	2,653	3,048	3,523	3,822	4,045	4,41	4,715	4,725	4,97	5,365	5,661	5,964	5,972	6,004	6,143	7,22	7,217	7,32	7,436
Italy	0,93	1,199	1,874	2,235	2,595	2,888	3,513	2,727	3,108	3,509	3,683	3,813	5,536	4,631	6,042	6,107	7,149	7,177	7,335	7,732
Spain	1,415	1,64	1,86	2,067	1,92	1,778	2,956	3,811	3,77	3,73	3,685	3,646	3,496	3,898	3,811	4,175	3,782	4,277	3,284	3,138
Netherlands	1,295	1,437	1,604	1,71	1,822	1,899	1,917	2,022	2,039	2,183	2,142	2,247	2,388	2,45	2,384	2,354	2,291	2,196	2,111	2,111
Romania	0	0	0	0	0	0	0,123	0,17	0,017	0,083	0,145	0,041	0,034	0,072	0,078	0,164	0,175	0,167	0,212	0,212

Fig. 3. Material recycling in EU (1994-2014) (mil. t)
Source: own calculation on Eurostat data [8].

As regarding Romania, Figure 3 shows that material recycling is reduced and oscillating, compared with other countries (this is why in the graph was plotted on the secondary axis). In 2014, the quantity of waste recycled in Romania was only 0.212 mil. Tonnes.
When analyzing the normalized indicator for 1995-2014 (waste recycled/capita), we see a similar trend as before: on the first place is Germany with an average of 250 kg/inhabitant/year recycled waste.

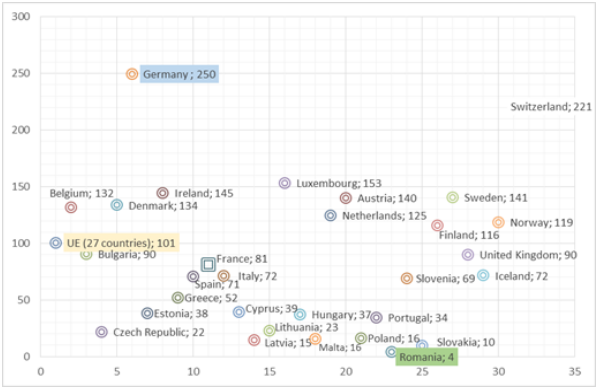


Fig. 4. Quantities of waste recycled in EU (1994-2014) (kg/inhabitant./year)
Source: own calculation on Eurostat data [8].

A consistent cluster of countries is positioned around the EU average (101 kg/inhabitant/year). Another cluster of countries is situated under the threshold of 50 kg/inhabitant/year (Portugal, Hungary, and Poland).
At the bottom of this group of countries is Romania with an average of 4 kg/inhabitant/year recycled waste. (Figure 4)
Consequently, an issue of concern is reaching the ambitious EU target mentioned at the beginning of this paper for the year 2020 of 50% municipal waste recycling (here including material recycling, reuse, energy recovery, bio digestion); this limit should be reached in 2020 by all member states [9].
In Figure 5 we could see the 50% limit as a red line and, in green, the recycling rate, as reported to Eurostat (data for 2014) for each country.

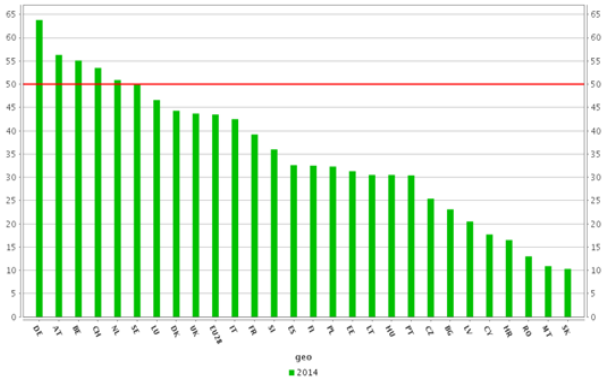


Fig. 5. Recycling rates of municipal waste, in EU (2014)
Source: Eurostat data [8].

Figure 5 reveals a complex situation. First, there are some member states that, in 2016, have surpassed the 50% recycling threshold. A number of five states have passed the threshold: Germany (63.8%), Austria (56.1%), Belgium (55.1%), Switzerland and Netherlands (50.9%). Second, there are six countries (Sweden, Luxembourg, Denmark, United Kingdom, Italy and Norway) which had a recycling rate in the interval [40%-50%]. These countries were near the EU recycling average rate in 2014 (43, 4%) and so they could easily reach the 50% target in 2020, without significant efforts.
In conclusion, there are 10 member states, out of 29 that are almost certain to surpass the 50% threshold.
After this group of countries, there are countries that may not reach the threshold. These countries are in the range of [25%-

40%] recycling rate. There were 12 countries in this situation (France, Slovenia, Spain, Finland, Poland, Estonia, Lithuania, Hungary, Portugal, Czech Republic and Latvia).

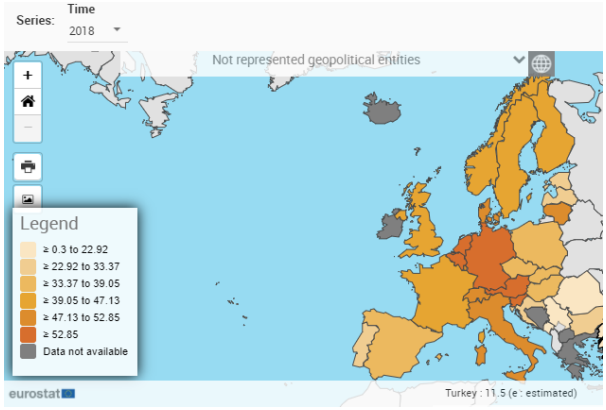


Fig. 6. Recycling rates of municipal waste, in EU (2018)
Source: Eurostat data map [8].

For the countries closer to the 40% recycling rate, there are chances to reach the target; however, those countries with a rate lower than 30%, are highly unlikely to reach the threshold. At the end, there is a group of countries with a recycling rate lower than 25%. These countries are: Bulgaria (23.1%), Latvia (20.5%), Cyprus (17.7%), Croatia (16.5%), Romania (13%), Malta (10.9%), and Slovakia (10.3%). The chances for this group of countries to pass the threshold of 50% are very remote. This outlook seems to be reaffirmed by the status on the recycling rate of municipal waste reached by the EU member states in 2018 (latest available data) displayed in figure 6. It should not be forgotten that recycling is a green business, and therefore a market for recyclables is very needed in order to develop this activity [19]. Regrettably, Romania remains among the least waste recycling countries in the European Union, although there are here some good opportunities offered by the implementing of circular economy or industrial synergy businesses in various economic sectors [12].

CONCLUSIONS

The analysis performed in this paper has led to several conclusions. There are no clear tendencies that waste management in EU is going in the direction of less waste, as the top priority in the hierarchy of waste management and a prerequisite for a resource-efficient, green economy.

The waste generated in Europe, in the last 20 years has a trend of stability. The biggest waste generator is Germany (both in absolute tonnes) and relative terms (tonnes/capita)); Romania has a modest contribution of 2.8% in total waste generated at EU level.

However, there is a clear trend for the waste recycling to increase its volume (2.66 times in 20 years); this trend is to be found in all member states.

The biggest waste recycler is again Germany, in absolute and relative terms. Other member states as UK, Italy, France and Spain have increased the quantities of waste recycled; Romania has still a very low contribution to the recycling activity, although this is another prerequisite for the waste management in a green economy.

As regarding the 50% recycling target, the situation is mixed. There are member states that have passed the threshold and some others that could do this until the end of 2020. The problem is within 13-14 countries which have such a low recycling rate that it is not reasonable to believe they could reach such a threshold by 2020 (Romania is part of this group of countries).

The fact that such a big number of countries cannot reach the target, may raise some questions about how this figure (50%) was determined and imposed to all member states.

In order to improve the situation and develop further and faster the sector of recycling in Romania, it is important to acknowledge some of the causes that put Romania in one of the last positions of green waste management and recycling in the EU.

There are many profound and inter-connected reasons for the state of underdevelopment of the recycling sector.

They are related to a whole area of issues such as the following:

(a)The lack of modern collection and treatment infrastructure;

(b)A sub-optimal use of funding available;

(c)The high share of biodegradable waste going to landfill;

(d)The poor enforcing of national strategies;
(e)The lack of separate collection;
(f)A poor use of economic instruments;
(g)The low taxes on landfilling (municipal) waste;
(h)The quite scarce application of pay-as-you-throw (PAYT) schemes.
The complexity and urgency of these issues call for some new topics and recommendations for future research.
It should now be taken into account that EU is further proposing several ambitious goals by 2030, as common EU or as binding targets:
(a)Recycling 65% of the municipal waste;
(b)Recycling 75% of the packaging waste;
(c)Reducing the landfilled disposed municipal waste to maximum10%;
(d)Interdiction of landfilling the separately collected waste;
(e)Using economic instruments in order to discourage landfilling;
(f)Simplifying and improving the definitions and harmonizing the calculation methods for waste recycling rates all over the EU;
(g)Applying practical measures promoting re-use and industrial symbiosis –by re-using one industry's by-product as raw material in another industry (a mechanism of circular economy);
(h)Implementing economic incentives so producers may launch greener products on the market, with supportive schemes of recovery and recycling (e.g. for packaging, batteries, electric and electronic equipment, vehicles).
It is therefore important to continue the research on waste management, in the urban as well as in the rural areas.
Such future research topics in Romania could be related to the best approaches able to:
(i)Impose taxes on the waste landfill and incineration to make recycling economically advantageous;
(ii)Rise the existing taxes on waste to enable incentives for recycling;
(iii)Better use of revenues from these taxes, to support waste prevention, re-use and recycling by facilitating separate collection, raising awareness and developing modern infrastructure;
(iv)Create/develop and monitor separate collection systems;
(v)Develop and perfect the controlling and transparency of the waste recycling schemes;
(vi)Amend the national strategies on bio-waste;
(vii)Enhance waste statistics;
(viii)Take advantage more of the EU funding to invest in the infrastructure and initiatives connected to the first stages of the waste hierarchy.

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