

Waste Management 2030+

The future of waste management in an overcrowded planet

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The scope of this article is to outline the major trends and challenges that will shape the future of waste management for the next decades of years. Although in our complex and unpredictable world “prediction is very difficult, especially about the future” as the great scientist Niels Bohr has mentioned, there are certain trends and facts that more or less create at least the “big picture” in which waste management will be evolved. Interestingly the discussion for those trends has not been directly linked with the future of waste management, at least according to the author’s knowledge.

Putting those trends together and trying to shape their consequences to waste management, it is clear that new challenges are emerging and the current status must be seen in a different way: our waste management systems and our market conditions, even in their best form, are incapable to handle the growing waste generation that is coming globally. And unless a new paradigm of global cooperation and governance will be adopted, a tsunami of uncontrolled dumpsites will be the prevailing waste management method, especially in Asia. Let’s see the major trends for the next decades.

Growing Waste Volumes

Waste amount is largely determined by two factors. First the population and second its consumption patterns which are controlled by the evolution of Gross Domestic Product per Capita (GDP/c).

According to the UN ^[1], between now and 2025, the world population will increase by 20% to reach 8 billion inhabitants (from 6.5 today). Moreover, around 2050, the total population will be around 9.5 billion ^[2], unless specific control measures will be broadly adopted. If the last become true, a population of 8-8.5 billion at 2050 may be considered as a successful stabilization.

It is important to note that this growth will be realized by 97% in Asia and Africa, which means to some of the poorest countries which have the less capacity to absorb it. After 2025 it is expected that Asia will hold more that 2/3 of the world population ^[3]. This growth also will boost the further urbanization of the population (urban population is expected to be around 65% of the total one after 2040) and the creation of extended zones of poverty around and inside megacities. The number of the inhabitants of slums will be double around 2025 and will reach 1.5 billion.

Besides overpopulation, a remarkable increase of GDP/c especially in developing countries is coming. In 2025, world production will be doubled in relation to 2005. By 2050 the world

production may be again doubled in relation with 2025. The global average GDP/c around 2025 will be more or less 1.5 times the current one and in a business as usual scenario it may be fourfold around 2050. Jeffrey Sachs ^[2] has estimated that in developing countries the GDP/c will be around 40.000 \$ around 2050, which is the USA GDP/c at 2005! It seems also that we are moving in a richer world where we will have more poor people in absolute numbers and less in percentages.

Obviously, both the increase of the population and the remarkable growth of global GDP/c will drive an increase in waste volumes. And although it is out of the scope of this article to estimate the waste growth expected it will definitely be a huge one. Just to have an idea about it, using macro-economic data from 30 OECD countries it has been estimated ^[4] that a 1% increase in national income creates a 0.69% increase in municipal solid waste amount.

But there is also some good news. It is known ^[5] that the bigger the GDP/c the more advanced and effective waste management systems and technologies are in place. So this global GDP/c growth will certainly multiply modern landfills, efficient collection systems, MBT and WtE facilities around the world. A lot of waste infrastructure development is coming and the technological advances will be globalized much more than they are today. There are still two questions that have to be answered:

Question 1: Will the expansion of modern waste management systems be capable to handle the increasing amounts of waste generated? Or the reality will be an ocean of new uncontrolled dumpsites, including some islands of advanced waste management and a continent of landfills? Let's keep the answer for the end of the article.

Question 2: How those advanced technologies will be available for the countries that are trapped in poverty? Because not all the countries are inside the bus of the global GDP/c growth and the outsiders, for the time being are more than 1 billion! And it seems that the distance between those poor countries and the rest of the world will be wider in the future.

Waste composition will keep changing

Speaking again globally, remarkable changes to waste composition are coming. For this article, I will highlight just two of them.

The first will be due to the changing food culture and habits to developing countries. As their GDP/c goes up, it is expected that until 2050 the demand for agricultural goods will rise by 70% and the demand for meat will double. Besides the serious issues related with food production and sufficiency, those changes will create new waste composition in a large part of the world. More organic fraction will be the dominant case in municipal waste, more agricultural and meat treatment waste will create new problems that have to be faced. And of course, such a change in waste composition makes the GHGs challenge for waste management more difficult than it is already. As an example it has been estimated ^[6] that globally, urban food waste is going to increase by 44% from 2005 to 2025. During the same period, and because of its expected economic development, Asia was predicted to experience the largest increase in food waste production, of 278 to 416 Gkg. If present waste management trends are maintained, landfilled food waste was predicted to increase world CH₄ emissions from 34 to 48 Gkg and the landfill share of global anthropogenic emissions from 8 to 10%.

The second serious change will be due to the production and then consumption and inclusion to waste streams of more and more complex products. Personalized medicine, new computers and gadgets, networked homes and full home management systems, fully customized consumer products, personal security and personal energy products are coming or they are already here. Some points of special interest are:

- The first is the rapidly growing stream of electronic waste (e-waste) which is already one of the most important problems of waste management, directly related with the crime of waste trafficking. As the world becomes more and more networked and interconnected and as e-products including PCs, gadgets, digital cameras, pervasive computing etc. are rapidly devaluated and become waste due to fast update and built-in obsolescence, the e-waste stream will become a major challenge of future waste management.
- The second is the stream of nanomaterials that are coming slowly but steadily. Nano – bio and e-technologies will create a whole spectrum of new artificial materials. Major breakthroughs within the next two decades will provide inexpensive ways to produce mass quantities of those materials. In addition, the function of such materials will move from “passive” to “active” with the integration of nanoscale valves, switches, pumps, motors and other components. Obviously, the easiness to throw them away will increase as they become less and less expensive.
- The main trend in consumer goods will be the personalization of them, which on one hand will create products more difficult to throw away and on the other hand it will make re-use much more difficult.

All that plethora of new products will be rapidly expanded globally and rapidly consumed ^[7] and finally transformed to new waste streams. So clearly there is a problem of time here. First, new products are launched, consumed and then transformed to new kinds of waste before an effective waste management solution is established for them. Most of the times, the problem of management of new kinds of waste is emerged after the product has been consumed. Second the time required establishing a new separate waste stream network or a new technical solution for new waste streams generally speaking is by far more than the lag - time between production of a new product and its transformation to waste.

Question 3: Is our waste management system capable to handle the plethora of new kinds of waste? Are the current social, political and financial conditions sufficient to resolve the problem of the growing complexity of waste streams? Let's see below...

What is the best we can do?

Before trying to answer the questions mentioned before, it is necessary to see what is the best example of waste management worldwide not in a country or a region but in a broader geographic unit, such a continent or at least a big part of it. This is necessary in order to avoid the mistake of generalization of any local or even national advanced waste management systems or any disadvantaged ones. From that point of view, I consider the

European Union example as more or less the most advanced continental waste management system.

Examining the best system's successes and failures will provide useful insight for a global thinking regarding waste management. Clearly, EU is going forward to a better, more expensive and more environmentally sound waste management ^[8]. Landfills and methane emissions are remarkably reduced, even with some exceptions on a country level, MBT and WtE facilities are expanding in all their forms and recycling has become a major trend with substantial results.

But there are some issues to discuss. From 2000 to 2008, the European exports of plastics waste have risen by 250 percent, reaching 2.27 million tones – approximately 5 million tones are annually recycled in Europe ^[9]. 87 percent of these exports are going to China including Hong Kong. The financial downturn seems to have worsened the situation, as the first quarter of 2009 has seen a 33 percent increase in export compared to the previous year.

Between 1995-2007 the amounts of non-hazardous waste exported to Asia have increased by a factor of ten for waste paper, a factor of eleven for plastics and a factor of five for metals ^[10]. At the same time, just for a comparison, the amount of paper and cardboard packaging waste recycled has increased from about 24 to 30 million tons and the amount of plastic packaging recycled has increased from about 10 to 14 million tons.

And if we speak about the hazardous waste streams, the crime of illegal waste shipment and waste trafficking is something that is going even worst during the current financial crisis. Exporting waste illegally to poor countries has become a vast and growing international business, as companies try to minimize the costs of new environmental laws, like those here, that tax waste or require that it be recycled or otherwise disposed of in an environmentally responsible way. And more than 20 million containers of waste now shipped each year either legally or illegally from EU to non EU countries.

As has been already successfully noted ^[11] “it is four times as expensive to incinerate trash in the Netherlands as to put it — illegally — on a boat to China. And the vast container ships that arrive in Europe and North America from Asia filled with cheap garments and electrical goods now have a profitable return cargo: garbage like steel cables, circuit boards and leftovers from last night's pasta meal”.

So let's wonder how successful the EU waste management would be without China and Asia to absorb both legal and illegal waste shipments? What will be the current recycling levels without Asia to receive such huge amounts of recyclables? Has our European waste management system been capable to face the e-waste problem? And how self-sufficient may be even the best waste management system in the world when it is so much and so strongly depended on a global (legal and illegal) trade of waste and materials? Well, everyone may answer those questions according his or her experiences, but I think that the best example we have has not been proved as capable and self-sufficient to face increasing volumes and rapidly changing composition of waste.

And if anyone is thinking that this is a European problem, there is another example of failure of even advanced waste management systems: the increasingly recognized problem of plastic floating landfills. Some million tons of plastic waste (6-10 maybe) are floating around Pacific Ocean and not only. It is estimated ^[12] that more than 80% of them are coming from land-based resources and the rest of them from marine-based resources. And a closer view of the possible land – resources includes USA and Japan, which certainly are considered as advanced waste management areas, comparing to the vast majority of the world.

Now we can try to answer the three pending questions.

Looking for answers

Regarding Question 1 (the capacity to face the rapid growth of waste generation), it is clear that although there is a certain future of further global expansion for WtE and MBT facilities, the expected growth of waste volumes will certainly create thousands or even millions of new dumpsites mostly because:

- The development of advanced infrastructure is and it will be expensive for a lot of years for most of the countries that need it more
- The required infrastructure, even when the financial resources are available, is delivered much slower than the rapid growth of waste generation
- The current waste management systems are not capable to jump from open dumps to high-tech systems

So thinking globally, the massive development of new sanitary landfills is the only realistic and achievable option for a universal step forward and even this will be difficult for some cases.

Question 2 refers to the poverty trap and the ways to overlap it. It is more than clear that unless we find new and more effective ways of global cooperation, or even global environmental governance according some people, our globalized market is not capable neither in favor to face the waste management issues in the poorest countries.

The governments of developed countries and their residents must understand that having one billion people in the worst social, food, water and hygienic conditions is a permanent and increasing threat for their living standards. And even if someone is thinking that the control of the global refugees streams will be successful (which is not the case in my opinion), environmental pollution and pandemics have clearly no borders, as we obviously experience during last years.

The necessity for a new global waste initiative is more than obvious and the lack of any relevant action is less than ridiculous. The poverty trap of the poorest countries may be easily transformed to a global growth trap.

Last but not least, I left Question 3, regarding the global capacity to confront the plethora of new waste streams. The paradigm of e-waste is a representative one. Although the e-waste market has been almost doubled between 2002 and 2009, the problem is not really

addressed and illegal, dangerous and sometimes criminal practices are the dominant methods for their management. Once again, the current market conditions and initiatives are not capable to find an environmentally sound solution for a problem that the rapid e-market growth has created. Unless global minimum standards for waste management are established, the driving forces for waste trafficking and criminal practices will be further strengthened when the quantities of new waste streams will become more and huger.

If this is not enough, the recent downturn of recycling programs due to the global financial crisis is another proof for the market incapability to sustain recycling and recovery activities. Once again, we need another type of global cooperation which will provide a different framework for market driven actions combined with strong environmental governance.

Another consequence of importance is that as new waste streams are coming, they will need more new different waste management networks for recovery and recycling purposes, thus the complexity of waste management will be exponentially grow driven by the complexity of product networks!

Instead of conclusions

Our world will be overpopulated and more and more interconnected. The defining challenge of the 21st century will be that the humanity shares a common fate. That common fate is already demanding for new forms of global cooperation against the blinding simplicity that is currently dominating our world. The paradox of a unified global economy and divided national societies poses the single greatest threat for our planet. And although there are appropriate waste management solutions, the main problem is the global framework that will put them in place where they are mostly required. Let's try to create it ...

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