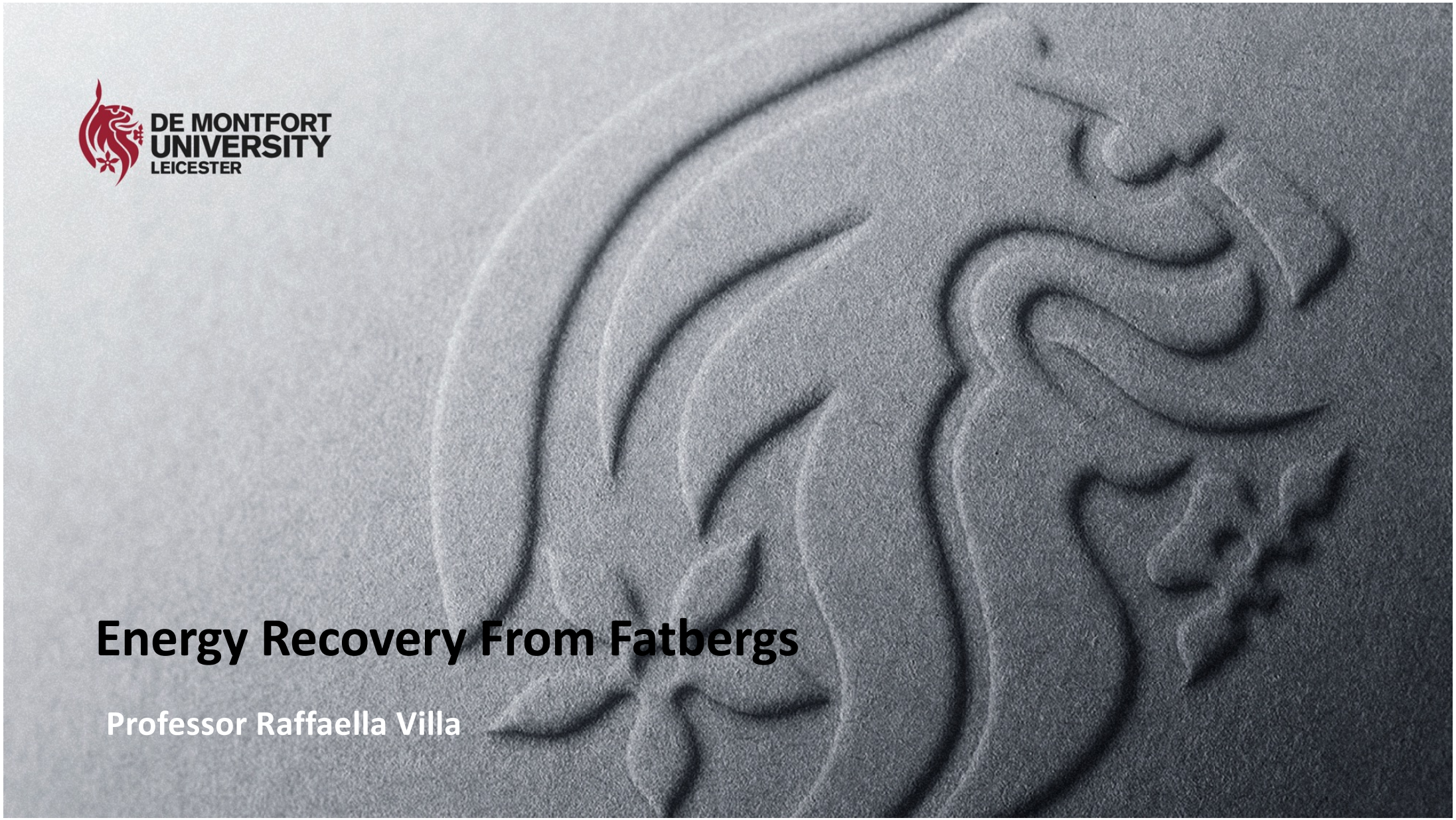


DE MONTFORT UNIVERSITY LEICESTER

Energy Recovery From Fatbergs

Professor Raffaella Villa

Content

- Why are we interested in fatbergs?
- What are fatbergs?
- Where do they come from?
- How do they form?
- Energy from fatbergs

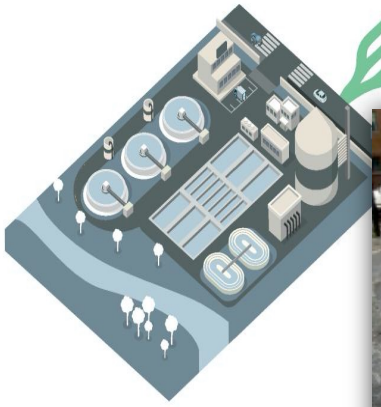
Why are we interested in fatbergs?

FOGs and un-flushable cause 80% of 366,000 blockages

£ 88 million clean-up costs for the UK water industry

Sewer blockages
Pumping station failure

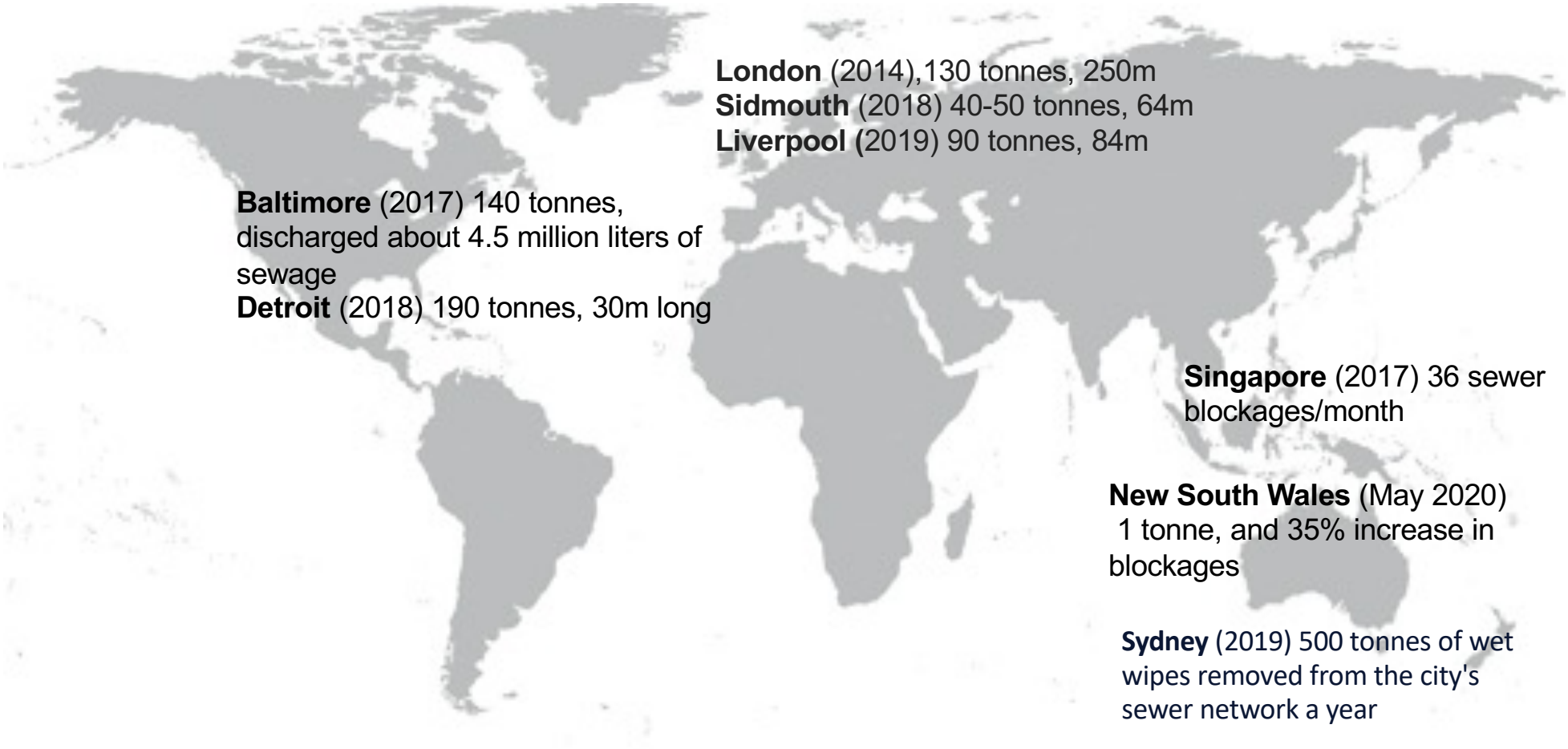
Sewer overflows



Water pollution

Impact at the treatment plant

Fatbergs around the world



London (2014),130 tonnes, 250m
Sidmouth (2018) 40-50 tonnes, 64m
Liverpool (2019) 90 tonnes, 84m

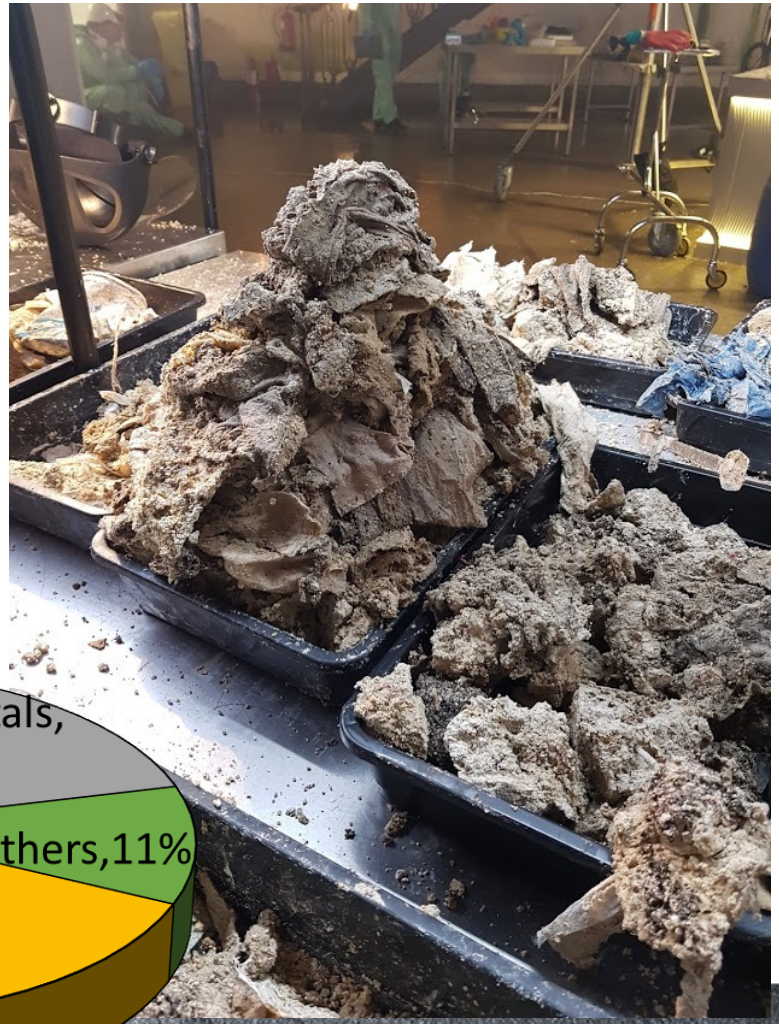
Baltimore (2017) 140 tonnes, discharged about 4.5 million liters of sewage
Detroit (2018) 190 tonnes, 30m long

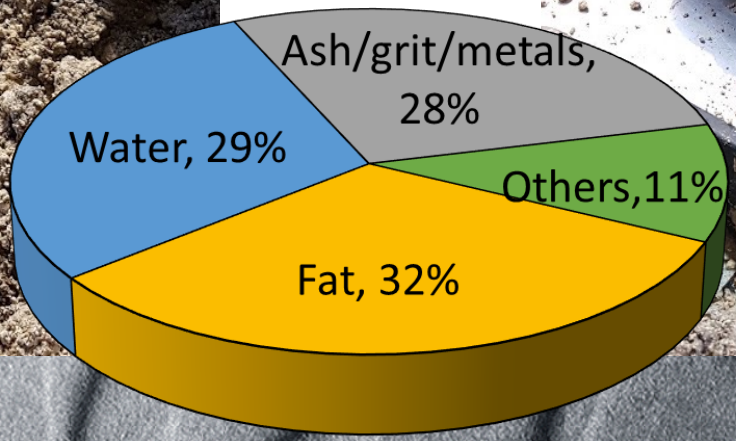
Singapore (2017) 36 sewer blockages/month

New South Wales (May 2020) 1 tonne, and 35% increase in blockages

Sydney (2019) 500 tonnes of wet wipes removed from the city's sewer network a year

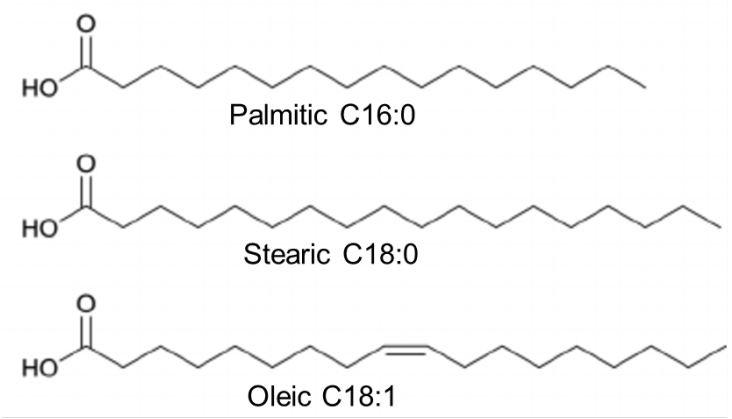
Fatberg composition





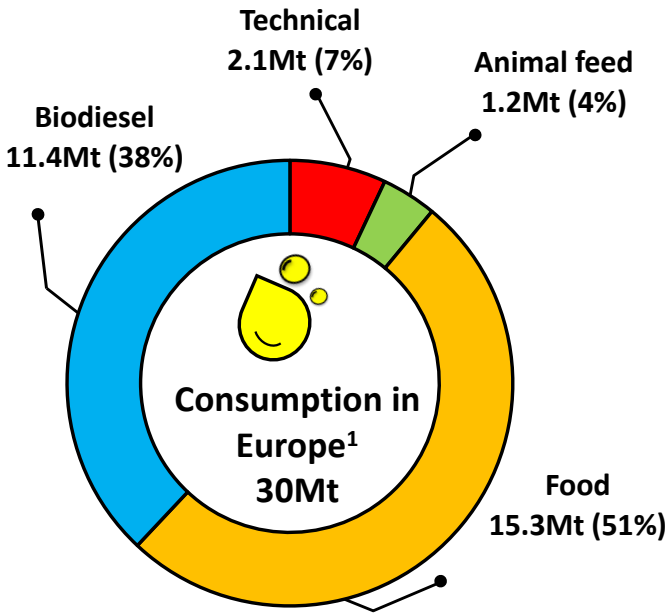
Where do they come from?

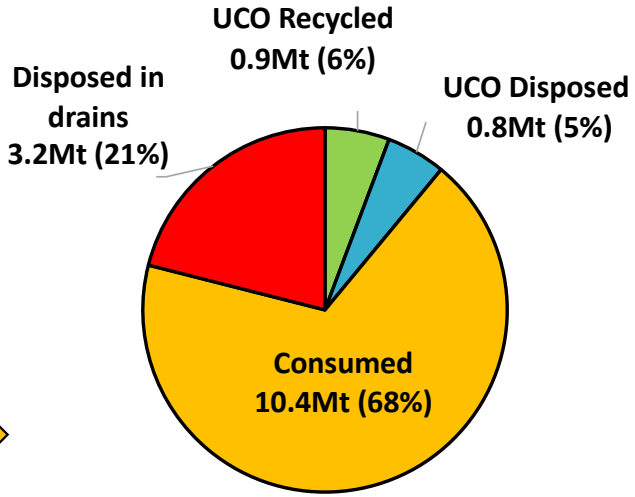
From our cooking activities



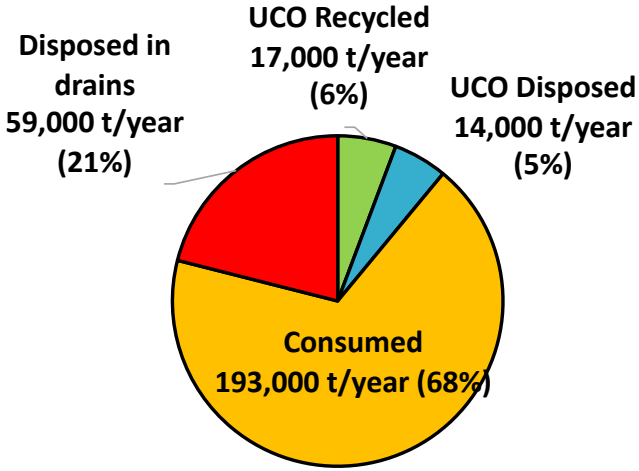
	Palmitic acid C16:0 %	Oleic acid C18:1 %	Stearic acid C18:0 %
Sunflower oil	6	28	3
Rapeseed oil(canola)	5	56	2
Olive oil	10	78	2
Coconut oil	9	7	2
Palm oil	44	40	4
Beef fat	27	48	7
Butter	26	28	11
Chicken/turkey fat	22	37	6
Lard	27	44	11
Salmon	11	25	4
Fatberg	69	10	9

Edible oil and fat consumption in Europe and the UK





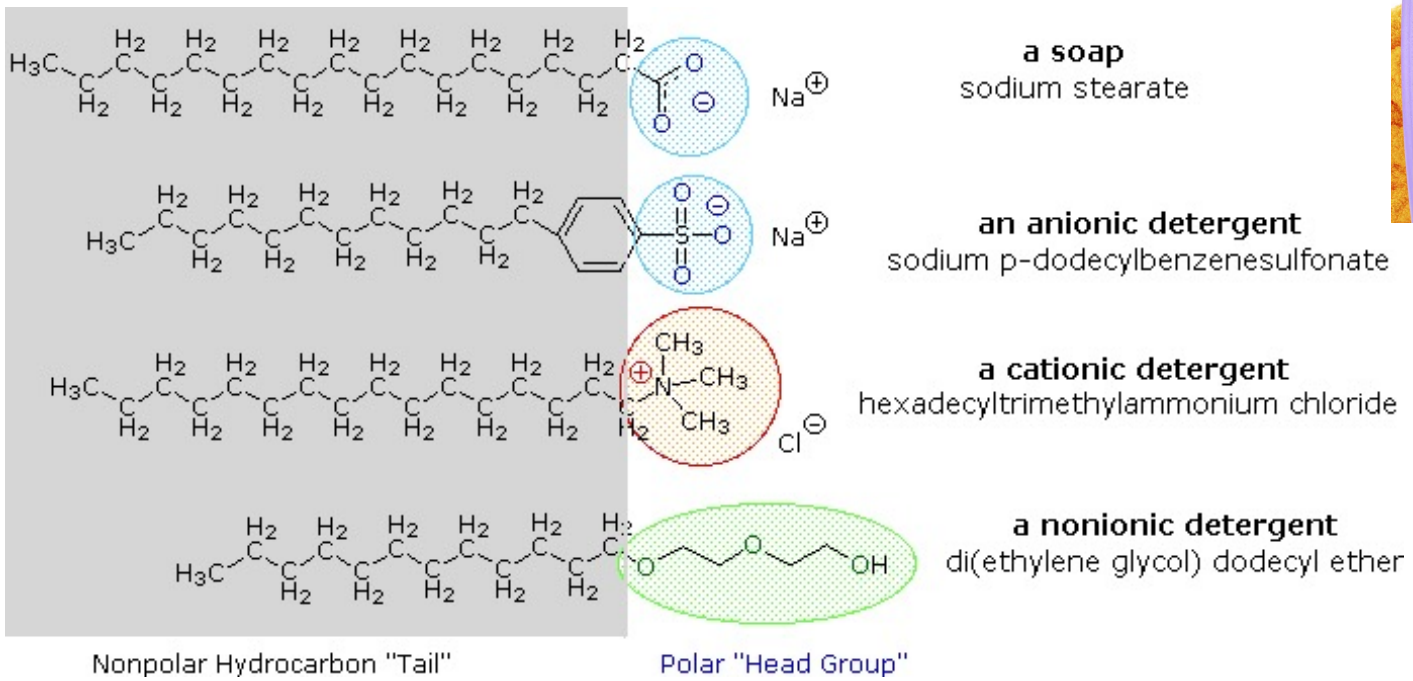
In the UK, edible oil and fat consumption is about 0.5 million t/year
283,000 tonnes of which are used for food production



[1]Includes oils and fats of vegetable, marine and animal origin. FAO (2019) Food Outlook BIANNUAL REPORT ON GLOBAL FOOD MARKETS

But maybe also from somewhere else…

Stearic acid, oleic acid, myristic acid, and palmitic acid are used to manufacture cosmetic creams, cakes, soaps, and pastes.



a soap
sodium stearate

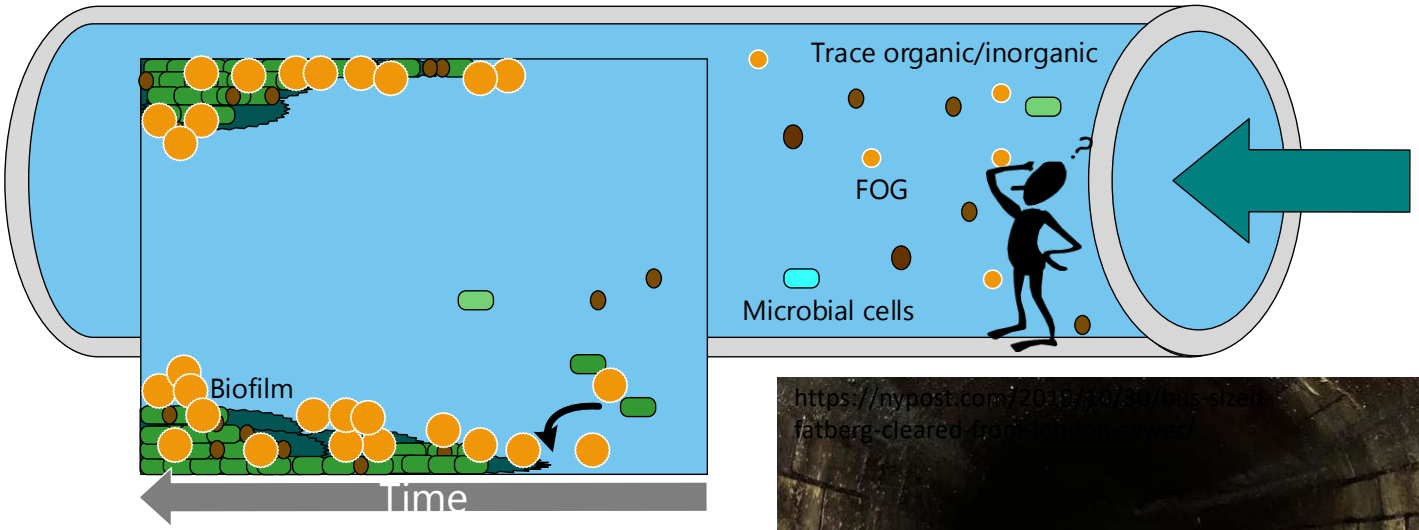
an anionic detergent
sodium p-dodecylbenzenesulfonate

a cationic detergent
hexadecyltrimethylammonium chloride

a nonionic detergent
di(ethylene glycol) dodecyl ether

Fatty acid salt use in 2018 was estimated at 0.8 Mt/year in Europe.

How does a fatberg form?



At least five reactions:

1. Fat solidification
2. Free fatty acid saponification
3. Biofilm formation
4. Protein precipitation
5. Starch?

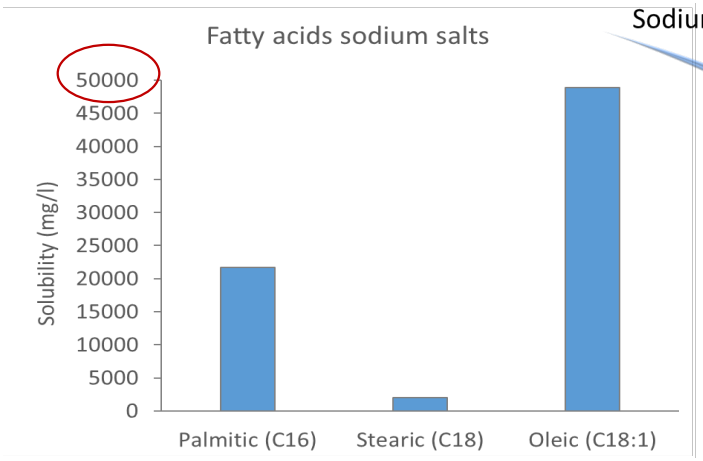
1. Fat solidification

Animal vs vegetable fats

2. Saponification or soap formation

Fat + Ash/lye + Heat =

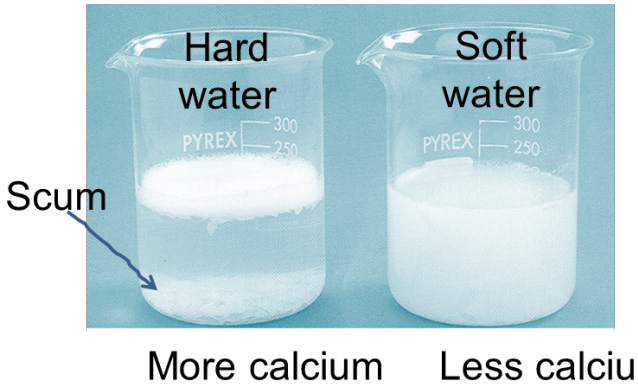
Or from sodium to calcium soaps….

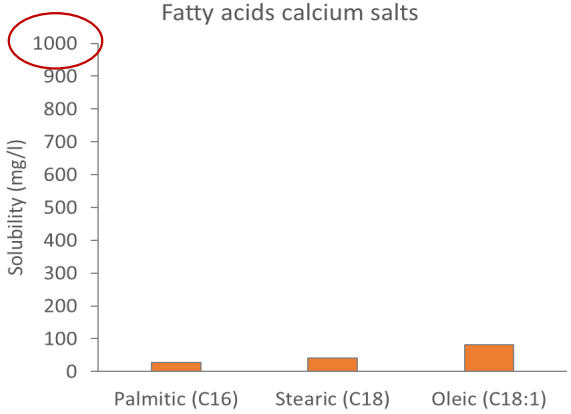


Sodium salts

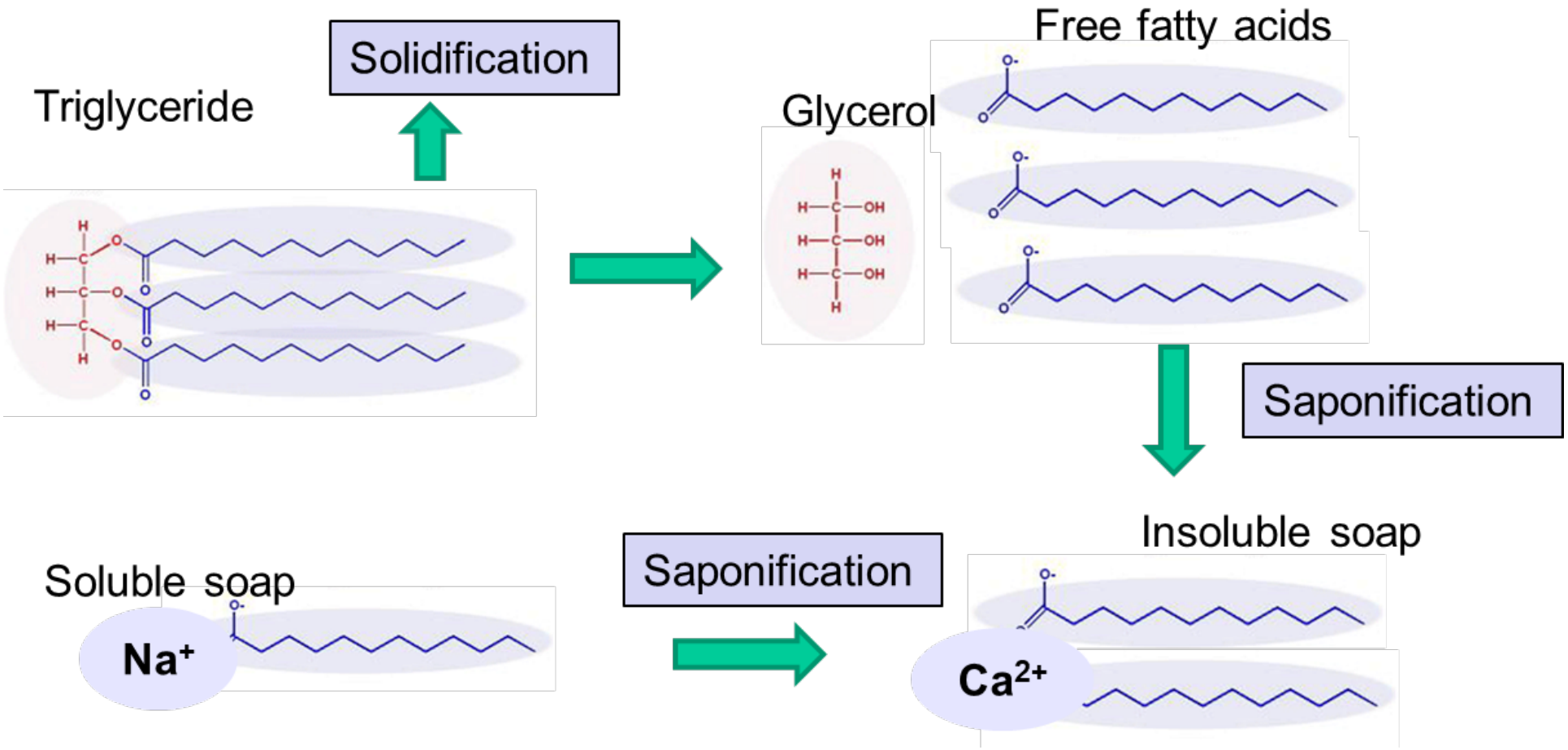
Solubility

Calcium salts

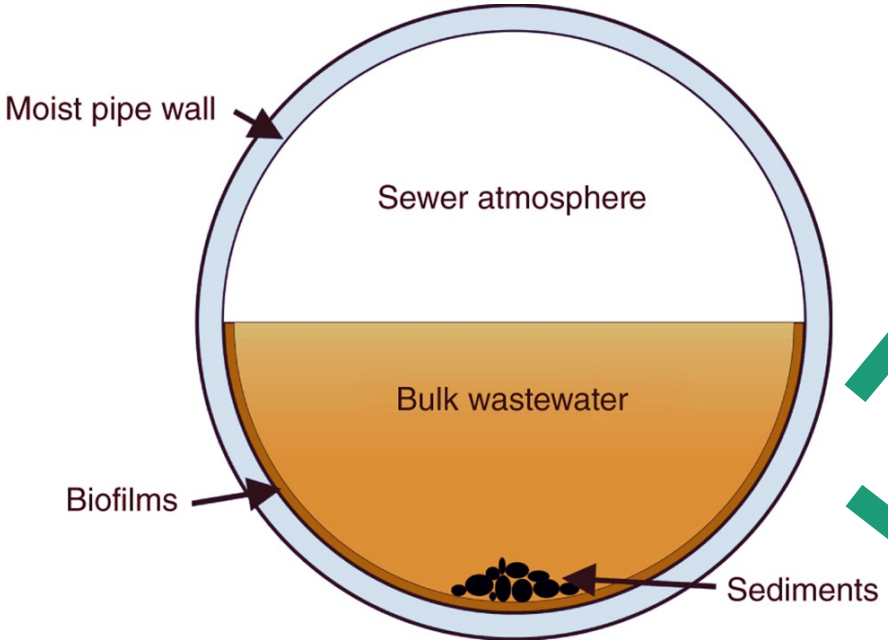


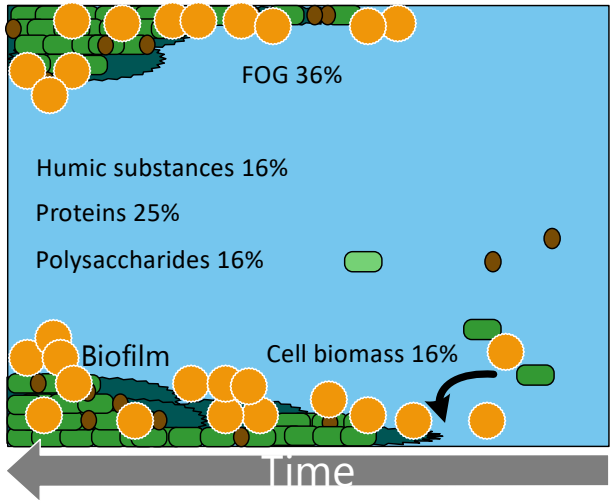


Fat summary: solidification and saponification



3. Biofilm formation





Wiley Interdisciplinary Reviews: Water Volume 3, Issue 4, pages 487-494, 12 APR 2016 DOI: 10.1002/wat2.1144

4. Protein precipitation

- High concentration of salt (protein salting out)
- Change of pH

5. Starch?

…and wipes to cement it!

FOG management

The Kitchen Best Management Practice

Disposal of Fats, Oils, Grease and Food Waste

Best Management Practice for Catering Outlets

WATER UK

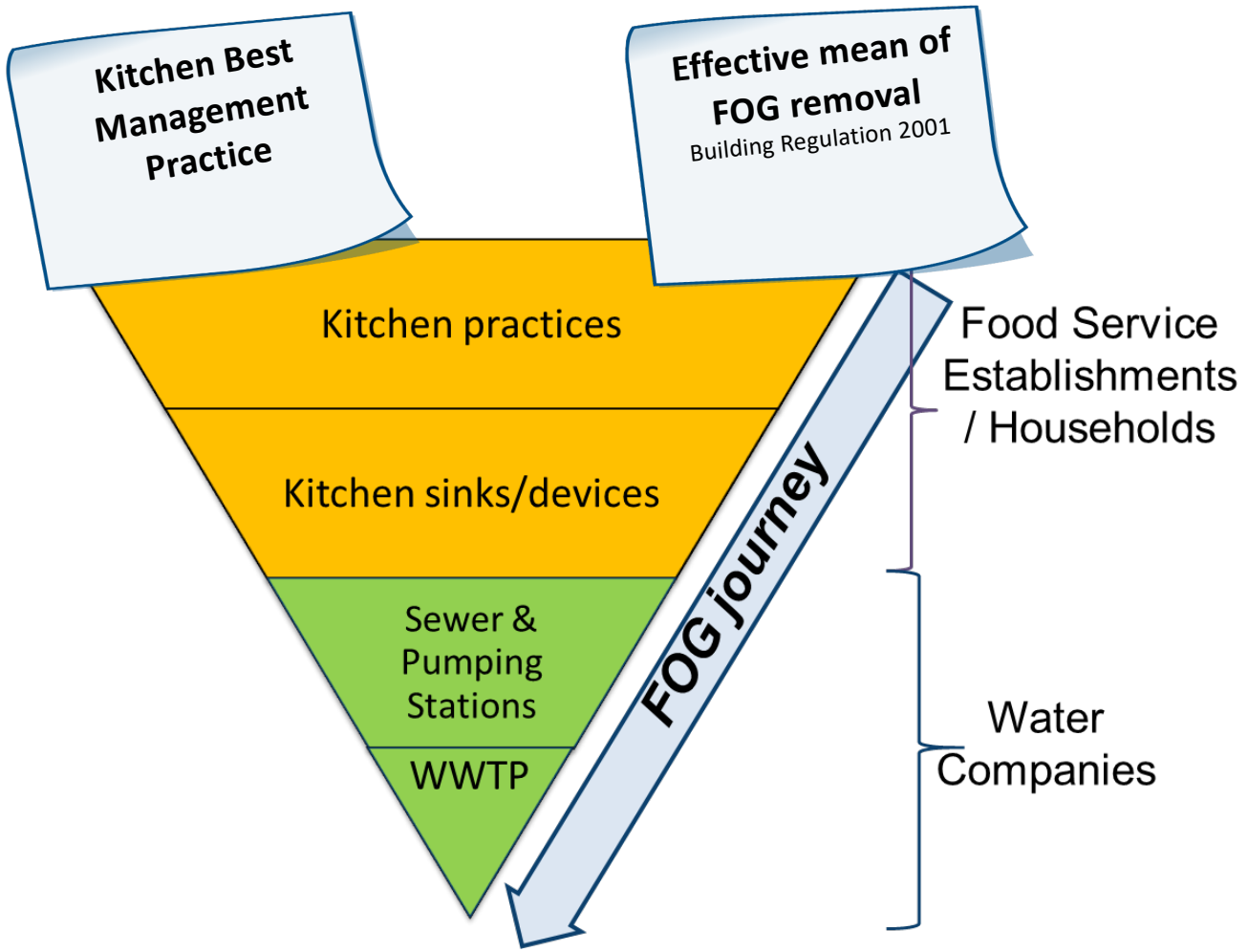
Working in partnership with

Environment Agency · Chartered Institute of Environmental Health · Consumer Council for Water · defra

Stop and think
– not down the sink

Checklist for managing fat, oil and grease in your kitchen

DOs	DON'Ts
Do wipe and scrape plates, pans and utensils before washing (and put the waste into the bin).	**Do not** put cooking oil, fat or grease down the sink.
Do collect waste oil in a suitable secure container.	**Do not** pour waste oil, fat or grease down the drain.
Do arrange for oil to be collected by a licensed waste contractor.	**Do not** put food scrapings into the sink (place in the rubbish bin).
Do use strainers in sink plug holes (and empty contents into the bin).	**Do not** sweep waste into floor drains (place rubbish in bin).
Do maintain Grease Traps and Enzyme Dosing equipment regularly.	**Do not** pour boiling hot water down the sink to try to dissolve fat and grease. It does not work!

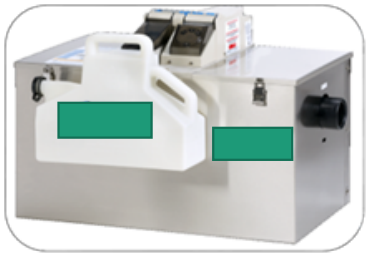


Means of FOG removal

Grease Interceptor

7.6 % Biological Dosing

Grease Removal Unit

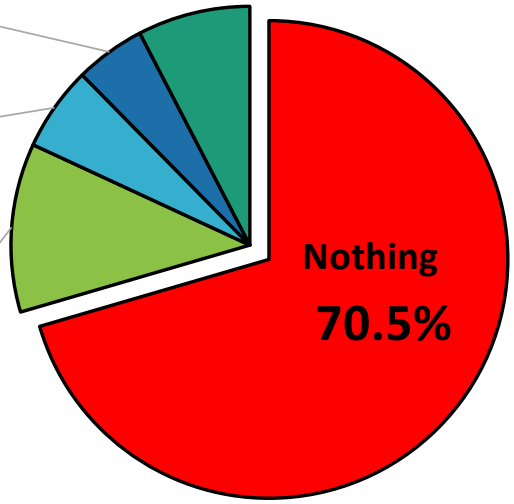


4.7%

5.7%

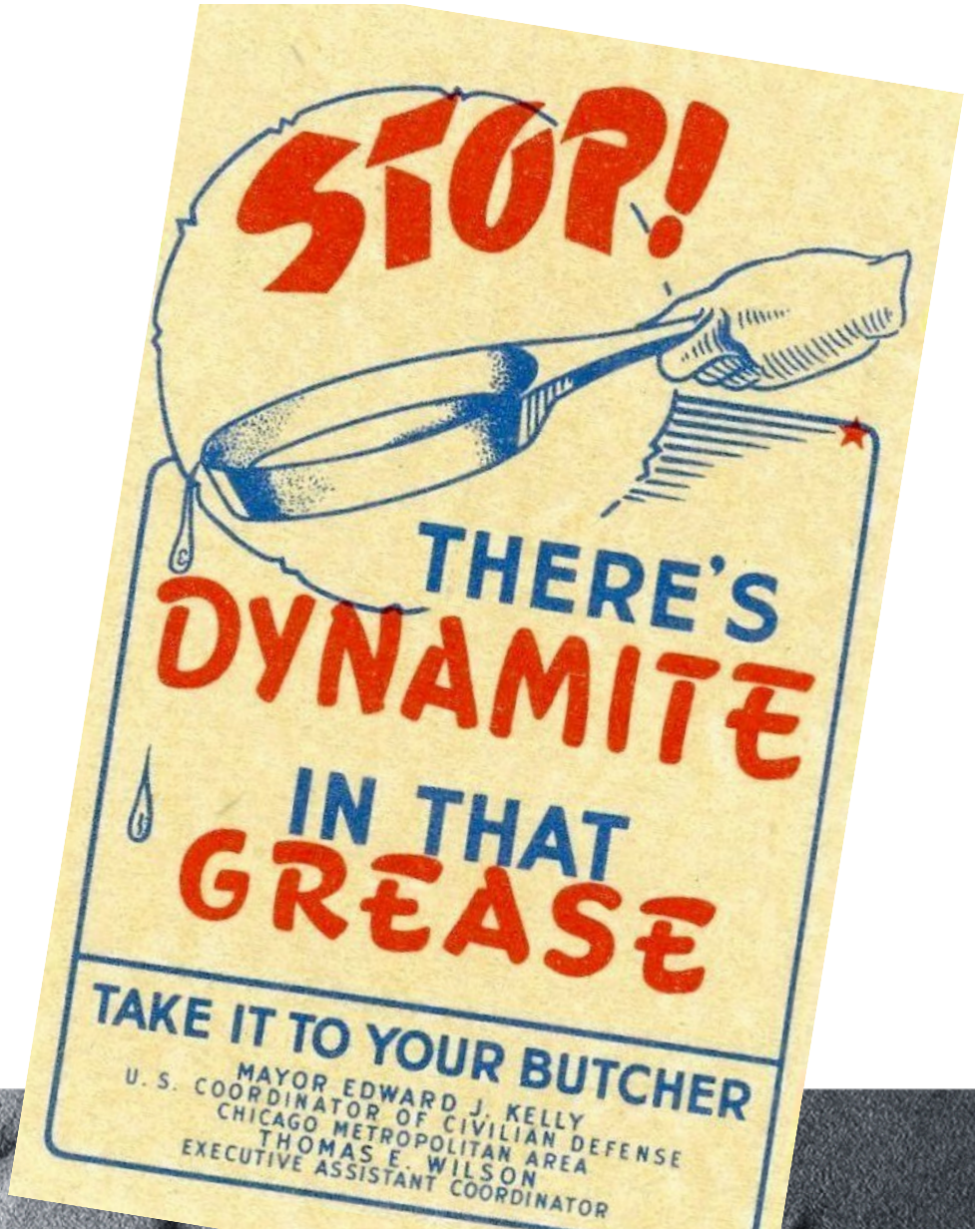
Grease Trap

11.4%



What can we do with FOGs?

Value recovery in the past….



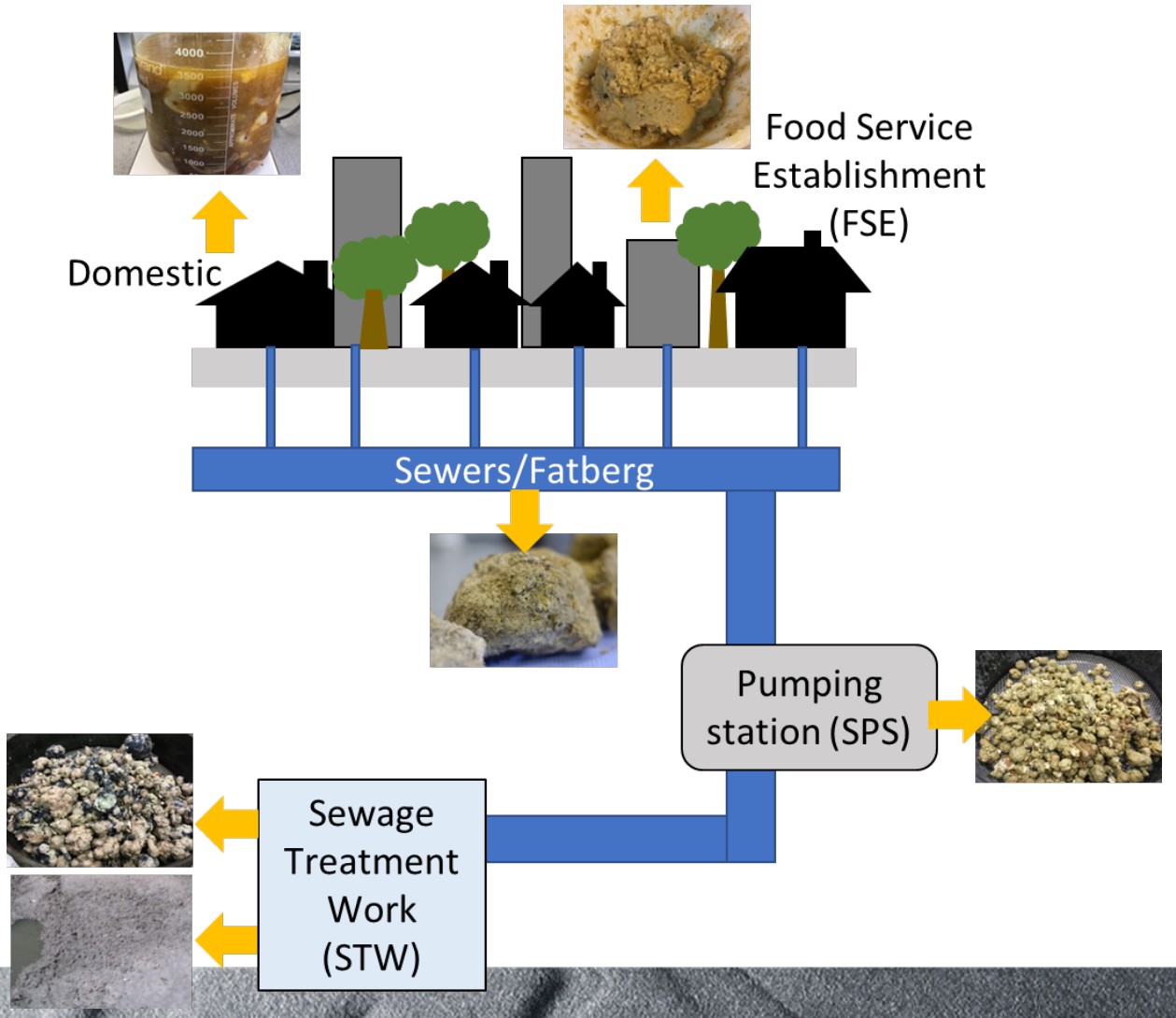
What can we do with FOGs?

ANAEROBIC DIGESTION = BIOMETHANE

BIODIESEL

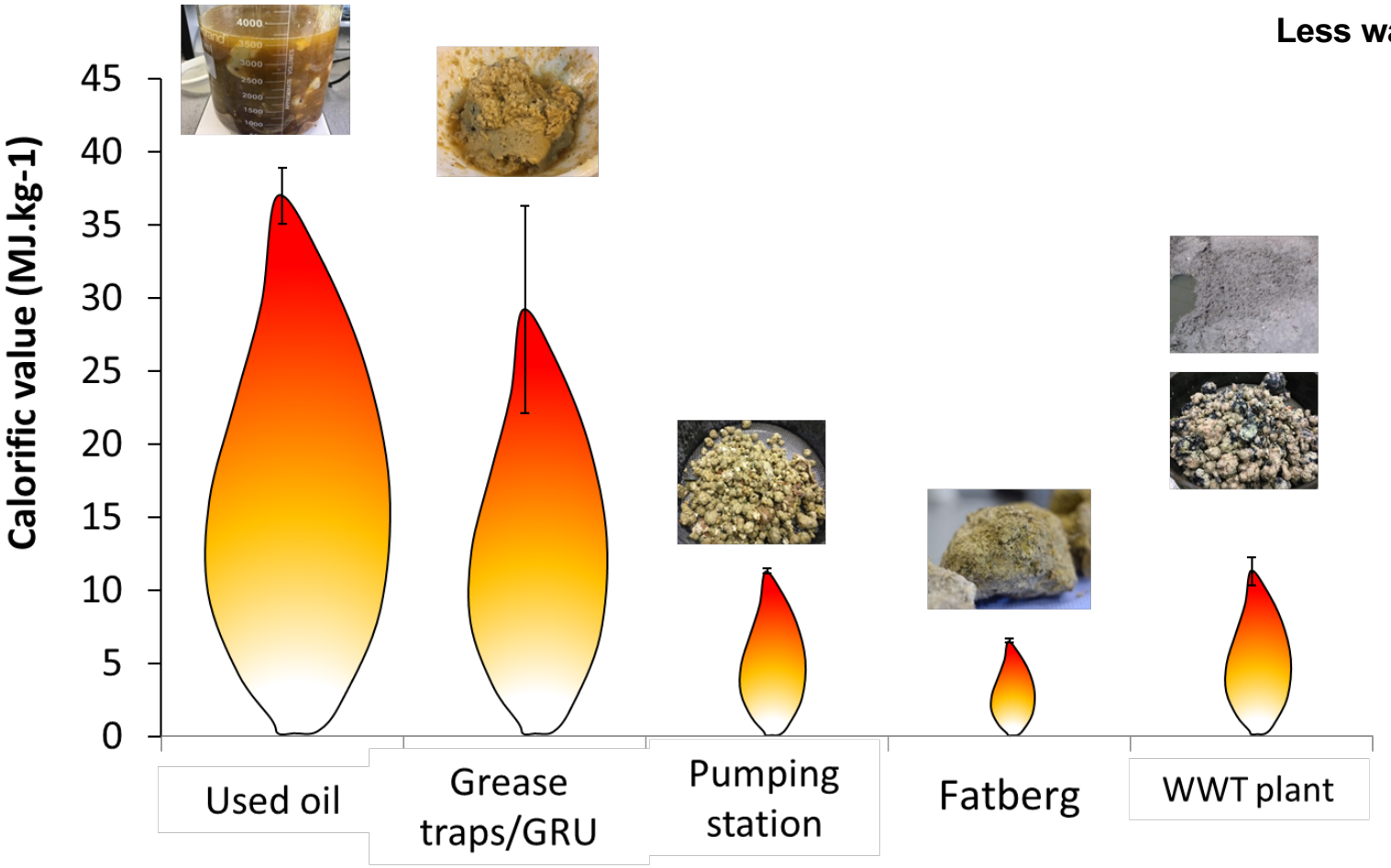
Energy recovery from FOGs

Approx
95,000 tonnes/year
from the
Thames Water catchment

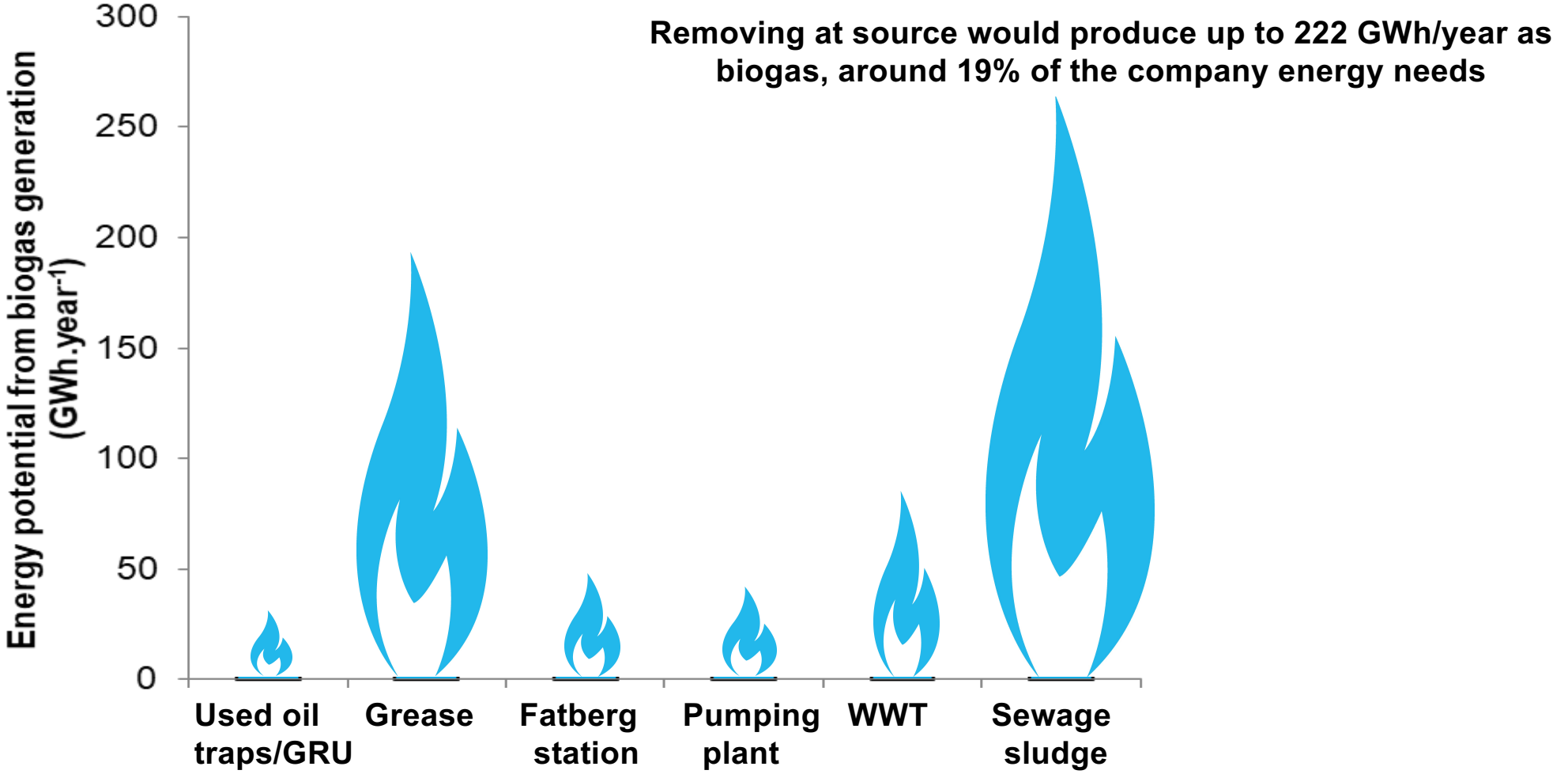


Energy recovery

Less water, more heat

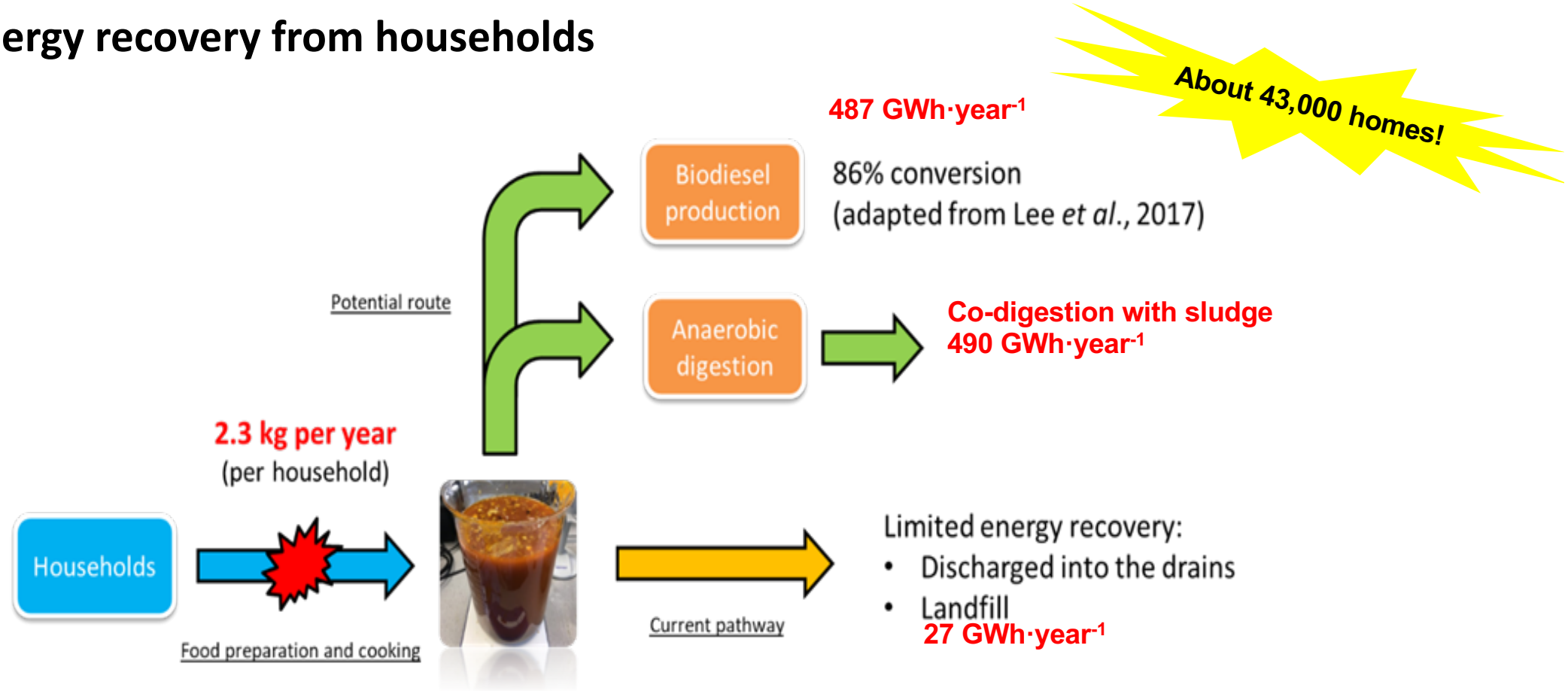


Energy recovery from FSE at catchment



Collin T., Cunningham R., Jefferson B. and Villa R. (2020) Characterisation and energy assessment of fats, oils and greases (FOG) waste at catchment level. Waste Management, 103, 399-403.

Energy recovery from households



…the cleaner the better for energy recovery!

The ‘FOG’ group and the sponsors

Prof Bruce Jefferson

Anna Cermakova

Dr Thomas Collin

Natalia Jawiarczyk

Dr Paul Barton

Dr Martin Fairley

Dr Caroline Gurd

Cranfield University

EPSRC
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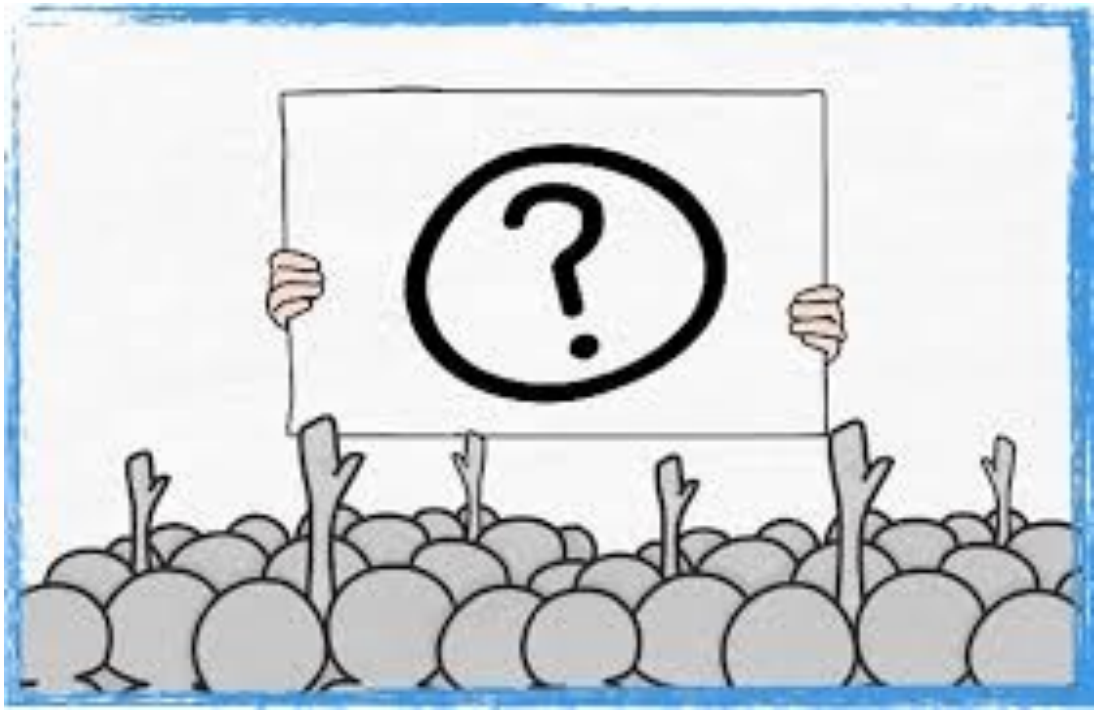

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