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Fats, oils, grease and kitchen practices implications for policy and intervention

Reshaping the domestic nexus

engaging policy understandings of kitchen practices and how they change

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E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

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This report is part of a research project bringing new ideas and evidence to bear on policy concerned with water, energy and food consumption. *Reshaping the Domestic Nexus* is a collaboration between research teams at the Universities of Sheffield and Manchester, in partnership with Defra, BEIS, Food Standards Agency and Waterwise. It is funded by the ESRC Nexus Network.

More on the project at nexusathome.wordpress.com

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REPORT SUMMARY

This report introduces a new approach to understanding the role of everyday household practices in domestic resource consumption and addressing the policy challenges this presents. To demonstrate this 'change points' approach we focus on one such issue: **household disposal of fats, oils and grease (FOG).** The problem of FOG in UK sewers has attracted increased attention in recent years. Industry responses focus on removing sewer blockages and reducing the FOG that enters sewers from commercial sources. However, around three quarters of sewer FOG comes from domestic sources, making household disposal a key priority for change.

Existing responses [p.5] to domestic FOG can be categorised into three approaches, focusing on:

- *Service provision* – management of the sewer system, requiring no changes within households
- *Individual decision making* – seeking influence through information campaigns, the dominant approach to preventing FOG from domestic sources
- *Social norms and networks* – targeted initiatives to influence behaviour through intervention in 'social context'

Here we present a fourth approach, tracing numerous 'change points' that occur in the process of carrying out routine household tasks (e.g. cooking, cleaning, laundry): moments in which resources are used up and waste is produced. In seeking to understand what influences these change points, and hence what successful intervention might entail, we draw on insights from **social practice theory**. This shifts attention from individual attitudes and behaviours to a systematic consideration of the multiple social, cultural and material factors that shape what people routinely do.

Our aim is to better mobilise this established body of academic work for practical use. In particular, we bring together evidence from what we term the **'home practices' literature**: recent empirical research applying social practice theory, and related social science approaches, to the study of household sustainability issues. This provides a distinctive but complementary addition to existing responses to domestic FOG, emphasising connections between everyday sequences of activity and wider cultural, political, technological and infrastructural factors.

Crucially, FOG disposal does not just happen because of decisions at the kitchen sink. Rather, actions throughout the stages of food provisioning – including shopping, food preparation, cooking, dealing with leftovers, and clearing up [p.10] – eventually lead to FOG entering sewers. Insights into what shapes behaviour at these change points [p.12] lead to a range of implications and recommendations for policies and intervention [p.14]. Specifically they should seek to:

1. *Take opportunities to make infrastructures more 'visible',* through targeted and well-timed media and customer communications
2. *Understand household routines in context* – identifying interventions which are likely to lead to lasting changes in habit – and design interventions that fit the existing rhythms of daily life
3. *Appreciate diversity within and between households*, learning from existing household responses to FOG, while anticipating any limits to transferability of successful initiatives
4. *Work with shared social norms* as well as individual knowledge and attitudes
5. *Recognise that kitchen practices are shaped by wider systems*, of food provision (supply chains, retail, etc.) and waste disposal. Interventions can therefore be targeted elsewhere, for example:
    - Product innovations that reduce likelihood of FOG production
    - Using retail environments and packaging as means of changing social norms
    - Providing effective alternative waste fat and oil disposal infrastructures
6. *Collaborate across sectors*, recognising the interdependencies of interventions and their resource consequences

THE ISSUE

The accumulation of fats, oils and grease (FOG) in sewers has gained increased public attention in recent years through the widespread image of the 'fatberg'. However, FOG is not a new problem; recognition of the problems it can cause in sewers dates back at least half a century.[1]

WRAP estimated that in 2012 UK households disposed of 1.6 million tonnes of food and drink waste via sinks and drains, including 55,000 tonnes of oil and fat. This equates to 2kg of oil and fat per household. This is an underestimate of the actual quantity of FOG entering sewers from domestic sources excluding, for example, the fat content of foods disposed of via the sink in large quantities, such as dairy products (310,000 tonnes) and meat (52,000 tonnes, mostly cooking residues).[2]

FOG causes problems at different stages of wastewater management. It accumulates in drains and sewers, restricting flow. This can lead to overflows and flooding, in turn causing property damage and pollution. In 2012-13 approximately 366,000 blockages were dealt with by water and sewerage companies across the UK, at a cost of £88m, with up to 80 per cent estimated to be caused by FOG and/or other items flushed down drains including wet wipes.[3] FOG which does pass through sewers causes further problems at wastewater treatment works, causing blockages and disrupting treatment processes.

However, FOG can be a resource. It can be recovered and put to use: for example, by conversion to biodiesel to power vehicles or acting as a co-digestant to enhance biogas production in anaerobic digestion.[4] Facilities for recovery are currently limited, but initiatives including recycling banks at supermarkets and door-to-door collection are under trial in selected locations.[3] In the absence of such facilities, householders are typically encouraged by the water industry to use existing food waste collections or the residual solid waste stream to dispose of small amounts of FOG, to take larger quantities to their local household waste recycling centre (HWRC) or are referred to their local authority for more place-specific instructions.[5,6]

As covered below, there is a range of responses to the challenges of FOG in sewers. The focus of the report is on *prevention* – specifically by setting out what can be learned through attention to how and why FOG goes down home kitchen plug holes.

OUR APPROACH

This report provides new evidence and ideas for tackling household disposal of FOG to sewers. It does so by presenting a new 'change points' approach. As will become clear in this section, the approach develops academic insights from social practice theory – and a broader body of empirical work that we term 'home practices' research – for practical application in policy settings. It is based on a synthesis of evidence from extensive existing research into everyday practices around food waste, water use, and other aspects of resource consumption in domestic kitchens. An emphasis on 'change points' provides a distinctive addition to existing understandings and approaches being applied to domestic FOG.

Focus on practices and change points

New evidence highlights that people seldom consciously 'demand' resources like energy and water but rather require those resources to do practices – such as cooking or cleaning. This project explores how evidence about these domestic practices can inform policy addressing water, energy and food consumption in homes. This report's focus on FOG hence leads us to examine the practices causing fats, oils and grease to go down plug holes in UK home kitchens.

Our approach begins by charting the sequence of very ordinary things that people do in the course of buying, preparing, eating and disposing of food. We characterise the moments that these activities are carried out as **change points**, in two senses. First, they are moments in which multiple possible courses of action could be pursued, each with different direct or indirect consequences in terms of using up resources and producing different forms of waste. Second, they are moments in which an item of food changes state or status, such as being heated up, or being designated surplus to requirements. Change points are therefore potential targets for intervention to change prevailing food practices.

We then draw together existing research evidence on **home practices**, from across the domains of water, energy and food consumption, to explore the factors that shape change points: what makes currently prevalent courses of action more likely than others and how might this plausibly change?

Placing FOG in the Nexus of water, food and energy

The ways that resources like food, water and energy are used are closely linked. At the simplest level, food-related practices result in disposal of FOG, leading to sewer blockages. Removing such blockages requires high-pressure hoses using large volumes of water and energy. Tackling the problem at source can therefore reduce demand for these resources.

Different ways of disposing of and reusing FOG and waste water create potential trade-offs and synergies. Recovered FOG can serve as a fuel in renewable energy generation. Reusing water from food preparation and washing up can save clean water while diverting grease and other food matter from the sewers. On the other hand, reusing fats and oils in cooking might risk conflict with both healthy eating and food safety agendas. The additional materials used in diverting FOG from waste water – foil, kitchen roll, plastic receptacles for collection – will have their own embedded energy in manufacture and distribution.

Recognising how the issue of FOG is situated in this nexus of resource relations helps to identify more holistic opportunities for intervention and also to anticipate trade-offs between different courses of action towards addressing FOG.

Work on the nexus of water, energy and food has typically focused on interdependencies in these resources' supply systems. This project focuses on practices performed in UK households' kitchens to explore the demand for these resources. As exemplified by the domestic kitchen, we argue that the water, energy, food nexus is present as much in people's homes and everyday lives as in sites of production.

The distinctiveness of the approach

Focusing on practices and change points, and paying attention to the interdependency of water, energy and food together allow our understanding of enduring policy problems – such as the inappropriate disposal of FOG – to be reframed, with important implications for intervention strategies.

Our approach is distinctive from other models of conceptualising and responding to such issues, a number of ways:

1. Systematically tracing a sequence of distinct yet interrelated **change points** in the process of food provisioning – not just the point of disposal – broadens the view of the direct and indirect causes of FOG disposal, multiplying the possibilities for potential intervention.
2. Starting from the practices that take place at these change points immediately draws attention to connections and overlaps between different policy concerns relating to use of water, energy and food. Intervening in any of these change points is likely to have implications across policy domains and objectives.
3. The approach brings a distinctive understanding of what shapes the activities undertaken at these change points.
    - Conventional behaviour change approaches characteristically seek to provide better information or incentivise particular courses of action in order to allow individuals to make more appropriate decisions.
    - Behavioural insights approaches draw on recent developments in social psychology and behavioural economics, demonstrating that much of what people do on a daily basis is 'automatic', habitual and unthinking, rather than deliberative. They look to change behaviour by either capitalising on these automated responses to stimuli or targeting particular periods of disruption to instil new routine patterns of behaviour.
    - Social practice approaches go further, recognising the routinised nature of everyday practice but also looking outside the individual to the multiple social, cultural and material factors that shape what people do. These 'external' influences are continually reproduced in how people carry out everyday practices, but systemic change happens 'if enough people do enough things differently enough'. [7]

    Thinking in terms of social practices implies a different, but complementary, approach to intervention, compared with those based on behavioural insights. Rather than focusing on small measurable changes to particular tightly defined behaviours, it emphasises connections between small-scale everyday activities and wider cultural, political, technological and infrastructural developments. The key imperative that follows is to think systematically about the different factors that can shape everyday kitchen practices, the interactions and interdependencies between these factors, and how intervening in one type of activity might have knock-on effects elsewhere.

Synthesising evidence

This report – and our 'change points' approach – is based on a thorough critical review of the burgeoning body of literature providing insight into domestic practices and their consequences for resource consumption. Several key fields of work are brought together in our review, especially those concerned with the dynamics of social practices[8] and household sustainability.[9,10] What makes this 'home practices' literature distinctive is a shift from giving attention to individual attitudes and behaviours to examining socially, culturally and materially constituted practices. This shift in emphasis informs the development of our 'change points' approach.

By emphasising the importance of social norms, meanings, rhythms, routines, materials and technologies, as well as inter-personal relations within the home, contributions to this literature together provide new framings of how resources are consumed and wastes produced as part of accomplishing the practices that make up everyday life. The 'home practices' literature has been taken up by policy and delivery bodies, notably WRAP[11] and the FSA.[12]

The 'home practices' literature has not so far addressed disposal of FOG into sewers; nor has the topic enjoyed much consideration by other social researchers. However, insights about FOG related practices are available from home practice research into related issues, with food waste[13–16] and water use[17–19] the most closely aligned. As the moments that result in FOG going down the plughole are inseparable from the broader routines and rhythms of kitchen life, broader literatures are also engaged. By drawing together findings from this work around the problematic of FOG, clear insights and implications are evident.

Introducing the 'Fats to fuel' project

Since March 2014, Yorkshire Water have partnered with the Karmand Community Centre in Bradford to run a door-to-door used cooking oil collection scheme. Each household is supplied with a lidded 5 litre plastic tub or 'fat vat' to save and store their used oil. These are collected once a month in exchange for a clean container. The oil is then sold to renewable energy producers for conversion into biofuels, raising money for the Karmand Centre.

This review and synthesis of existing evidence is complemented in the report by reflecting on a case study of an ongoing FOG intervention: the 'Fats to fuel' project in Bradford. This was chosen as an example of a live initiative that usefully illustrates some of the key insights and challenges raised in the report. Given the clear parallels between FOG and food waste when it comes to householders' practices, relevant lessons from parallel interventions into food waste disposal are also presented. However, there remains a need for further dedicated FOG-focused research and so the report finishes with some key questions deserving investigation.

EXISTING RESPONSES

Sources of FOG

Responses to FOG vary according to source. Sources of FOG are classified into three categories:

1. **Industrial** premises, such as food processing sites and dairies, are the most strictly regulated in terms of waste liquid management. As a result, industrial FOG is not considered a significant part of the problem, with campaigns instead directed at commercial and domestic sources.[4]

2. **Commercial** sources are a key target for current interventions due to the high levels of FOG generation from a relatively small number of premises. While the availability of data is limited, food service establishments (FSEs) are considered particularly problematic due to the high volume of fats entering the sewer at a single point. This can lead to localised blockages, especially at locations with multiple restaurants and takeaways.

3. **Domestic** sources are a relatively low priority in FOG prevention. Compared to the higher concentration of FOG arising from a relatively small number of premises such as FSEs, homes individually produce small amounts. However, recent research commissioned by UKWIR estimates that, in terms of overall quantity, domestic properties account for approximately 70 to 80 per cent of all FOG in sewers.[4] Focus on the domestic is therefore well justified.

Responses to FOG

Across different sources, responses to the FOG problem can be grouped into three broad categories:[20]

1. **Acceptance** means waste water management adapting to the reality that fats, and other currently problematic materials, are routinely disposed of via liquid waste streams. Sewers could be redesigned and replaced to better accommodate this additional waste matter and reduce the likelihood of blockages, by using different construction materials or by changing the diameter and gradient of pipes.[21] However, wholesale replacement of the network would be prohibitively expensive.[1]

2. **Removal** of accumulations of FOG physically from sewers, with any damaged pipes repaired or replaced. This is a common approach and tends to occur reactively in response to a reported blockage.[4,22] High pressure jets are used to break up the deposits, which are then extracted and either redirected to landfill or recirculated to be used for fuel. Removal is an expensive process, is labour intensive and presents logistical challenges relating to access.[22,23] Furthermore, if being reused as an energy source, FOG recovered from sewers is likely to be more contaminated and so require more treatment than if it were collected prior to disposal.[4]

3. **Prevention** of FOG 'at source', keeping it out of sewers. For the above reasons, these preventative measures are the favoured approach in water industry strategy.[23]
   Disposal of inappropriate materials via sinks and drains – known as 'sewer misuse' – is understood to be the most important cause of blockages and the preferred focus for intervention, rather than the performance of sewers. It should be noted that while this report works with the water industry assumption, we are not currently aware of life cycle analysis or other similar studies that quantify the relative costs and benefits of different disposal routes.

'Fats to fuel': from removal to prevention

The initiative was launched in response to a series of sewer blockages in the immediate area, which culminated in substantial investment in clearing, repairing and upgrading the local sewer system. The collection scheme was initially intended as a means to engage local residents in the issue, raise their awareness and reduce the number of repeat incidents. Generating energy and raising money were secondary goals to preventing blockages. In its first year the scheme collected 1,000 litres of cooking oil from 85 households on two streets. It has since expanded to cover 283 households in the area, as well as providing fat vats to students living in university accommodation in the city.

This report's focus on how to prevent FOG being disposed from domestic kitchens to sewers is therefore timely.

Approaches to FOG from domestic sources

A range of approaches to preventing FOG disposal in domestic kitchens have been developed, piloted and used. The following categorisation of approaches, originally applied in relation to reducing domestic demand for water,[24] can also be applied to tackling FOG, framing what is distinctive about the approach advocated in this report.

Service provision

Both 'Acceptance' and 'Removal' above fit in to this category. Water companies' predominant response to FOG in sewers is to remove consequent blockages, repair damage and clean up after floods. Each of these represents technical and service oriented approaches which require no direct input from householders. There is already recognition that these responses are not sustainable in isolation, not least due to the major costs involved. Another concern is that these responses focus attention squarely within the domain of wastewater management and so risk finding narrow solutions to narrowly defined problems, meaning any potential benefits from cross-domain collaboration are likely to be missed.

Individual decision making

Appealing to consumer decision making has now emerged as the preferred approach of the water industry to prevention of FOG. For the most part this has involved information campaigns – via websites and social media or through letters and leaflets delivered to homes – that seek to draw fresh attention to the problem of FOG and/or suggest tips for disposing of fats in other ways.

Typically the focus of this communication is on what gets termed **'sewer misuse'**, covering food waste and FOG alongside discussion of other non-flushable items such as wet wipes, nappies and sanitary products. The latter are often given more attention, especially in providing practical solutions, since these are more tangible for customers and relatively simple to effect change: placing non-flushable items in a bathroom bin rather than in the toilet.

From a wastewater management perspective, the two issues of kitchen FOG and bathroom non-flushables are inseparable, with fat accumulations and products such as wet wipes often combining in sewers to cause blockages. However, it makes less sense from a householder perspective to address the two issues together, since they arise during quite different types of activities in quite separate parts of the home: beginning with an understanding of household practices in context, in addition to how the problem presents itself in sewers, is therefore vital for designing successful interventions. Furthermore, although the broad message is the same, the practical responses to dealing with solid waste paper and plastic materials are considerably different to those for dealing with a messy and formless substance like fats and oils.

There is limited evidence as to the success or otherwise of these campaigns. In relation to FOG, as with related fields of behaviour change, there is recognition that people's behaviours are difficult to change, and that any changes are difficult to sustain. Information campaigns might lead to temporary improvements, but repeatedly need following up with reminders.

More targeted interventions, typically in problem or 'hotspot' areas, have taken a lead from more developed theories of behaviour change, including behavioural insights approaches. This means, for example, recognising that consumer decision making is not always a conscious, deliberative process; and that there are likely to be disparities between people's considered attitudes and how they act on a routine basis. With this in mind, recent initiatives have sought to take advantage of disruptions in existing routines – for example a local sewer blockage that has impacted on particular households – as an opportunity to question existing habits and try to shape new ones.

Another related recognition is that people learn through doing, rather than simply through the communication of information. Behaviour change schemes, then, have also provided simple tools – plastic plate scrapers, 'gunk pots' for collecting and disposing of fat, funnels to help in decanting used oil into bottles, etc. – to encourage households to try for themselves different ways of disposing of waste food and FOG. These can be part of broader recognition of the need to provide a working alternative to disposal via the sink, backed up by appropriate infrastructure.

Social norms and networks

A limited number of initiatives actively try to engage social norms and social networks in seeking to change behaviours around FOG. For instance, campaign literature presents certain desirable attitudes and behaviours as 'normal', supported by relevant statistical evidence as to their prevalence, reflecting a technique widely used in behavioural insights approaches. For example:

> *Where we have used the Keep it Clear campaign, most people are already putting their waste in bins and recycling their used cooking oil. And it's working – sewer blockages have gone down by an average of 52%*[25]

The idea is that people are implicitly influenced by what they believe to be common practice, in a way more powerful than direct instruction. This, however, represents a narrow application of the concept of 'social norms', understood as biases in the way people think that can be put to instrumental use in trying to subtly shape individual behaviour. A broader application would seek to understand *how* certain behaviours become 'normal' in a particular time and place, including the different roles played by different actors and agencies – e.g. governments, TV personalities, community leaders or family members – in this process.

Some of the more targeted behaviour change initiatives have also started to use social networks to help communicate and normalise desirable behaviours, by identifying key actors and groups that are judged to

Lessons from food waste: the power of social networks

WRAP's consumer-facing campaign, Love Food Hate Waste (LFHW) seeks to engage with householders to raise awareness of food waste and encourage related changes in how people buy, store, prepare and eat food. LFHW's 'cascade training' model of delivery recognises that:

1) Householders are embedded in networks of social relations within and outside the home; and
2) Learning often results from these social connections and occurs in the process of personal interactions, especially in practical settings when new ways of carrying out practices can be demonstrated first hand.

Cascade training works on the assumption that 'everything we say or do tends to ripple through our network, having an impact on our friends (one degree), friends' friends (two degrees) and our friends' friends' friends (three degrees)'.[28] Volunteers attend a training session to learn more about food waste and how to play a part in reducing it. They are then expected to pass the learning on to their friends, family, colleagues and neighbours, who are then encouraged to do the same within their own social networks.

The cascade model was found to be successful in passing on information, especially at the first 'degree' of connection, with over 90 per cent of volunteers 'cascading'. On average they each shared their learning with between 16 and 38 people (depending on the method of estimation used), who in turn each passed it on to two further people. Also important was the method of communication. In the majority of cases this happened informally – in the course of ordinary conversation – and often took place 'in the kitchen, around food and in very practical situations'[29] involving not only dialogue but allowing friends and family to observe changed practices.

hold influence within a community. A number of more developed initiatives piloted in response to domestic FOG highlight the importance of recognising diversity within and between households, including the different roles played by different household members in domestic management, and the different approaches required to work with different groups of people or in different locations. This approach is exemplified by Anglian Water's 'Keep it Clear' campaign[26] and has also been central to Yorkshire Water's 'Fats to fuel' scheme in Bradford, working with volunteers from a local community centre and university accommodation services.[27]

Social practices and change points

The fourth category of approaches decisively shifts the locus of intervention away from individual preferences, instead focusing on shared practices. It has so far not been applied for intervention into FOG prevention.

Here, disposal of FOG is understood as a consequence of deeply intertwined patterns of activity, cultural conventions and expectations, and the broader technological and infrastructural context. This approach offers means to reframe and enhance existing interventions, and to enable identification of new forms of intervention. It therefore offers a means to develop and build upon existing interventions and approaches in relation to domestic FOG prevention. The following sections articulate and evidence this approach.

FOG AND KITCHEN PRACTICES

So what does a 'change points' approach to FOG prevention provide in terms of understanding opportunities and challenges for intervention? From a social practice perspective, the 'creation' of FOG and their journey to the kitchen plughole are part of broader routines and rhythms comprising life in the kitchen.

In the course of buying, eating and disposing of food, households engage in a series of different processes: shopping, food preparation, cooking, dealing with leftovers, and washing up. During each process a variety of liquid and solid wastes can be produced. Each of these stages in the path of food presents various ***change points*** – moments where numerous possible courses of action could plausibly be pursued, with different implications for what ends up in sewers and other waste streams.

Understanding where FOG comes from

Shopping

Decisions made when buying food can ultimately impact on the levels of FOG and other waste matter that enter the sewerage network:

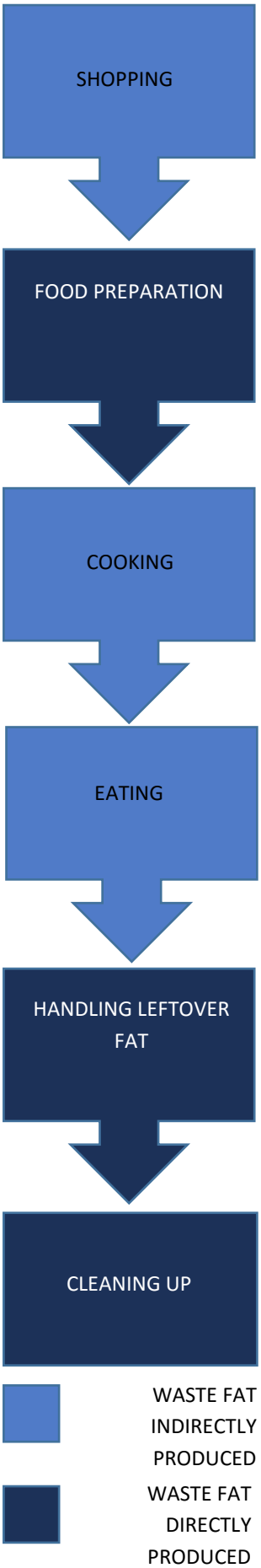
- Some types of food release large amounts of fat during cooking (e.g. meat), while others release much less or none at all (e.g. leaner varieties of meat, vegetables)
- Some foods are more likely than others to be cooked in oil or other fats, reflecting cooking conventions, tastes and the material properties of the food.

All other things being equal, reducing the purchase and consumption of foods that release more fat, or require more cooking oil, can reduce the quantity of FOG later entering sewers.

Food preparation

Preparing food often begins with rinsing, scrubbing, peeling, trimming or otherwise removing matter that is considered unpleasant or unhealthy to eat. These steps towards making food edible are the first point where liquid and solid waste are directly produced and sorted: waste water in washing food, solid waste in separating edible food from unwanted detritus. In practice the distinction between liquid and solid waste here is not absolute, since solids are commonly mixed up with the waste water, at least in small quantities. Waste water can then be dealt with in two main ways:

- Disposal via the drain. If a sink strainer is fitted this can be used to catch any larger pieces of solid waste and redirect them towards the kitchen bin or food waste caddy; otherwise these will also be washed down the drain.
- Save the water and put it to some further use, for example watering plants, thus reducing overall demand on both water provision and sewerage services.



STAGES IN THE FLOW OF FOOD

Cooking

Many items can be cooked in multiple ways, with different methods of cooking producing different amounts of leftover fat. Potatoes, for instance, might be boiled, baked, roasted, sautéed or deep fried. Fatty meats like bacon or sausages are variously fried, grilled or cooked in the oven. Choosing between these different methods can result in starkly different quantities, and qualities, of FOG to be managed.

The details of how particular cooking methods are carried out are also important. This might mean reducing the amount of oil used in frying, for example, or lining grill pans and roasting tins with foil, providing an easier way of collecting and disposing of leftover fat via the solid waste stream.

Eating

In itself, eating has very limited consequences for FOG production. Most directly, eating and its location as part of having a meal, can result in different quantities and forms of residues including of FOGs. For example, the use of serving dishes or not can have an effect on the total amount of food residue to be dealt with, as can different standards in relation to clearing one's plate. However, the eating is of more consequence in being the practice which most clearly shapes the other change points. Norms, expectations and standards of what constitutes a meal shape what is bought, how it is prepared and cooked, and so what there is to be disposed.

Handling leftover fat

Cooking often produces leftover fat in liquid form, including used cooking oil and juices released in cooking meat. Again, there are multiple possibilities as to what can be done with these substances. They might be:

- **Seen as waste** and discarded. Although they are liquid when hot, or even at room temperature, they solidify at cooler temperatures and so complicate the distinction between liquid and solid waste. As a result, some people might pour them down the drain, while others dispose of them via solid waste collections.
- **Reused in cooking**. Meat fats can be used, for example, in making gravy or roasting vegetables. Some types of vegetable oil used in deep frying can be saved and used again.
- **Collected and recycled** for non-food use, especially in generating renewable energy. Used cooking fats can be converted into biodiesel to fuel vehicles or electric generators, or be added to anaerobic digestion of other waste matter to improve yields of biogas production.

Cleaning up

Finally, liquid and solid waste are produced in cleaning up after food: washing dishes, wiping surfaces and rinsing packaging for recycling. In the process, clean water mixes with residual food and grease to become dirty dishwater: again, solid waste is often combined with waste water.

However, this can be minimised:

- By placing any scraps of food in the kitchen bin or food waste caddy
- By wiping plates and pans with kitchen roll to remove any residual grease before washing.

After washing up, waste water can be dealt with in the same two ways as in food preparation: it can be poured down the drain or it can be saved and put to further use, for instance watering plants.

What shapes what happens at change points?

This section presents understanding of why some courses of action at key change points tend to be more likely than others, and where attempts to intervene might find some traction. The key message is that although FOG is discarded in these change points, the causes may well be elsewhere: in the complexities of daily routines, in relationships and the division of labour within the home, in social norms and cultural conventions, in the configuration of kitchens and the material properties of food (especially fat), in the systems of provision and of disposal.

Invisible infrastructure and unconscious routines

For the most part, households consume resources and create demand for services not for their own sake, but in the course of carrying out mundane everyday practices. These resources – and the infrastructures that provide them and carry them away – are instrumental in activities such as cooking, cleaning and doing the laundry, yet they go largely unnoticed. The invisibility for example, of energy services reflects their consistency and reliability: they tend to come into focus only when they are interrupted in some way, for example by a power cut. As such, the impacts of appealing to people's attitudes about drains and sewers are likely to be limited, since many people rarely consider their existence.

More generally, much of what people do on a day-to-day basis is a matter of routine. It follows stable patterns and involves little conscious reflection. This can limit the effectiveness of campaigns that aim to encourage behaviour change through providing information and advice. However engaged someone is by the campaign, translating their new knowledge into practical action will always be difficult.

Time and convenience

The specific ways that people carry out domestic tasks are carefully coordinated to fit alongside any number of other ongoing time commitments including employment and caring responsibilities. Even within the kitchen, preparing and eating food happens alongside a wide range of other activities. The process of cooking a meal, for example, might be interspersed with other tasks such as feeding pets, emptying bins, washing up, answering the phone or helping children with homework.

It follows that any proposed changes in how people carry out these tasks need to represent a good fit with the wider rhythms of daily life. For example, asking householders to take their used cooking oil to a municipal household waste recycling centre might be a poor fit with existing routines, while collection banks at supermarkets – already visited on a regular basis – might be less disruptive; doorstep collection is likely to be more convenient still.

Diversity within and between households

Often, households are not singular units, but are comprised of relationships between different people, sometimes with differing needs, priorities and roles. Moreover, responsibilities for negotiating multiple competing demands within and outside the home fall disproportionately on women. The work of feeding the household exemplifies this imbalance. Repertoires of meals are often constrained by the frequently narrow range of foods that some family members are willing to eat, as well as by the complex scheduling of many family lives. The requirement to balance the conflicting needs of different household members represents a potential barrier to reducing the use of fatty foods, the amount of oil used in cooking or saving fats for reuse in subsequent meals.

There is also a need to recognise diversity between households with different combinations of widely varying people at different life stages, and with different characteristics and preferences. Factors including the gender division of domestic work, the use of supermarkets versus smaller local shops, the types of food eaten and how they are prepared (including the use and reuse of fats), and prevailing approaches to cleaning up and disposing of waste, may all vary according to, for example, the age, social class or ethnicity of

household members. Representing these differences in the design and implementation of interventions is likely to improve the fit with people's existing routines and commitments.

Social norms and cultural conventions

In considering the diversity of UK households, it becomes apparent that how people go about domestic activities is not merely a matter of personal preferences or individual habits. Instead, kitchen practices are shaped by shared, conventional understandings about what is and isn't food, what it means to cook and eat 'properly', hygiene and cleanliness, prudent use of resources and environmental responsibility. These conventions change over time and vary geographically and culturally, but they can be difficult to intervene in, at least in predictable and controllable ways.

Recognising the strength of shared understandings helps shed further light on potential difficulties faced by attempts to change *individual* consumers' attitudes and behaviour by targeting them with information. However, sustained campaigning on multiple fronts – factoring in the influence of high profile intermediaries (e.g. celebrity chefs), how goods are marketed and sold, the work of community groups and word of mouth between friends and neighbours – can potentially start to change the direction of conversation at different scales.

Handling problematic materials

Cultural understandings that distinguish food from non-food, what is clean from what is unclean, and so on, are very significant when it comes to the physical properties of fats, oils and grease. They can be troublesome materials to handle. The fact that they are liquid at cooking temperatures, and often at room temperature, makes them simpler to dispose of via liquid waste than via solid waste channels, yet their tendency to solidify and accumulate in the specific physical and chemical conditions of drains and sewers makes this disposal highly problematic.

FOG is not only difficult to deal with, but many also find it unpleasant. Evidence from broader research into food disposal suggests that when food begins to deteriorate, its material properties – and the bodily reactions caused by its appearance, smell and feel in the people handling it – play an important role in how it is discarded. The more effectively and reliably it can be sealed off and ejected from the home with minimal

'Fats to fuel': success factors

Organisers of the Bradford 'Fats to fuel' project acknowledge a number of critical factors in its success to date, demonstrating the importance of considering the multiple social, cultural and material influences that shape what happens in home kitchens:

- Recognising the educational value of doing something practical and that behaviour change can be a more involved process than simply providing written information
- Providing a working alternative – an effective infrastructure for disposing of fat – alongside instructing people not to pour it down the drain
- Sensitivity to the specific cooking practices and cultural conventions of local people, reflecting the significant British Asian population as well as members of Slovakian, Polish, Romanian, African and White British communities, all having engaged with the scheme
- Collaborating with an established community organisation, combining 'bottom-up' local community knowledge and experience with the 'top-down' legitimacy and resources of a large regional water company
- Being a visible and recognisable presence in the area and drawing on word of mouth between neighbours to increase participation

Reliably carrying out collections at regular intervals, helping householders to develop new routines around FOG disposal

human contact, the better. If the same is true of householders' reactions to leftover fats, which is highly plausible, then successful interventions to divert FOG from sewers will mean providing an alternative, yet similarly effective, option for quick and seemingly hassle-free disposal than the kitchen sink.

IMPLICATIONS FOR INTERVENTIONS TO PREVENT FOG

As discussed in the *Existing responses* section, there is a range of existing approaches to dealing with domestic FOG. Most resources go into tackling blockages downstream from the kitchen plughole. These responses follow the model of 'service provision', requiring no change in what householders do. By contrast, initiatives aimed at preventing FOG disposal from home kitchens are predominantly focused on effecting change to individual decisions and choices through information provision, with limited evidence for that information having substantial effect. A small proportion of overall investment into dealing with domestic FOG goes into more targeted initiatives which consider the significance of social norms, interpersonal relationships, the potential for changes to the material context of practice (such as provision of means of fat collection) and the importance of considering social diversity.

On the basis of the evidence we present above, we argue that initiatives like these could be complemented by a fourth approach, rooted in understandings of everyday activities in a given household as enactments of wider social practices. The key imperative that follows is to **think systematically** about the different factors that can shape everyday kitchen practices, the interactions and interdependencies between these factors, and how intervening in one type of activity might have knock-on effects elsewhere. Traditional approaches often focus on a particular policy problem, assuming that broader contexts stay largely the same, whereas the 'change points' approach assumes that all aspects are potentially able to change.

As stated in the *Synthesising evidence* section, while much can be drawn from work on closely related issues there is a need for more research on FOG prevention specifically, which could provide the basis for more specifically relevant proposals for intervention. Nevertheless, from the synthesis of work above, we can identify a number of interventions which follow. Below these are differentiated between those that focus on change directly to practices in the kitchen, and those that target intervention elsewhere in the broader systems (e.g. of food provision, waste disposal) that could have influence on domestic FOG production.

Changing practices in the kitchen directly

As shown above, FOG can end up in sewers as a result of a whole range of potential change points over the path of food into, through, and out of domestic kitchens. Existing initiatives use a limited range of means to intervene only into those practices which are most clearly related to FOG disposal. A practice approach enables a more holistic understanding of the situations that lead to FOG disposal, and appreciation of the range of factors influencing those situations. In so doing, it shows different potential targets for intervention, as well as a fuller basis for anticipating challenges and trade-offs.

Key implications that follow from the discussion are that policies for intervention should seek to:

- **Take opportunities to make infrastructure more 'visible'**. Attention to practices helps understand why the infrastructure beyond the plughole is invisible to householders. Opportunities to make a difference to this could be considered. For example, cases where FOG blocked sewers 'act back' through flooding could be emphasised; or the costs of FOG removal highlighted on customer bills.
- **Understand household routines** to identify interventions which enable householders to habituate desired changes. Existing schemes which provide counter-top fat disposal caddies as part of a collection scheme are an example of this, offering to fit into routines of handling waste fats and cleaning up.

- **Recognise the rhythms of daily life** through which people achieve balance between competing priorities. Interventions need to fit into those rhythms. For example, asking householders to take their used cooking oil to a municipal household waste recycling centre might be a poor fit with existing routines, while collection banks at supermarkets – already visited on a regular basis – might be less disruptive; doorstep collection is likely to be more convenient still.
- **Appreciate diversity within and between households**, enabling both:
    - Anticipation of the challenges of transplanting initiatives that have been successful in one situation to another
    - Identification of opportunities for intervention with specific applicability, such as recognising an opportunity for oil recovery or reuse relevant to a particular culinary culture.
- **Work with shared social norms** as well as individual knowledge and attitudes:
    - The properties of fats, oils and greases in the kitchen are key to the difficulties of changing what people do with them, but their problematic character and the disgust they can elicit can also be worked with to effect change, by heightening awareness and a sense of responsibility for the consequences of disposal. Press coverage of major 'fatbergs' indicated the potential traction here.
    - The sense of sewers as collective provision and civic responsibility towards them could be deployed (though made more difficult to sustain given privatisation).
    - Opportunities to work with community groups or social media can be means to effect change to collective social norms.

Changing systems to shift kitchen practices

What people do in kitchens is shaped by wider systems. For example, when people buy, prepare and cook food these activities are part of a wider complex of interdependent practices together making up the 'food provisioning system', including farming practices, retail practices and so on. Changing the way that food is supplied will impact on how people eat, and vice versa. Similarly, how people dispose of food waste (including FOG) is part of a complex of interdependent practices making up the 'food disposal system', including waste management practices, governance and the operation of all associated infrastructure.

Opportunities for intervention in kitchen practices and their consequences in terms of FOG may therefore be found elsewhere.

- **In the food supply system**, product innovation could reduce the likelihood of kitchen FOG production. For example, the rise of oven chips has helped displace home chip pans and their consequences, including for FOG. Food retail could also be a means for effecting changes to social norms, through communication of the consequences of disposing fats down the plughole and means to avoid it, targeted to the situations where those messages are most pertinent.
- **In the food disposal system**. If households are to be told *not* to dispose of FOG via the liquid waste stream, there need to be changes to waste disposal infrastructure that – from a user perspective – are effective and reliable at ejecting unwanted materials from the home, without significantly adding to competing demands on time and resources.
- Drawing on evidence from the provision of food waste caddies, this is likely to include some means of collecting and storing excess fat in the home with minimal mess, without being an obtrusive presence in the kitchen, combined with a reliable service for recovering the collected fat and directing it to where it can be processed for reuse in energy production. As we saw earlier, conventional liquid and solid waste disposal mechanisms are largely invisible because they function effectively and reliably. For alternative ways of disposing to become routine parts of people's lives, they too need to function as effectively and reliably.

Water companies and renewable energy companies have begun to pilot schemes for collecting waste oil and putting it to use as a fuel. It is important that experiences from these schemes are shared and built upon.

Lessons from food waste: providing appropriate infrastructure

Evidence[30] from separate food waste collections in many UK local authority areas provide some valuable lessons for thinking about alternative disposal of FOG:

- Participating households go to considerable lengths to accommodate food waste collection caddies into the size, shape and layout of their kitchen and into their everyday routines of food preparation and cleaning. Flexibility, convenience and reliability of provision are therefore key important features of successful collection schemes.
- Many participating householders are wary of having to handle unpleasant material or of keeping a food waste caddy on their kitchen worktop, associating them with uncleanliness and a potential to contaminate food preparation areas. This emphasises how strongly the messy nature of decomposing food impacts on disposal decisions. The same is likely to apply to handling FOG.
- Those not participating in collection schemes commonly cite concerns with hygiene, odours or vermin; interestingly, relatively few participating households reported experiencing these problems in reality. This suggests an important role for peer advocacy of such schemes, making use of existing social networks and relationships of trust.

Collaboration and locating responses in the nexus

Designing and implementing interventions that consider multiple infrastructural and resource implications requires collaborative working across policy domains.

- Providers of liquid and solid waste management services need to work together to ensure adequate infrastructure for household FOG disposal is in place. This can be challenging due to the complex geography of waste governance, with water and sewerage services delivered by regional monopolies and solid waste disposal often contracted to multinational companies at local authority level.
- Policy actors responsible for water, energy, food and waste – together with relevant academics and business representatives – could usefully collaborate to negotiate various resource-related trade-offs and synergies. For example, those in the water sector might not be best placed to lead on developing interventions relating to fatty foods or alternative heat sources for cooking, but their support and input might be valuable.

FUTURE RESEARCH

Sharing learning and best practice

A range of organisations – water companies, renewable energy producers, food retailers and community groups – have already piloted innovative schemes designed to keep domestic FOG out of sewers and provide alternative means of disposal and recovery. However, few of these initiatives have been subject to detailed research and evaluation, or the results are not widely available.

It is important that learning from existing interventions is harnessed to better inform future strategy, including what has been successful, the roles played by different sets of actors, enablers and barriers to take-up or roll-out of the scheme, and any unanticipated wider implications.

'Fats to fuel': highlighting challenges of intervention

Alongside its successes, the Bradford 'Fats to fuel' scheme also highlights some potential challenges faced in sustaining and expanding domestic cooking oil collection, which are in the process of being addressed. The project is delivered on a largely voluntarily basis by a Yorkshire Water network protection technician (alongside core responsibilities) and a member of the Karmand Centre. Any further expansion of the service would increase this workload and may require funding of staff and/or volunteer time. This raises wider questions around the financial (and environmental) sustainability of door-to-door oil collection schemes, which would benefit from further research. Can enough oil be collected and sold to make expanded provision viable, given the costs of collection and the relatively small quantities per household? Can this expense be absorbed by water companies, effectively being subsidised by savings made through reduced sewer maintenance? Alternatively, are there opportunities to integrate cooking oil collection into existing recycling collection schemes[31] and what impact (positive or negative) would this have on participation rates?

Empirical research into FOG and kitchen practices

As emphasised above, this report has used learning from closely related issues (food waste and water use) as well as broader research into kitchen practices, to consider implications for FOG prevention. There is clearly scope for research specifically addressing FOG. Empirical questions which should be the focus of future empirical research into domestic FOG include:

- What actually goes on in key change points in relation to FOG production? What factors are most influential in shaping different courses of action?
- How do households respond to the different types of intervention already in place (e.g. information campaigns, oil collection)
- How are 'fat vats' etc. received and accommodated within the kitchen?
- Do people have to *value* fat, see it as a resource etc. to recycle it? Or is it sufficient to have a convenient way of disposing of it?
- What are the actual trade-offs between different systems of resource provision and disposal in practice? Is the assumption that it is environmentally more sustainable to dispose of FOG via the solid waste system rather than through sewers a safe one?

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28. WRAP Evaluating the impact of cascade training http://www.wrap.org.uk/sites/files/wrap/Evaluation%20of%20Cascade%20Training.pdf. (2012) p.11

29. WRAP ibid. p.24

30. Between 2007 and 2009 WRAP coordinated a major programme of food waste collection trials across 21 local authorities in England and Northern Ireland. The evaluation of these trials (WRAP, 2009, Evaluation of the WRAP Separate Food Waste Collection Trials) remains a key source of evidence on food waste collection schemes. Further evidence drawn upon here comes from in-depth qualitative studies of the use of food waste caddies,[10] as well as a Literature Review on the Relationship between Household Food Waste Collection and Food Waste Prevention (WRAP, 2011) and more recent guidance on best practice implementing food waste collections, including reflections on a series of pilots (11 local authorities, 2013-15) designed to increase capture from such schemes (WRAP, 2016 Household food waste collections guide).

31. For example, since 2012 Oadby and Wigston Borough Council in Leicestershire have incorporated fortnightly kerbside collection of fats and cooking oil into their existing recycling provision. http://www.oadby-wigston.gov.uk/pages/recycling_history_in_oadby_and_wigston