Waste in the UK and the world

As the world's population size has grown, waste generation has increased rapidly. This has had a significant effect on humanity, wildlife and the environment. As a result, governments have tried to replace traditional disposal methods, which result in pollution, with sustainable alternatives. Recycling rates keep increasing, yet projections indicate that we will soon be producing more waste than ever before.

In this briefing, waste generation is analysed. Different disposal methods and the factors that affect waste generation will be considered. We will conclude that recycling can surely minimise the amount of avoidable waste per individual, but projected population growth will inevitably cause greater total waste generation. Sustainability policies and technological developments may improve the current situation and reduce waste generation per capita, but only population stabilisation can lead to permanent waste reduction. Hence, the government should embrace population stabilisation policies.

Waste through the ages

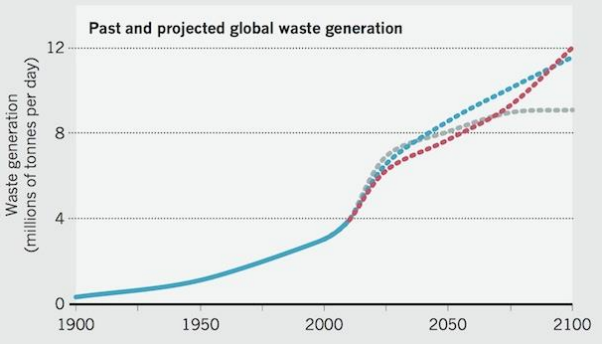
While waste disposal was once a local concern, today it is a global challenge. The consumption of finite resources, and the damaging of the earth in the processes of mineral extraction, pollution and waste management, transcend borders. [1]

Global

In the previous century, the world population grew substantially. At the same time, the world was changed by urbanisation, industrialisation and increased levels of affluence. Consequently, waste production has increased tenfold.[2] The total generation of solid waste worldwide will have tripled by 2100.[3] Globally, $205 billion was spent in 2010 on waste related challenges, and this figure could rise to an estimated $375 billion per year by 2025.[4]

Waste problems are most acute in emerging urban areas. Urban residents typically generate four times more waste than their rural counterparts.[5] There are fewer products to throw away in rural areas due to lower rates of manufacturing and consumption.[6] The amount of waste produced by city dwellers tends to reach a limit once they become richer, as societies then start to regulate their solid-waste generation.[7]

The number of urban residents is growing rapidly. In 1900, 13 per cent of the population lived in cities and produced 300,000 tonnes of rubbish per day. By 2000, 2.9 billion city residents produced more than three million tonnes of waste per day.[8] Moreover, the 40 per cent growth in Gross Domestic Product (GDP) witnessed among members of the Organisation for Economic Co-operation and Development since 1980 has led to approximately the same increase in waste generation.[9] Future rates of waste accumulation may, then, depend in part on the growth of (urban) population and on GDP increase.[10]

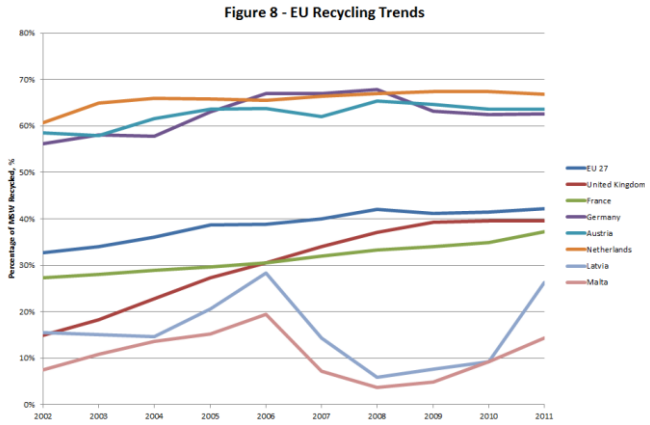


Graph: Smithsonian

The graph above shows predictions of global waste-generation growth in different possible futures. The grey line — indicating a low population-growth scenario — is the only one to peak before 2100. The blue and red lines — representing current and high population projections respectively — continue to increase after 2100.[11]

Waste generation in the UK

The UK is attempting to change its throwaway culture into a zero-waste economy, in which waste materials are reused, recycled or recovered, and are only disposed of when there is no other alternative.[12]



Graph: KRR

Waste management in the UK has changed rapidly in recent years. In the previous century most waste ended up in landfills, and recycling procedures were hardly utilised.[13] The UK saw its recycling rate increase from approximately 15 per cent in 2001 to 40 per cent in 2011. In spite of this, it was still far behind countries like the Netherlands, Germany and Austria, and fell below the European Union (EU) average.[14]

In 2012, the UK generated 200 million tonnes of waste, of which 5.9 million tonnes were hazardous.[15] Typically, waste is analysed in different categories, and these are set out below.

Households

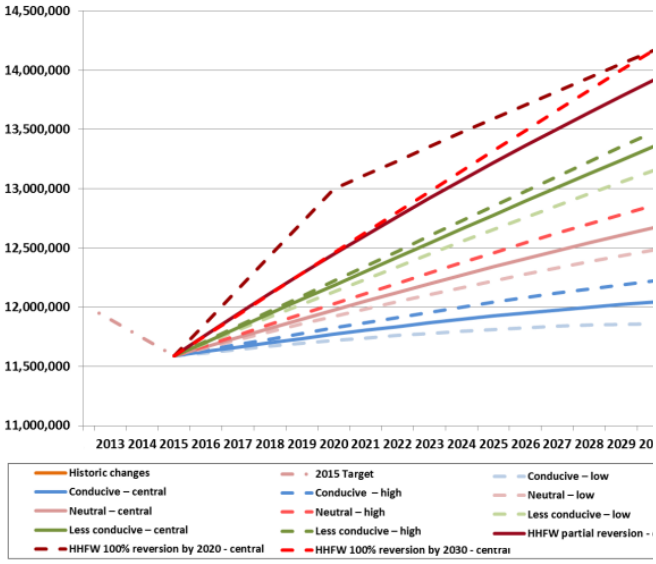
Since 2007 – 8 the amount of household waste generated in England has fallen annually by just over two per cent. This means that England produced 22.6 million tonnes of waste in 2012 – 13, which equates to 423 kg of waste per resident. Of this, 183 kg, or 43.2 per cent, was recycled.[16] Household waste accounts for 14 per cent of the total waste accumulation in the UK.[17]

Nearly 80 per cent of all household waste ended up in landfills before 2000. By 2013, this had fallen to approximately 35 per cent. At the same time, both recycling and incineration rates peaked at 42 and 22 per cent respectively.[18]

Food waste is a big component of household waste.[19] According to current predictions, the UK will produce between 11.8 and 13.6 million tonnes of food waste in 2025, compared to 11.6 million tonnes in 2015.[20] This increase can be explained as follows:

- Extreme food waste reduction is no longer easy to achieve, because the simplest ways of achieving reductions have already been realised.[21]
- Population growth will mean that more people will be producing waste. Hence, even if the

amount of waste per capita reduces, the sum of waste accumulation will increase. [22]



Graph: adapted from WRAP

The graph above displays future food waste predictions. Among these are low, central and high population increase projections, combined with conducive, neutral and less-conducive economic scenarios. It is clear that only the light-blue dotted line — which represents low population growth in combination with a conducive economic situation — leads to reduced food waste rates.[23]

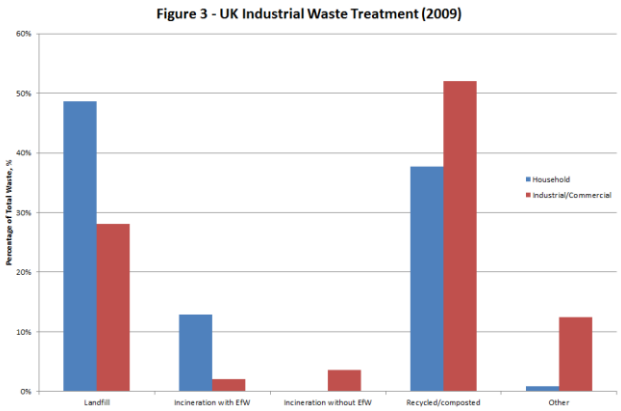
Commercial Industries

Commercial industries produced 24 per cent of the UK's waste in 2012.[24] With 67.9 million tonnes of waste produced in 2002 and 47.9 million tonnes in 2009, commercial industries have become less wasteful.[25]

Between 2002 and 2009, the rate of recycling rose from 42 to 52 per cent of the total waste produced, while the proportion of waste sent to landfills fell from 41 to 24 per cent.[26] This change is mostly attributed to landfill taxation and recycling laws and regulations.[27]

Construction and demolition

Most waste is generated by the construction and demolition sector: this industry is responsible for 50 per cent of the total waste generated.[28] This means that around 100 million tonnes of waste were produced in 2012. The EU has set a target that 70 per cent of non-hazardous construction and demolition waste must be recovered by 2020. The UK currently manages to recover 86.5 per cent of its own non-hazardous waste in this sector. [29]



Graph: KRR

The chart shows that, in 2009, a relatively high percentage of industrial waste was recycled compared to household waste. Moreover, landfill disposal was a comparatively unpopular choice. A possible reason for the difference is that industrial waste retains more value than household waste. This makes recycling and reuse an attractive solution.[30]

Sewage

Sewage waste causes a threat to human health and the environment when released untreated into rivers and oceans.[31] Globally, more than 200 million tonnes of human waste goes untreated annually. In the developing world, 90 per cent of sewage is discarded in rivers, lakes and oceans.

Even in the developed cities, sewage systems are often overwhelmed.[32]

- In the UK, 347,000 km of sewers collect over 11 billion litres of waste water every day.[33]
- The expected increase in the UK population will provide water companies with a challenge, as they will need to expand their facilities to provide all households with access to the sewage system.[34]
- Currently, London's sewers overflow on a weekly basis, flushing around 39 million tonnes of untreated sewage into the Thames every year.[35]

Waste disposal

Several methods are commonly used for waste disposal:

Landfill

Landfilling is the least favourable waste treatment method according to many, including the EU, even though it is often a cost-effective disposal method.[36] Waste is buried, and this process is accompanied by negative side-effects:

- Landfills cause great atmospheric damage, as rotting waste produces high levels of methane, a gas more harmful for the environment than CO_2.[37] At the same time, toxic gases are produced when different substances are mixed in landfills, and these have an adverse effect on air quality.[38]
- Landfills pose a hydrological threat, because they facilitate the creation of leachates, which could result in the pollution of groundwater.[39] Wildlife and humans suffer from this.[40]
- Landfills produce flammable gases. Methane, for example, is highly combustible. Landfill fires are difficult to put out.[41]
- Some landfills are transformed into recreational areas once filled, and in the process they are covered with grass. Yet, the management of the gases that are released by the fills is complicated. All waste products have different degradation times, varying from weeks to millions of years.[42] Moreover, reuse of landfill areas creates the risk that humans and wildlife will come into contact with contaminated substances.[43]

Incineration

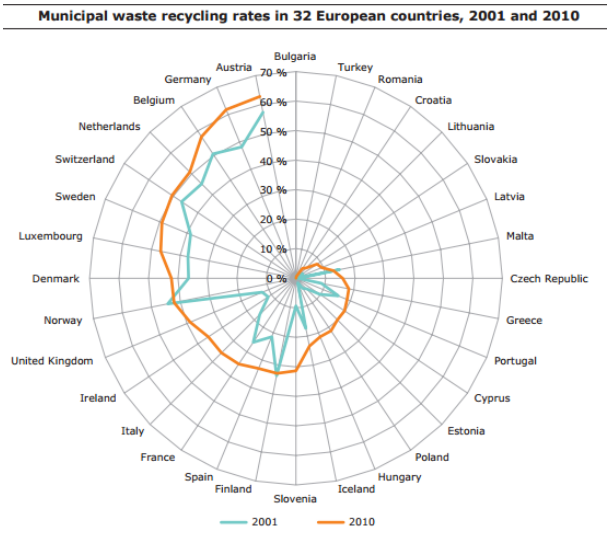
Incineration is a process by which the organic substances contained in waste are combusted. The process turns waste into ash, flue gas and heat. While heat can be used to generate electric powers, flue gas must be cleaned before it is released into the atmosphere. [44]

Incinerators reduce the solid mass of waste by up to 96 per cent.[45] The remaining materials that cannot be used are sent to landfills, but as their mass has been reduced significantly, there is a lower volume to dispose of. For that reason, incineration is a popular waste-disposal method in countries that lack space.[46] While this method ensures that hazardous toxins are destroyed due to high temperatures, it also has negative side-effects:[47]

- It is an expensive waste-disposal method. The facilities required are expensive, and limiting pollution is also costly.[48]
- Energy produced from waste is the most expensive form of energy.[49]
- Incinerators use three to five times more energy than they recover from waste. [50]
- Even though attempts are made to clean the by-products from pollutants, incineration generators are great polluters compared to fossil fuel operated generators. [51]

Recycling

Recycling is a process by which waste material is converted into reusable objects. In this way, resources that would otherwise be lost are conserved. As such, recycling contributes to the sustainable development of the Earth.[52] It leads to less waste, and consequently to lower waste-related challenges on the long term.



Graph: EEA

While the collection and sorting of materials for recycling can be time-consuming and expensive, it is considered the most desirable waste disposal method, and as a result the rate of recycling in Europe is currently increasing greatly.

Waste hierarchy

The UK follows the EU's five-step waste hierarchy model, in which waste reduction and disposal are ordered based on desirability.[53]

The model stresses the need to reduce material consumption in the first place. Following this, it focuses on attempting to repair and reuse products before turning to disposal. Recycling is the most desirable disposal option, as it turns waste into a useful substance. Other recovery methods, including incineration with energy generation, are also among the more desirable methods, since they at least make use of waste. Disposal in landfills and incineration without energy generation are ranked last.[54]

Implications of waste increase

Increases in waste have severe implications for humanity, wildlife and the environment.

Environment

The generation of waste harms the environment in many different ways. On the one hand, there are disposal methods, such as landfills and incineration, that release toxic substances. On the other hand, we produce hazardous waste, such as nuclear by-products, which we cannot dispose of.

The sea is heavily polluted with plastic and other debris.[55] Furthermore, the release of untreated sewage into the sea leads to the development of infectious diseases.[56] It can also cause eutrophication, which leads to an increase of algae that reduce oxygen levels in the water and block sunlight. This has led to the extinction of various marine species.[57]

Healthcare

The contamination of coastal marine areas with untreated sewage means that humans are more likely to get sick when consuming seafood or after swimming.[58] In fact, sewage is the cause of a major public health crisis that kills 1.4 million children every year.[59]

Hazardous waste also has severe consequences for human health. Though it is as yet inconclusive, research suggests a relationship between hazardous waste emissions and certain forms of cancer.[60] Moreover, asbestos is known to cause up to 5000 deaths per year in the UK, and the nuclear disaster in Chernobyl had a serious impact on the heath of humans and wildlife.[61,62]

Costs

The more waste is generated, the bigger its impact will be on the environment and on our health. Consequently, costs will rise. First of all, the generation of more waste means that more waste need to be disposed of. Secondly, more waste-producing individuals will require more expansive waste treatment and sewage systems. Finally, the pollution that has already been created must be reduced and treated as much as possible. Altogether, costs will increase significantly when waste generation grows.

Future possibilities

While it is projected that waste generation will increase in the future, it is possible to bring the peak of waste generation forward so that we can enter a stage in which waste generation decreases. To achieve this, we must move towards stable or falling populations, manage consumed goods more efficiently and invest in the development of new and improved technologies.[63]

Technology

Throughout the years we have developed technologies to minimise some of the long-term damage caused by waste. Yet in spite of this, much can still be gained through further technological advancements.

- There are types of waste that we cannot yet dispose of in a fast and safe manner. It is of great importance that we continue to develop

methods to safely dispose of hazardous waste, such as nuclear by-products.

- Inventions such as the floating barrier produced by the 'Ocean Cleanup Project', which aims to filter plastic from the sea, should be promoted.[64]
- Encouragement of cradle-to-cradle thinking could, in the long term, substantially reduce the amounts of waste. It promotes the principle of upcycling — creating products of higher environmental value than their material inputs — over recycling processes that focus on downcycling, which leads to quality loss.[65,66,67]
- Initiatives to start underground waste collection, as opposed to above-ground waste collection, would reduce CO_2 emissions and could allow for more efficient waste disposal in densely-populated urban areas with narrow streets.[68]

Sustainability policies

The development of sustainable energy subtraction methods could simultaneously reduce environmental damage, pollution and waste accumulation.

- Current reliance on fossil fuels causes the environment great damage, both during extraction and consumption. Currently, sustainable energy-resources cannot generate as much energy as their fossil-fuelled counterparts, but further development could overcome this problem.[69]
- The promotion of the attitude that is it better to purchase durable products, rather than promoting a mass consumption and throwaway culture, could greatly reduce waste accumulation.
- Promoting policies that incentivise people to produce less waste could lead to further waste reduction:
  - The recent introduction of a plastic bag charge in England is a step in the right direction. A similar measurement caused supermarket carrier bag usage in Wales to fall from 351 million in 2010 to 77 million in 2014.[70] It is predicted that the bag charge could reduce plastic bag usage in England by 80 per cent in supermarkets, and by 50 per cent on the high street.[71]
  - Promoting the re-use of existing packaging could be experimented with. Examples of this could be, for instance, using empty glass jars for leftovers, or restocking empty egg cartons with loose eggs.
  - Promoting the replacement of chemical cleaning products with non-hazardous products, such as cleaning-vinegar and sodium bicarbonate. This is not only more affordable, but also significantly better for the environment.[72]
  - The use of durable personal sanitary products, such as menstrual cups and reusable nappies, would reduce waste accumulation and is affordable for

consumers.[73] Menstrual cups cost the average US woman $104 in a lifetime, while tampons and pads add up to $1900. Moreover, each woman produces 250 – 300 pounds of waste each year from these single-use items, whereas the menstrual cup can be reused for an average of ten years.[74]

Population stabilisation or decline

While improvements to technology and sustainability policies can reduce the generation of avoidable waste, there will always be unavoidable waste. Inedible parts of foods, such as eggshells, are unavoidable, and the same applies to human excrement. Population stabilisation is the only way in which unavoidable waste levels can be controlled.

Conclusion

Waste is an inevitable by-product of human civilisation. As global population size has grown and many people have moved to urban areas, consumption and waste accumulation have increased rapidly. With these developments, the challenge of waste disposal has grown.

Landfills were traditionally popular for waste disposal, but their negative side-effects, and the realisation that the Earth is limited in space and supply, caused a move towards other methods. Both incineration and recycling have gained popularity, but while the latter is a sustainable waste disposal method, it cannot limit waste generation indefinitely. It can only reduce avoidable waste levels, but a large proportion of generated waste is still unavoidable.

Sustainability policies and technology will allow us to minimise avoidable waste levels and to reduce the effects of the pollution that has already been created. Population stabilisation, however, is the only change that can reduce waste production to a level that is manageable for both the environment and humanity. Consequently, the government must encourage policies that stimulate this change.

[1] http://atlas.aaas.org/pdf/107-110.pdf
[2] http://www.nature.com/news/environment-waste-production-must-peak-this-century-1.14032
[3] http://www.worldbank.org/en/news/feature/2013/10/30/global-waste-on-pace-to-triple
[4] http://www.worldbank.org/en/news/feature/2013/10/30/global-waste-on-pace-to-triple
[5] http://www.nature.com/news/environment-waste-production-must-peak-this-century-1.14032
[6] http://www.nature.com/news/environment-waste-production-must-peak-this-century-1.14032
[7] http://www.nature.com/news/environment-waste-production-must-peak-this-century-1.14032
[8] http://www.nature.com/news/environment-waste-production-must-peak-this-century-1.14032
[9] http://atlas.aaas.org/pdf/107-110.pdf
[10] http://www.nature.com/news/environment-waste-production-must-peak-this-century-1.14032
[11] http://www.smithsonianmag.com/science-nature/when-will-we-hit-peak-garbage-7074398/?no-ist
[12] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265543/pb14101-waste-manage-post-adopt-20131212.pdf
[13] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265543/pb14101-waste-manage-post-adopt-20131212.pdf

[14] http://www.krrprostream.com/blog/wp-content/uploads/2014/01/Figure-8-MSW-Recycling-Trends.png
[15] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/487916/UK_Statistics_on_Waste_statistical_notice_15_12_2015_update_f2.pdf
[16] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265810/pb14100-waste-management-plan-20131213.pdf
[17] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/487916/UK_Statistics_on_Waste_statistical_notice_15_12_2015_update_f2.pdf
[18] http://www.krrprostream.com/blog/wp-content/uploads/2013/08/Figure-2-UK-Waste-Treatment-Rate-Trends.png
[19] http://www.nature.com/news/environment-waste-production-must-peak-this-century-1.14032
[20] http://www.wrap.org.uk/sites/files/wrap/UK%20food%20waste%20-%20Historical%20and%20future%20changes%20(FINAL)_0.pdf
[21] http://www.wrap.org.uk/sites/files/wrap/UK%20food%20waste%20-%20Historical%20and%20future%20changes%20(FINAL)_0.pdf
[22] http://www.wrap.org.uk/sites/files/wrap/UK%20food%20waste%20-%20Historical%20and%20future%20changes%20(FINAL)_0.pdf
[23] http://www.wrap.org.uk/sites/files/wrap/UK%20food%20waste%20-%20Historical%20and%20future%20changes%20(FINAL)_0.pdf
[24] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/487916/UK_Statistics_on_Waste_statistical_notice_15_12_2015_update_f2.pdf
[25] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265810/pb14100-waste-management-plan-20131213.pdf
[26] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265810/pb14100-waste-management-plan-20131213.pdf
[27] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265810/pb14100-waste-management-plan-20131213.pdf
[28] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/487916/UK_Statistics_on_Waste_statistical_notice_15_12_2015_update_f2.pdf
[29] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/487916/UK_Statistics_on_Waste_statistical_notice_15_12_2015_update_f2.pdf
[30] http://www.krrprostream.com/blog/waste-in-the-uk/
[31] http://www.cep.unep.org/publications-and-resources/marine-and-coastal-issues-links/wastewater-sewage-and-sanitation
[32] http://www.livescience.com/16713-7-billion-people-world-poop-problem.html
[33] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69582/pb6655-uk-sewage-treatment-0
[34] http://www.water.org.uk/policy/environment-and-resilience
[35] http://www.bbc.co.uk/news/uk-england-london-24046324
[36]http:/www.advanceddisposal.com/for-mother-earth/education-zone/learn-about-landfills.aspx
[37] http://greenliving.lovetoknow.com/Environmental_Problems:_Landfills
[38] http://greenliving.lovetoknow.com/Environmental_Problems:_Landfills
[39] http://www.wegreen-usa.org/landfill-problems.html
[40] http://greenliving.lovetoknow.com/Environmental_Problems:_Landfills
[41] http://greenliving.lovetoknow.com/Environmental_Problems:_Landfills
[42] http://greenliving.lovetoknow.com/Environmental_Problems:_Landfills
[43] http://www.actapress.com/Abstract.aspx?paperId=35046
[44] http://www.wrfound.org.uk/articles/incineration.html
[45] http://www.wrfound.org.uk/articles/incineration.html
[46] http://www.wrfound.org.uk/articles/incineration.html
[47] http://www.wrfound.org.uk/articles/incineration.html
[48] http://www.energyjustice.net/incineration
[49] http://www.energyjustice.net/incineration
[50] http://www.energyjustice.net/incineration
[51] http://www.no-burn.org/downloads/Incinerator_Myths_vs_Facts%20Feb2012.pdf
[52] http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel/problems_in_environment/recyclingrev1.shtml

[53] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69403/pb13530-waste-hierarchy-guidance.pdf
[54] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69403/pb13530-waste-hierarchy-guidance.pdf
[55] http://www.theguardian.com/business/2016/jan/19/more-plastic-than-fish-in-the-sea-by-2050-warns-ellen-macarthur
[56] http://www.theguardian.com/business/2016/jan/19/more-plastic-than-fish-in-the-sea-by-2050-warns-ellen-macarthur
[57] http://www.theguardian.com/business/2016/jan/19/more-plastic-than-fish-in-the-sea-by-2050-warns-ellen-macarthur
[58] http://www.theguardian.com/business/2016/jan/19/more-plastic-than-fish-in-the-sea-by-2050-warns-ellen-macarthur
[59] http://www.livescience.com/16713-7-billion-people-world-poop-problem.html
[60] http://www.documents.hps.scot.nhs.uk/environmental/incineration-and-health/incineration-of-waste-and-reported-human-health-effects.pdf
[61] http://www.hse.gov.uk/asbestos/faq.htm
[62] http://www.who.int/ionizing_radiation/chernobyl/backgrounder/en/
[63] http://www.nature.com/news/environment-waste-production-must-peak-this-century-1.14032
[64] http://www.theguardian.com/environment/2015/nov/13/worlds-largest-ocean-cleanup-operation-one-step-closer-to-launch
[65] http://www.alternative-energy-news.info/cradle-to-cradle/
[66] http://www.theguardian.com/sustainable-business/businesses-waste-resource-cradle-to-cradle
[67] http://intercongreen.com/2010/02/17/recycling-vs-upcycling-what-is-the-difference/
[68] https://waste-management-world.com/a/the-future-of-waste-collection-underground-automated-waste-conveying-systems
[69] http://www.conserve-energy-future.com/advantages-and-disadvantages-of-renewable-energy.php
[70] http://www.bbc.co.uk/news/uk-34346309
[71] https://www.gov.uk/government/news/plastic-bag-charge-introduced-in-england
[72] http://www.sustainablestuff.co.uk/ProtectAgainstHazardousChemicals.html
[73] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291130/scho0808boir-e-e.pdf
[74] http://wondergressive.com/menstrual_cups_sustainable_periods/