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MTT

Synergies between energy and material efficiency on farms

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Towards Smart Farm Energy Solutions, Seminar and Workshop,

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Food and drink industry

It is also one of the largest contributors to unsustainable use of natural resources, in the EU and in our global footprint. The relationship between consumption and food and drink and resource use and depletion is described in the Figure below, looking along the life-cycle. Resource depletion includes eutrophication, habitat change, climate change, water use, soil erosion and pollution[103]. The size of these impacts is on an upward trend. Along the whole life-cycle, consumption of food and drink in the EU causes 18% of the EU's material use[104].

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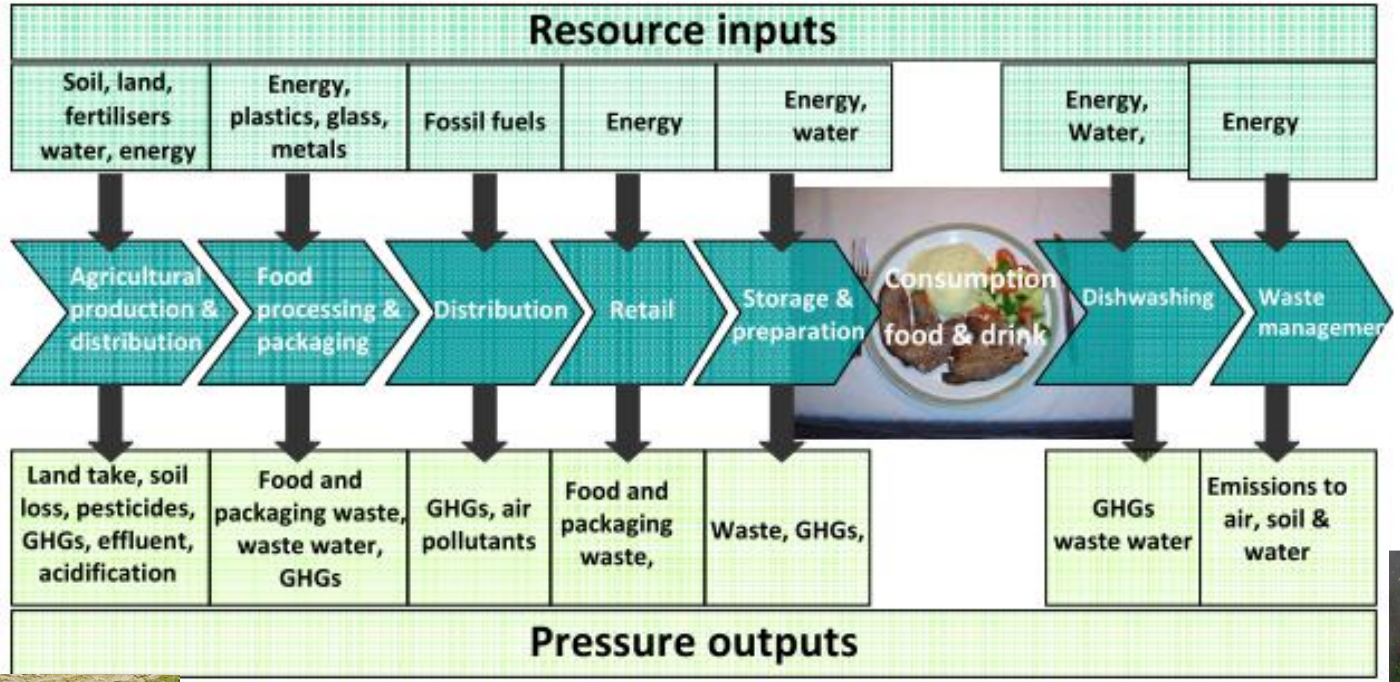
Analysis associated with the Roadmap to a Resource Efficient Europe
Part II

Food and drink industry – Recourse utilisation and environmental pressure



http://ec.europa.eu/environment/resource_efficiency/

Meat and dairy products

The greater impacts of animal products come from:

- Land degradation: The production of 1 kilogram of meat requires several kilograms of vegetable products, depending on the livestock product. As a result, the livestock sector accounts for 70 percent of all agricultural land and 30 percent of the land surface of the planet[116]. This magnifies agricultural impacts. In addition, the livestock sector may be the leading player in the reduction of global biodiversity through its demand on land, for example, as the major driver of deforestation, as well as of climate change. Its resource demand also leads to overfishing, sedimentation of

- Greenhouse Gas emissions: The livestock sector contributes 18 percent of greenhouse gas emissions measured in CO2 equivalent looking at life-cycle impacts[119].

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Meat and dairy products

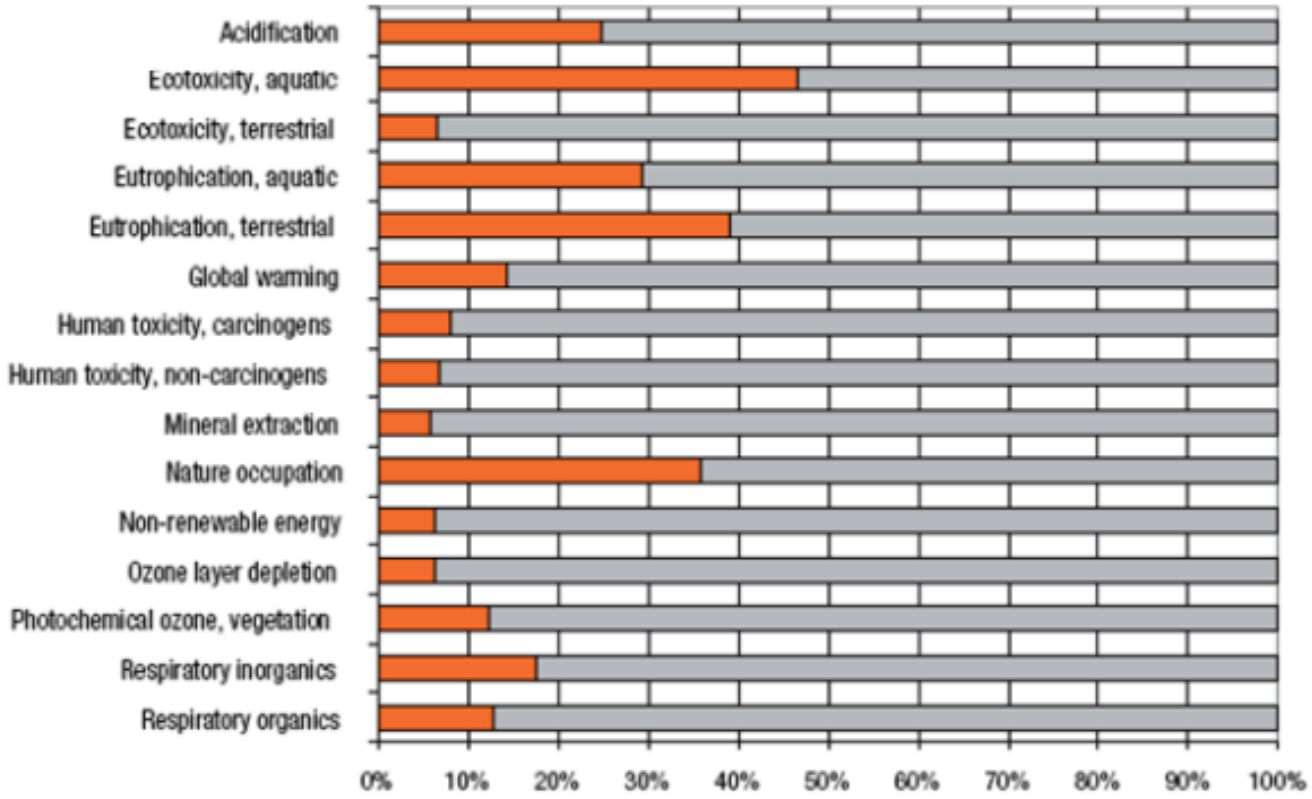

Figure : Percentage contribution of meat and dairy products to the environmental impacts of EU-27 total consumption (Source: B.P. Weidema et al., Environmental Improvement Potentials of Meat and Dairy Products (IMPRO), JRC, 2008)

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Agriculture energy in Finland

- Energy
  - mainly from fossil resources
  - 12 TWh/a, 8 TWh oil (tractors 3.6 TWh), 2.6 TWh electricity
- High variation between farms
  - TTS: electricity consumption 50-70 unit dairy farms: 40 000 – 200 000 kWh /a
- Nitrogen fertiliser production 2.1 TWh

Bioenergy resources in EU

	2004 (Mtoe)	%	2020 (Mtoe)	%
Forest	61,5	85	75	34
Agriculture	3,5	5	97	44
Waste	7,3	10	23	11
Import			25	11
Total	72,3	100	220	100

Year 2020 AEBIOM estimation

Biofuels for transport

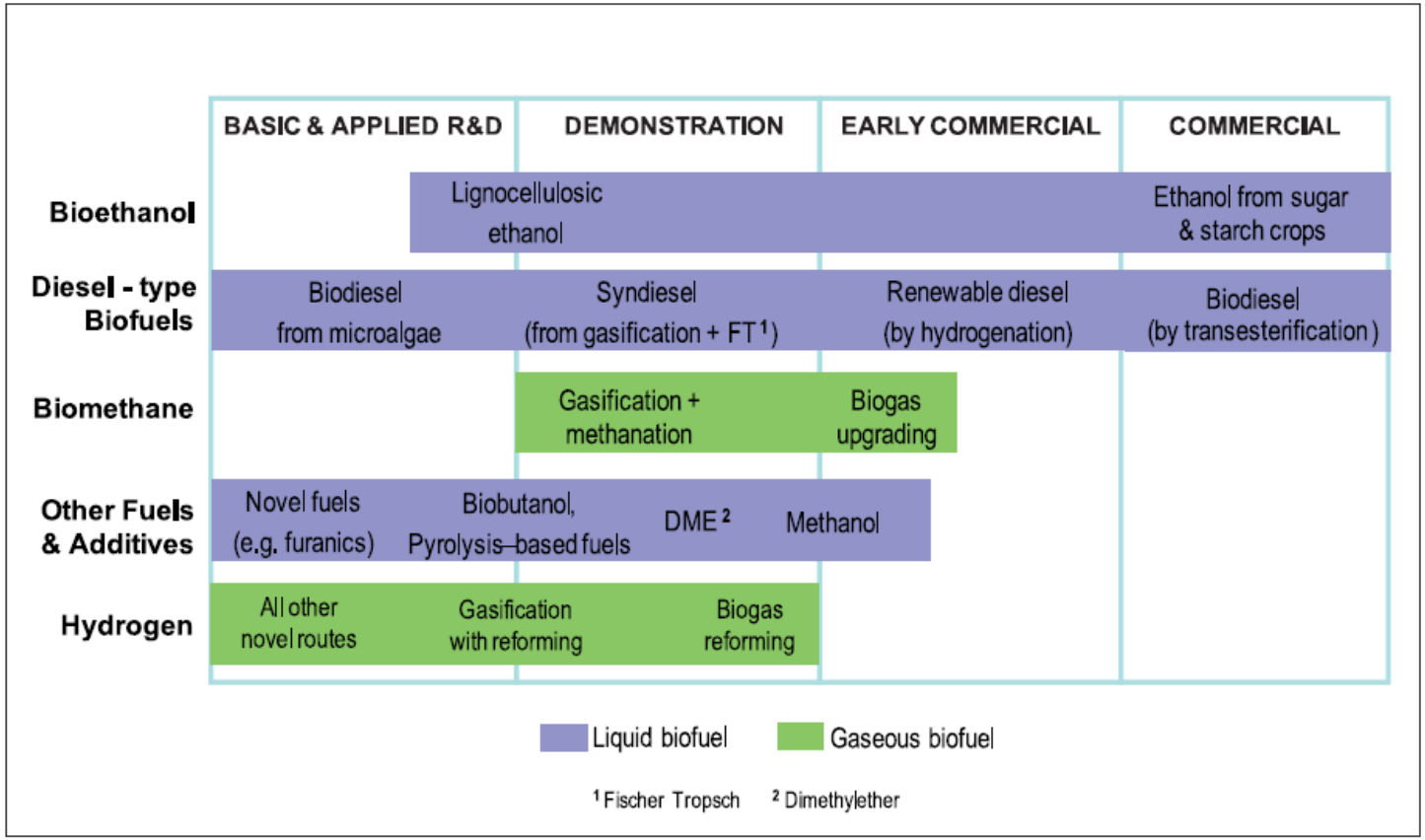

Figure 5. Development status of the main technologies to produce biofuels for transport from biomass. Source: E4tech, 2009.

IEA Bioenergy ExCo 2009:06

Methane from Manure, Wastes and Energy Crops

Nitrogen 14 kWh/ kg

Crop Cultivation

Harvesting

Storage

Pre-Treatment

Biogas production

Methane

Heat
Electricity
Biofuel

Storage of Digestate & Post Gasification

Post-Treatment

Digestate

Nutrient recycling

Biowastes
Industrial Waste
Manure
Wastewaters
Sludge

Landfill

Biogas upgrading and fuelling

-high GHG reductions
-several upgrading technologies
-capacity 500-2000 m^3/h

Farm scale biogas

-manure digestion
-biogas utilisation
    -CHP, upgrading to biomethane
-digestate utilisation

Complementary RE
-forest bioenergy
-thermal, solar, wind

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Farm-scale biogas plant - MTT

300 m^3 post-digestion tank
- CSTR (one mixer)
- Gas hood on top
- Automated digestate pumping to storage tanks (200 m pipeline)

300 m^3 reactor
- CSTR (two mixers, gas mixing possible)
- Operational temperature +20…+55 °C
- Automated manure pumping from 100 m^3 pre-storage tank
- Gas hood on top
- Digestate by gravity to post-digestion

Feeding screw
- For plant biomass (pre-chopped)

Technical space
- 60 kW CHP
- 80 kW boiler
- Biogas measurements
- Process automation and operation

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Photos: Sari Luostarinen

Research with the farm-scale biogas plant

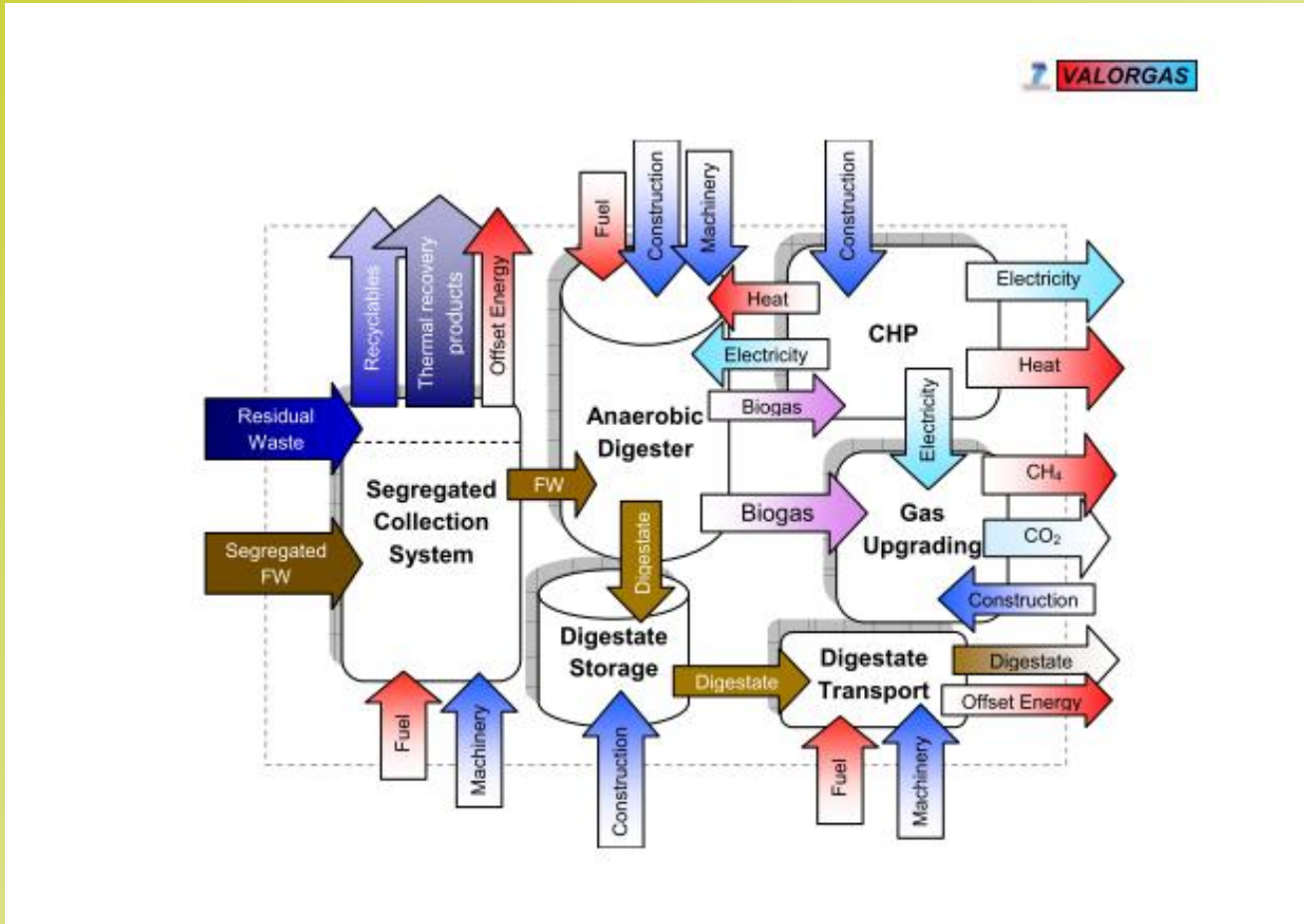
- Practical solutions for agricultural biogas plants
  - Suitable co-substrates
    - Plant biomass (e.g. grass silage, by-products from onion production, reed canary grass)
  - Operational optimisation (e.g. retention times, loading, feeding intervals, mixing)
  - Holistic management (from manure collection in cowhouse to digestate use on fields)
- Digestate as fertilizer
  - Field experiments
    - Comparisons between mineral fertilizer, raw manure, raw digestate and mechanically separated digestate
    - Grass and barley
    - Injection into soil
    - Practical training for technical staff





Photos: Perttu Virkajärvi & Sari Luostarinen

Kitchen waste to biogas & fertiliser – LCA



www.valorgas.soton.ac.uk

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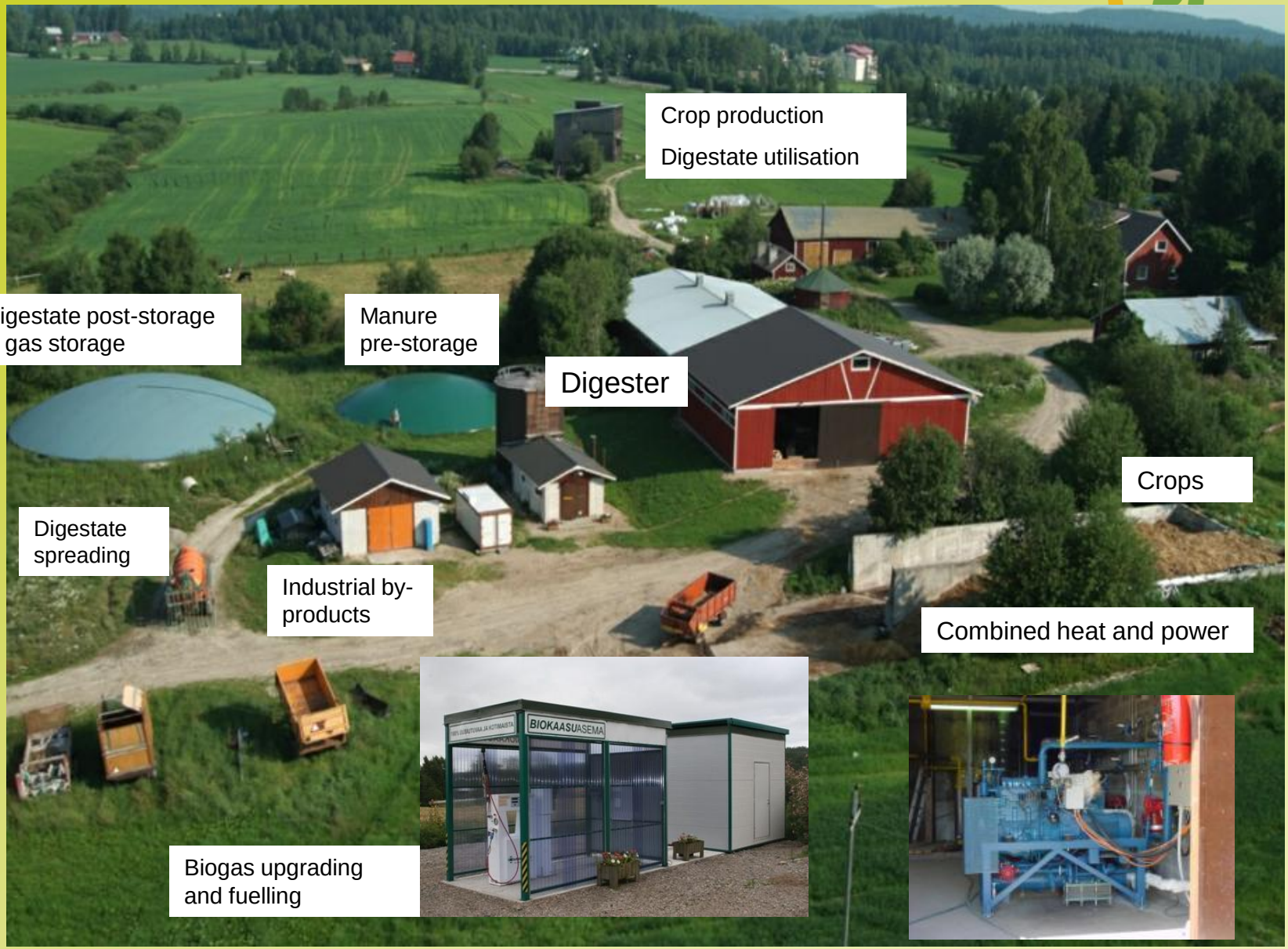
Kitchen waste composition

% wet weight	UK [a]	Finland	Portugal	Italy	Ave	WRAP [b]
Fruit and vegetable waste	60.9	44.5	59.2	69.0	58.4	46.6
Pasta/rice/flour/cereals	1.5	0.4	0.2	12.4	3.6	2.5
Bread and bakery	9.0	3.8	3.1	2.8	4.7	13.4
Meat and fish	6.7	4.3	7.3	6.2	6.1	8.4
Dairy	1.7	2.0	0.7	1.4	1.4	3.5
Drinks (tea, coffee))	7.1	27.5	0.2	0.0	8.7	8.0
Confectionery, snacks etc	0.7	3.2	0.3	0.0	1.0	1.7
Mixed meals	12.3	6.3	29.0	1.4	12.2	12.9
Other food	0.2	8.0	0.0	6.9	3.8	3.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

[a] Data from 8 sites using all food waste categories

[b] Based on WRAP

Sustainable farming ?



Thank you


VALORGAS
www.valorgas.soton.ac.uk
Valorisation of food waste to biogas
Project 241334
Sponsored by FP7 ENERGY.2009.3.2.2
Biowaste as feedstock for 2nd generation