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FOOD, WATER AND WASTE PROGRAMME

GLOBAL FOOD WASTE MANAGEMENT:
AN IMPLEMENTATION GUIDE FOR CITIES

Executive Summary

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According to the United Nations Food and Agricultural Organization (FAO), 1.6 billion tonnes of food is lost and wasted globally every year, inflicting severe environmental and socio-economic damages.

Poor management of food waste causes the loss of natural resources, human health issues, pollution of rivers and seas, the generation of methane emissions from dumps and landfills, and a missed opportunity to recover valuable energy, organic matter, nutrients and water contained in the food waste. To illustrate the scale of the environmental impact, managing food waste sustainably could reduce greenhouse gas emissions by up to 518 million tonnes, which is the equivalent of taking all the cars off the road in the European Union.

In 2015, as part of the UN's Sustainable Development Goals (SDGs), all UN Member States committed to end hunger, ensure access to clean water and sanitation for all, make cities sustainable (including by "paying special attention to municipal and other waste management") and take urgent action to combat climate change. Without the sustainable management of food waste, these commitments cannot be met - so it is clearly essential to take action on this front.

As a result of continued global urbanisation, over 70% of the human population will live in cities by 2050, so there is a particularly pressing need to improve the management of food waste in urban areas.

This report aims to help policy and decision makers in cities to improve the management of food waste in towns and cities across the world. It provides a background to the key issues surrounding food waste and clear evidence to support the implementation of food waste collections and treatment alternatives. The report shares the experience of cities that have taken a lead and acts as a guide on how to deliver sustainable urban food waste management in practice.

1.6 BILLION

TONNES OF FOOD ARE LOST AND WASTED GLOBALLY EVERY YEAR

Understanding food waste

The first step towards sustainable food waste management is to understand the types and sources of waste being generated and determine the impacts that they cause. The FAO estimates the global cost of food waste to be approximately USD 2.6 trillion; this includes not only the value of the wasted food itself but also the greenhouse gas emissions, water scarcity, biodiversity loss, soil erosion, nutrient loss, reduced yields, wind erosion, and pesticide exposure. Clearly, reducing food waste and managing it more sustainably has the potential to deliver significant tangible benefits to the lives of millions of people around the world, as well as serving to protect the natural environment upon which we all depend for a sustainable future.

For the purpose of this report, 'food waste' means any food or inedible parts of food removed from the food supply chain to be recovered (for example, through anaerobic digestion or composting) or disposed of (for example, through disposal to landfill).

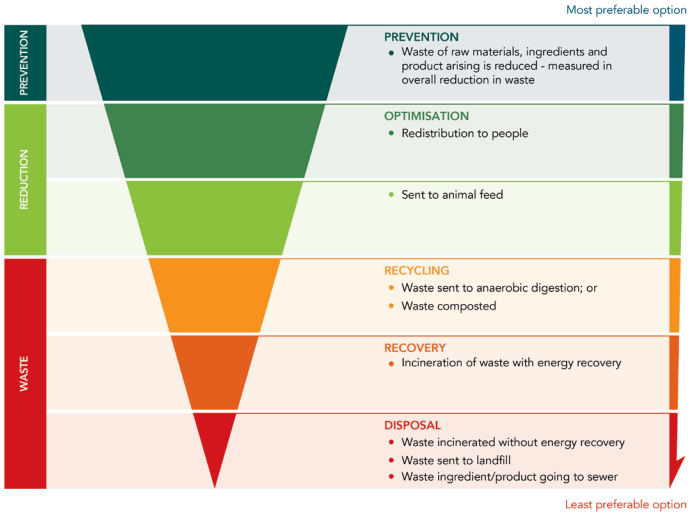
Preventing food waste

Cities may wish to treat food and drink material in line with the FAO hierarchy (provided below) which illustrates the agreed order of preference for the management of such resources. As shown, the most effective way to reduce the impact of food waste is to minimise its production, preventing it where possible; indeed, there is an SDG to reduce food waste generation per capita by 50% at the retail and consumer level by 2030. To achieve this commitment, action must be taken in all cities and nations. This action could include the introduction of regulations or voluntary initiatives designed to drive the redistribution of food to where it is needed and to influence consumer purchasing habits. Each location and its communities may have different characteristics which are causing food waste and it is important that this is taken into account when attempting to reduce it.

MANAGING FOOD WASTE SUSTAINABLY COULD REDUCE GHG EMISSIONS BY UP TO

518 MTons

FOOD AND DRINK MATERIAL HIERARCHY



Collecting food waste

As previously stated, all reasonable steps should be considered to reduce food waste in the first instance. However, some food waste is unavoidable. This remaining material may be collected and delivered to an appropriate processing facility so that it can be recycled. To enable the maximum recovery of energy and nutrients, it is preferable to collect organic wastes separately from other waste streams. Collecting food waste separately allows it to be measured and makes the scale of waste generation plainly evident – this in itself can cause a reduction in its production as individuals and organisations become more aware of the impact.

City of Milan

The City of Milan, Italy, was one of the pioneers in implementing a segregated food waste collection programme from households. In 2012, the city started separate collection of residential food waste from a quarter of its area. This service was previously available only to businesses such as restaurants, hotels, schools and supermarkets. After an initial period of 1.5 years, in 2014, the service was extended to all households in the city.

About 140,000 tonnes of food waste is collected annually from all of its 1.4 million inhabitants and businesses/industries, representing circa 100kg per person per year.

Food waste is discharged in a transfer station and transported to an integrated anaerobic digestion and composting facility by using large-capacity trucks (30 tons payload). The facility, built in 1997, is located in Montello near Bergamo and has since doubled in capacity. The plant digests the collected waste under thermophilic conditions into biogas for the generation of electricity, for which the installed capacity of the plant is about 9 MWel.. In addition, biogas is converted into biomethane to be fed into the national gas grid.

MILAN HAS ACHIEVED

86%

FOOD WASTE CAPTURE RATE

Processing food waste

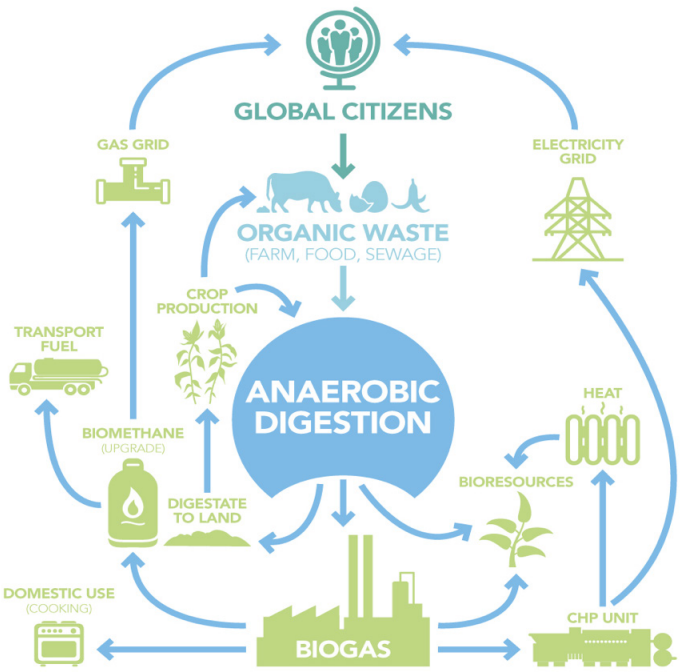
There are a number of options available for the processing of food waste and food waste mixed with other waste. These include composting, gasification, pyrolysis and anaerobic digestion (AD), offering different advantages and disadvantages. The report examines the options, describing each one and assessing their performance in terms of energy and nutrient recovery, water management, building soil organic matter and tackling climate change mitigation.

The following table illustrates that anaerobic digestion enables renewable energy generation, nutrient recovery and building of soil organic matter, essential for mitigating climate change, sustainable growth and industrialisation.

TECHNOLOGY	SUPPORTS FOOD WASTE REDUCTION	COST SCALE 1-5 (LOW-TO-HIGH)	ENERGY PRODUCTION	NUTRIENT RECOVERY	CAN BUILD SOIL ORGANIC MATTER
FOOD WASTE SEPARATELY COLLECTED					
Anaerobic digestion	✓	4	✓	✓	✓
In-vessel composting	✓	3	x	✓	✓
Windrow composting	✓	2	x	✓	✓
Liquefaction	✓		Dependent on context		x
Rendering	✓		Dependent on context		x
FOOD WASTE COLLECTED IN RESIDUAL WASTE					
Gasification	x	5	✓	x	x
Incineration and energy recovery	x	4	✓	x	x
Landfill without gas extraction	x	1	x	x	x
LFG extraction	x	2	✓	x	x
MBT	x	2	✓(with AD)	x	x
Pyrolysis	x	5	✓	x	x

What is anaerobic digestion?

Anaerobic Digestion (AD) is the natural breakdown of organic matter to produce biogas – a mixture primarily composed of carbon dioxide, methane and water vapour. The biogas produced can be used to make electricity, heat, gas and fuel. A co-product of anaerobic digestion is a valuable biofertiliser, referred to as digestate, which is the remaining solid and liquid organic matter – a stable, nutrient-rich substance which can help restore organic matter and nutrients in soil. AD can utilise a variety of feedstocks, one of which is food waste, with others being agricultural residues, manures, sludges and energy crops. Only through separately collecting food waste for AD can the full energy benefits be realised and the quality of the resulting digestate product be assured.



What are the benefits of anaerobic digestion?

The flexibility of AD and its ability to provide a multitude of benefits is unique - from the production of low carbon, renewable gas, heat and electricity for homes and businesses, to the recycling of vital nutrients back to soils, to improving sanitation. Towns, cities and nations could see great value in implementing the separate collection of food waste and processing it using AD. Due to the efficiency of the AD process, making use of naturally-occurring microorganisms to break down waste, AD can recover up to 60% more energy from food waste than other technologies. A tonne of composted digestate may contain up to 70% organic matter, of which of 5% may be the valuable nitrogen, phosphorus and potassium needed to grow crops.

What can AD deliver for your city?

- **Production of renewable energy- electricity, heat or transport fuel**
- **Provision of low carbon fertiliser**
- **Organic matter to help build soils**
- **Off- grid, localised energy production**
- **Enhanced energy security from domestic sources**
- **Substitution of fossil-fuel energy**
- **Generation of heat from co-generating units within biogas plants**
- **Production of baseload energy**
- **Climate change mitigation**
- **Improvement in urban air quality**
- **Contribution towards a circular economy**
- **Contribution towards food security**
- **Solid waste management improving health and sanitation**
- **Protection of water bodies**
- **Provide employment**

Policy recommendations

Given these multiple benefits, the following policy recommendations are considered by municipal authorities:

- **Undertake large-scale food waste awareness-raising and prevention campaigns;**
- **Require businesses to separately collect food waste**
- **Provide separate collections of food waste to households**
- **Require use of all food waste in line with the food material hierarchy, whether this through use as animal feed, composting or anaerobic digestion**

To overcome the barriers to policy implementation, political leadership is required, and the following process might be appropriate for implementation efficiency:

"How to" implement food waste collections

- **Assess waste sources – know your waste**
- **Establish the base case**
- **Assess the national policy and regulatory framework**
- **Identify the required expertise, potential partners**
- **Develop food waste prevention strategies**
- **Assess the feasibility and cost-benefit of different collection and treatment techniques**
- **Propose an integrated waste management strategy**
- **Run a pilot programme, phasing-in changes**
- **Prepare financing and implementation model**
- **Set sufficient budget for communications and public relations and continue public outreach over the long term**
- **Set high operational standards**
- **Monitor, evaluate and feedback improvements**

City of Oslo

In 2006, the City Council in Oslo decided to establish source-segregated collection of food and plastic waste from residual waste of households. It was agreed that this should be sorted into different coloured plastic bags to be sorted at central sorting plants based on the colour.
After some years planning and building, the first sorting plant was opened on October 1, 2009. After that, several treatment plants were changed and build, and in the summer 2013 the biological treatment plant at Romerike went into operation. Since then, this plant has delivered both compressed and liquefied biogas, delivered mainly to buses and waste trucks in Oslo.

IN OSLO, FOOD WASTE IS COLLECTED FROM

660,000

INHABITANTS

Feedstock collected

Food waste is collected from 660,000 inhabitants of Oslo with a collection rate of about 25 kg food waste per person. It is collected on a weekly basis from the residents, along with other waste. Small amounts of soiled kitchen paper may be added provided they are not full of soap.

Collection process

The City of Oslo has implemented a collection process which is a combination of door side collection by the city and delivery of waste to kerbside collection points or recycling stations by residents.
The collection system is based on colour-coded plastic bags. The residents dispose food waste in a green bag and clear plastic packaging in a blue bag. These green and blue bags are available for free in supermarkets. Residual waste is collected in normal shopping bags and paper and cardboard in a separate container. All bags are discarded into the same waste container from which the city collects them. The coloured bags are sent to optical sorting plants from where food waste is sent to an anaerobic digester, plastic is sent for recycling and the residual waste to incinerators with energy recovery. Garden waste, clothes, electronic waste, hazardous waste are taken to collection points or recycling stations by residents.

City of Auckland

The City of Auckland, New Zealand, is highly urbanised, with food waste accounting for 40% of the waste stream. In 2012, Auckland Council established 2 goals:

- **Reducing kerbside refuse by 30% by 2018 from 2012 baseline;**
- **Achieve zero waste by 2040 by turning its waste into resources.**

In order to achieve these targets, separate kerbside collection of food waste was identified as a key step.

A pilot trial was rolled out to 2,000 households to get a good estimate of participation rates, volume of collection, contamination levels, resident behaviour, customer satisfaction, barriers, benefits and to identify best practices. Before rolling out the trial, a postcard was sent out informing residents about the trial. This was followed up by door-to-door visits by waste advisors. The trial ran for four months during which 23L kerbside bins, 6L caddies for kitchen, and compostable bags were delivered to the residents along with how-to information booklets, collections calendar and date of first collection.

Once the collections started, waste advisors made follow up visits to resolve any issues such as undelivered bins and rubbish taken out on the wrong day. They also conducted audits of the waste and left feedback tags on the bins if separation was done incorrectly or if contamination was found in the separated food waste. Periodic quantitative and qualitative surveys were also conducted during the trial period and it was found that residents were receptive to separate food waste collection with an approval rating of 93%.

Further trials in different areas and types of housing have been planned leading to full service roll out to 490,000 households by 2021.

The separate food waste collection programme is a great example of organically growing the collection infrastructure. The one-on-one interaction of waste advisors with the residents to make the collections for them. The residents indirectly gain from participating in a public good service like recycling or collection food waste.

AUCKLAND AIMS TO ACHIEVE ZERO-WASTE BY 2040 BY TURNING ITS WASTE INTO RESOURCES.

What is in the report?

If you are a policy or decision-maker in a town or city, this report can kick-start your journey to a more sustainable food waste management that improves the wellbeing and resilience of the communities that you represent. The content of each chapter is briefly summarised below for ease of use.

CHAPTER 1: SOURCES AND IMPACT OF FOOD WASTE

Understanding why and how food waste is generated is essential in developing effective policies to minimise its impact. This chapter describes the sources of waste and quantifies its impact.

CHAPTER 2: PREVENTING FOOD WASTE

The UN SDGs require the halving of food waste by 2030 and this chapter emphasises the importance of this aim, providing examples of initiatives taken by cities to work towards this.

CHAPTER 3: COLLECTING FOOD WASTE

Some food waste is unavoidable and must be collected and transported to an appropriate facility for processing. Ideally, food waste should be collected separately – this chapter explains why separate collections are recommended and some of the key considerations in implementing such systems.

CHAPTER 4: FOOD WASTE TREATMENT TECHNOLOGIES

There are a range of technologies and methods for the processing of food waste but some deliver greater environmental and socio-economic benefit. This chapter assesses the available options.

CHAPTER 5: ANAEROBIC DIGESTION

AD recovers energy and nutrients from food wastes, through the natural breakdown of organic material to generate biogas and biofertiliser. This chapter explains how AD works and provides a detailed description of the technology, highlighting examples of AD plants around the world.

CHAPTER 6: PRODUCTS OF AD

This chapter explains how the products of AD – primarily biogas and biofertiliser – can be used and managed to the greatest advantage.

CHAPTER 7: POLICY RECOMMENDATIONS, BARRIERS AND IMPLEMENTATION

Drawing upon the experience of cities and towns with existing food waste collections and AD facilities, the final chapter of the report provides recommendations to policy-makers on sustainable food waste management. It highlights the barriers to implementing projects, information on the wider policy environment at national level, and an implementation guide on the process to follow to implement sustainable food waste management.

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This report has benefited from contributions given by

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