

The background of the slide features a photograph of several flags flying on tall poles. The most prominent flag is the European Union flag, which is blue with twelve yellow stars arranged in a circle. Below it, the Italian flag (green, white, and red vertical stripes) is visible. To the right, parts of the Indian flag (saffron, white, and green horizontal stripes) and the German flag (black, red, and gold horizontal stripes) can be seen. The flags are set against a modern building with large glass windows. A thick white diagonal line runs from the top left corner towards the bottom right, separating the text area from the image.

The European Union Report

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Introduction

The European Union (EU) is an economic and political union of 28 states, based predominantly in Europe. The EU has strived to develop an internal single market via systems of law which apply in all member states to ensure the free movement of individuals, goods, services and capital between nations, legislation in the judicial system and to ensure policies on trade are kept standard. A monetary union established in 1999 became finalised in 2002 where 19 member states use the euro currency. In order to better understand the impact of synthetic biology and sewer problems we contacted the EU to get a standardised view of member states in terms of economy, media and genetically modified organism (GMO) use. An online form and follow up email was sent to get in contact with the Europe Direct Contact Centre, where we were given the opportunity to ask 5 questions with detailed responses being received across the course of a month.

Economic Impact of Fatbergs

Sewage blockages, fatbergs and drain damage have an extortionate cost on national governments with the UK spending approximately £15 to £50 million per year clearing almost 300,000 fatbergs from the sewers. The New York Times estimated that clearing grease blocks cost the city \$4.65 million in 2013-14. This cost accumulates from removal of the fatberg, repair to the sewers and mitigating any environmental damage caused. To better understand this economic expenditure, we asked the EU the following question:

How does the removal of fatbergs impact the European economy (and if not, is this a future matter of concern?)

EU Response

EU legislation on wastewater treatment requires Member States to collect and treat wastewater. In particular, the design, construction and maintenance of collecting systems has to be undertaken in accordance with the best technical knowledge not entailing excessive costs, including as regards the volume and characteristics of urban waste water (as in Annex I to Directive 91/271/EC).

Articles 3, 10 and 12 of the Directive establish general provisions on collection systems and treatment plants, but the discharge of fats and greases is not specifically regulated. Discharge permits to the sewer system under regional or municipal legislation in the different Member States often includes further limitations on fats and greases.

The Commission has not received specific information from MS on the impact of fatbergs on wastewater collecting systems and on the (additional) maintenance costs needed to address this issue.

The EU has a guide to ensure the treatment of wastewater is highly regulated and managed only by professionals of that sector. This information inspired the creation of our restaurant waste oil report, which looks at the UK legislation on vegetable oil collection and disposal. The EU is also not aware of the financial cost of fatberg removal, which suggests that the problem is not of European concern as fatbergs dominate the UK, due to the aged Victorian sewers that are incapable of dealing with the fats, oils, grease and wet-wipes responsible for the blockages. Therefore, our project hopes to reduce this huge cost of removal and the need of manual labour which is accompanied with relevant risks of the specialised workers who carry out the physical degradation of fatbergs.

Misleading Advertising

Water UK have set up a campaign which stands for the banning of misleading wet wipe advertisement in 2016. This came about after a report was presented to the Advertising Standards Authority calling for a ban on the word 'flushable' on wet wipes, which do not degrade in the sewers like toilet paper. Key leaders in this campaign include the Marine Conservation Society of the UK and the Litter Free Coast and Sea society. In conjunction with this, Thames Water have began an anti-fatberg campaign to advertise the 3 P's to flush down toilets –pee, poo and paper, a campaign that our iGEM team have collaborated with to take inspiration from. To understand the impact of misleading advertisement, the following question was presented to the EU:

In context of your laws on misleading advertising, what is the EU's stance on 'flushable wet-wipes', which are not safe for the sewage system and result in fatbergs and blockages?

EU Response

False claims about products' environmental credentials mislead consumers but also give an unfair advantage to the company making them. Within the EU, Directive 2006/114/EC on misleading and comparative advertising and Directive 2005/29/EC on unfair commercial practices provide Member States with the tools to address 'misleading advertising.' The primary responsibility to ensure the implementation of this legislation and to take legal action vis-à-vis undue practices lies with national authorities.

This response shows that the negatives of misleading advertisement must be met with corresponding activities from the nations respective government, and increased campaigns to solve these issues appear to be the only successful action being undertaken. Therefore, we hope to educate people via public outreach about flushable wet wipes and by getting in touch with South West Water who have begun a large campaign and petition to ban the word 'flushable' from being included on wet-wipe packaging.

Antibiotic Resistance in Sewers

A report from the National Food Institute from the Technical University of Denmark shows the analysis of sewage collected in 74 cities from 60 countries. This globally comparable data showed a shocking amount of antimicrobial resistant bacteria in metagenomic data. The highest levels of resistant strains exist in Asia, Africa and South America, and the most diverse strains in Brazil, India and Vietnam. A further study conducted by the American Society for Microbiology showed that wastewater from hospitals and pharmaceutical plants found 385 *acinetobacter* strains with oxytetracycline resistant. This wastewater, which ends up in sewers, is washes past fatbergs, where bacteria can colonise the fats to use as energy sources, allowing genes to be passed on and resistance to be spread. Dangerous species of bacteria such as *E.coli* and *listeria* and drugs such as hordenine and ostarine (illegal bodybuilding drugs) have been found in the Whitechapel monster fatberg in London, raising concerns of health. Therefore, we asked the EU the following question:

With rising reports of fatbergs and the antibiotic resistant bacteria within them, what is the EU doing to tackle this threat to public health?

EU Response

Proper waste management remains essential. Certain waste, such as single-use plastic products or household waste - including cooking oil, tampons, wet wipes etc - end up in the environment as a result of inappropriate disposal through the sewer system.

The EU Waste Framework Directive 2008/98/EC provides measures and instruments to protect the environment and human health by preventing or reducing the generation of waste as well as to ensure the proper management of this waste.

National authorities should therefore take measures to reduce the generation of waste originating fatbergs, and, in addition, should adopt appropriate measures to ensure that this household waste is properly managed, setting separate collection schemes for fats, cooking oils and grease, for instance.

In addition, the EU has taken specific actions. Directive 2019/904 on single-use plastic products, including wet wipes for personal care and domestic use, that are frequently disposed of through the sewer system or otherwise inappropriately disposed. This Directive requires Member States to take measures to incentivise responsible consumer behaviour and to inform consumers on appropriate waste management options for the product and the resulting negative environmental impact of littering or of other inappropriate means of disposal of the product. It also requires producers to help cover the costs of prevention by raising awareness of the impacts of improper disposal/flushing, as well as litter clean up and data gathering and reporting. In addition, wet wipes will require a clear and standardised labelling which indicates how waste should be disposed, the negative environmental impact of the product, and the presence of plastics in the product.

Specifically on antimicrobial resistance, the EU One Health Action Plan contains a number of actions to raise awareness on the need to reduce use of antibiotics and stop the spread of resistant bacteria. We do not have specific studies on the spread of these bacteria via waste.

The response shows an understanding of items that are incorrectly disposed of and result in sewage blockages ranging from plastics to wet-wipes and the need for consumers to be adequately informed of the risks and dangers of these behaviours, particularly with the misleading advertisement on wet wipes. Therefore, it is important for prevention of fatbergs to be a focal point in the fight against fatbergs, as this will avoid any potential niches for antibiotic resistant bacteria to colonise. Regarding the problem of antibiotic resistance, this is a separate issue that must be tackled from a medical perspective from prescription to consumer use. There is no definite data on these species of bacteria in fatbergs yet the analysis we hope to carry out on our fatberg sample should provide us with data to this problem.

Proper Waste Disposal

To better understand the correct disposal of waste cooking oil we looked at the current UK regulations to compile together a report on restaurants and their waste vegetable oil disposal. However, we wanted to better understand this on a larger scale, with particular focus to those companies that do not follow the correct legislation and the types of action that should be taken against harm to infrastructure, thus the following question was asked:

Regarding your policy on proper waste disposal, what actions do you feel should be taken against companies harming our infrastructure?

EU Response

Member States are responsible to ensure adequate monitoring and enforcement of the implementation of EU legislation, to identify non-compliance situations and to take the appropriate action, including remediation, to address any infringements of EU legislation.

This response shows that the member states have their own responsibility to prevent damage to their own infrastructure and in particular, inspired us to create a report which highlights the UK Acts that lead to prosecution and establishment closure should waste cooking oil not be dealt with in the correct manner with the paperwork to ensure these processes are managed by officially licenced agencies in conjunction with the UK Environmental Agency.

The Use of Synthetic Biology & GMOs

Synthetic biology is the interdisciplinary branch of biology and engineering and for our purpose, is the fundamental part of iGEM. As our approach to tackling fatbergs revolves around the use of genetically modified organisms (GMOs) in public areas such as the sewers, it is important to understand the legislative laws surrounding the use of these species. Current laws do not allow our project to be commercially used however we wanted to better understand the potential to use GMOs in tackling environmental problems. We asked the following question:

What is the EU's stance on using synthetic biology and GMO (genetically modified organisms) as a modern day solution to public issues?

EU Response

The European Commission follows the continuous progress in modern biotechnology, to consider how the EU can benefit from innovation in the food and agricultural sector while maintaining high safety standards. In the last decade, a variety of new techniques has been developed, based on advances in biotechnology.

The three Scientific Committees SCHER, SCENIHR and SCCS, upon request from the Commission, published in 2014 and 2015 three opinions on synthetic biology, focusing on its scope and definition, risk assessment methodologies and safety aspects and research priorities.

In April 2017, the High Level Group of the Commission's Scientific Advice Mechanism (SAM) prepared an Explanatory Note on New techniques in Agricultural Biotechnology providing an overview of new techniques and explaining differences and similarities with conventional breeding and established techniques of genetic modification.

This note covers applications in animals, plants and microorganisms for food and feed production and outlines the agricultural application of new techniques in the fields of synthetic biology and gene drive.

Following the ruling of the EU Court of Justice on new mutagenesis techniques in July 2018, in which the Court clarified that organisms from new mutagenesis techniques fall within the scope of the EU GMO legislation, the Commission is now working with EU countries and stakeholders to implement the Court's ruling.

From the response we concluded that research is able to find potential solutions while being subject to strict safety checks however although GMO uses have not advanced, the techniques and methods have. Agriculture seems to be the biggest area for potential GMO use in conjunction with genetic modification of organisms covering plants, animals and microorganisms. We decided to adapt our project to minimize the release of GMOs into the environment by using our bacterial lipases as enzyme powders to use in pans to breakdown fats before being poured down the sink, or upon fatberg extraction from the sewer, we could use the lipase to treat the fatberg to ensure more efficient biomethane production to further reduce the carbon footprint.

Therefore, techniques are being increased but safety and measures of safety prove to be a hurdle to the use of synthetic biology to modern day solutions. From this, we understood the precautions needed and we decided to help educate people on the benefits of synthetic biology, as often fear of the unknown is a limiting factor in progression of inventions.

Conclusion

The responses we received from the EU prove to be imperative to our project and provided us with a clear overall view of the economic cost of sewer blockages, the role of the media in misleading environment which has contributed to fatberg formation (wet-wipes) and the need for correct waste disposal. The use of synthetic biology is an emerging method of solving modern day problems and we hope to provide our project in a manner which is both safe in guidance with current legislation and with a strong public outreach scheme to better educate people on the preventative measures which will tackle fatbergs.

References

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