



# EnviRecover

Response to Concerns and Issues – Air Quality and Pollution Issues

Community Liaison Group 3<sup>rd</sup> March 2010



CONSULTING & IT



ENERGY



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WATER & INFRASTRUCTURE

## Agenda

1. Regulation of Energy-from-Waste Plants (Q:4)
2. Operation of Energy-from-Waste Plants (Q: A1)
  - Types of waste to be burned (Q: D3, B18)
  - Fly Ash (Q: J1, J2)
  - Monitoring of Emissions (Q: B8, B9, B10, B11, B12)
  - Compliance Records (Q: B4)
3. Assessment of Impact (Q: B5, B6, B7, B15, B16, B20)

## Regulation of Energy-from-Waste Plants (1)

Old-style incinerators were regulated under the Clean Air Act

- Very little abatement
- High emissions. Dioxins 10-100 ng/m<sup>3</sup>

Municipal Waste Incineration Directives 1989

- Applied to all plants by 1996
- Imposed stricter controls on combustion and emissions, requiring larger boilers and more abatement
- Dioxins down to 1 ng/m<sup>3</sup>
- Led to most UK plants being closed. Some were replaced. A few were upgraded

Waste Incineration Directive (WID) 2000

- Applied to all plants from 2005
- Emissions reduced further. Dioxins now 0.1 ng/m<sup>3</sup>

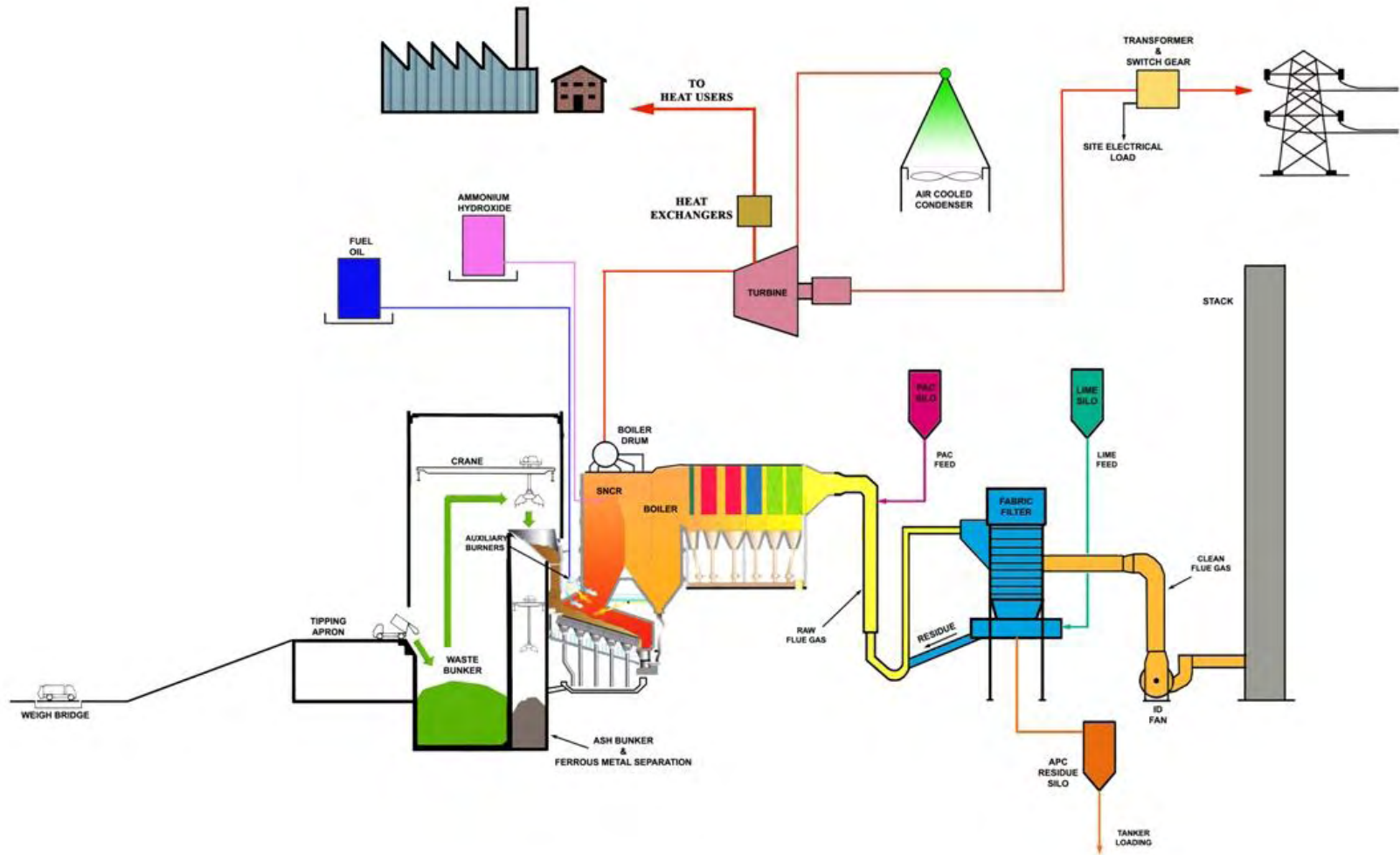


## Regulation of Energy-from-Waste Plants (2)

### Emission Limits in WID:

Parameter	Units	Half Hour Average	Daily Average	Periodic Limit
Oxides of Nitrogen (as NO <sub>2</sub> )	mg/Nm <sup>3</sup>	400	200	-
Particulate matter	mg/Nm <sup>3</sup>	30	10	-
Volatile Organic Compounds	mg/Nm <sup>3</sup>	20	10	-
Hydrogen chloride	mg/Nm <sup>3</sup>	60	10	-
Hydrogen fluoride	mg/Nm <sup>3</sup>	-	-	2
Carbon monoxide	mg/Nm <sup>3</sup>	100	50	-
Sulphur dioxide	mg/Nm <sup>3</sup>	200	50	-
Cadmium & thallium and their compounds (total)	mg/Nm <sup>3</sup>	-	-	0.05
Mercury and its compounds	mg/Nm <sup>3</sup>	-	-	0.05
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	mg/Nm <sup>3</sup>	-	-	0.5
Dioxins & furans ITEQ	ng/Nm <sup>3</sup>	-	-	0.1

# Operation of Energy-from-Waste Plants (1)

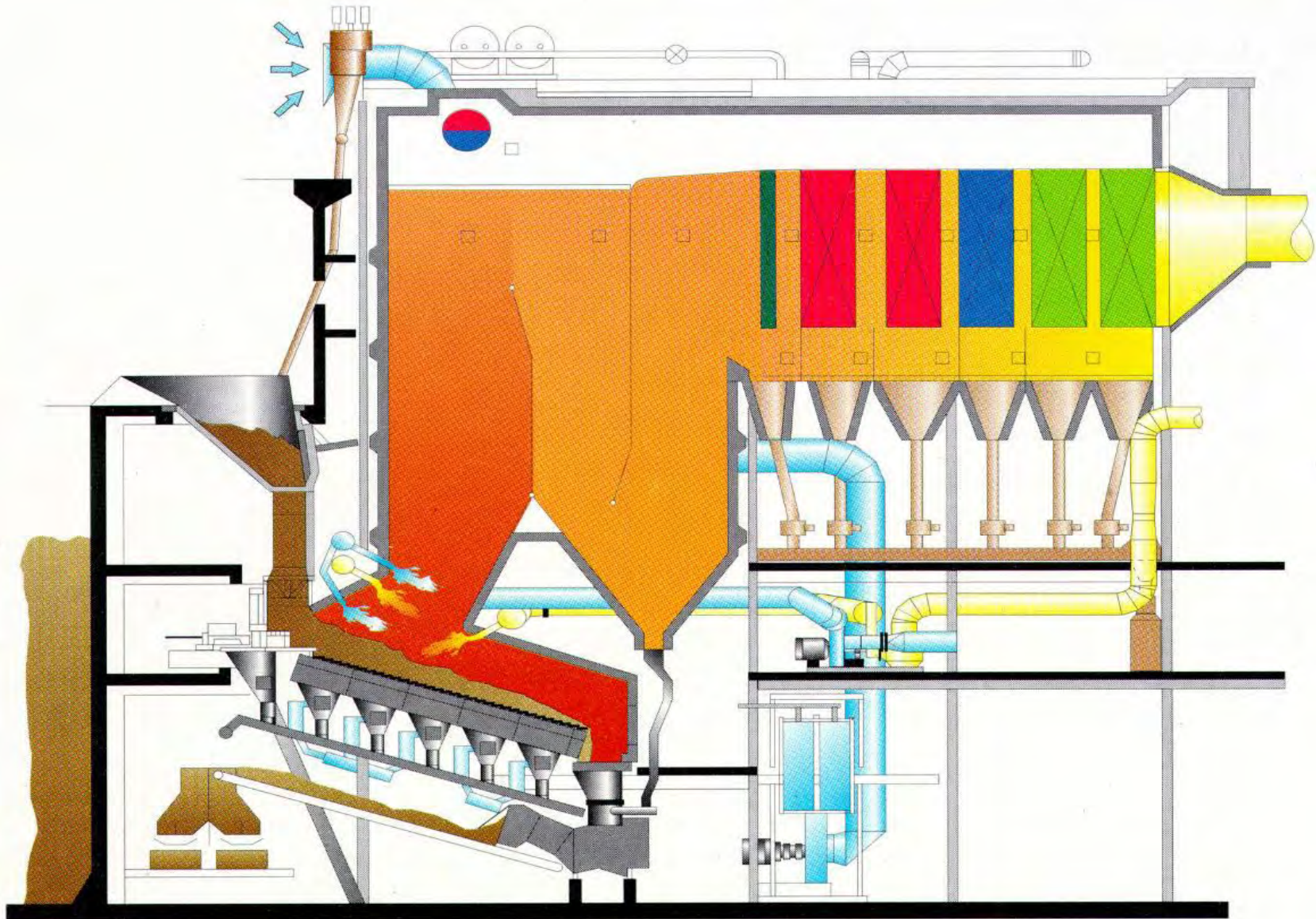


## Operation of Energy-from-Waste Plants (2)

- Waste is delivered in lorries and tipped into bunker.
- Waste is mixed by cranes and then lifted into feed chute.
- Waste is fully combusted on the grate. Air is added through the grate (primary air) and above the grate (secondary air).
- Gases are maintained above 850°C for at least two seconds to ensure complete combustion. Ammonia is injected to control oxides of nitrogen.
- Heat is extracted from the gases through the boiler to make steam.
- Steam is passed to the turbine to generate electricity and heat.
- Exhaust gases are cleaned:
  - Lime injection for acid gases
  - Carbon injection for dioxins and metals
  - Bag filtration for particulates, including metals
- Bottom ash (from the grate) is removed for processing and reuse.
- Bag filter residues are hazardous, due to lime content, and are sent for suitable disposal.



# Operation of Energy-from-Waste Plants (3)



## Operation – APC residues

The material collected on the bag filters is called Air Pollution Control Residues.

It consists of:

- Fly ash – light material carried over from the boiler.
- Unreacted lime
- Reaction products from acid gas abatement – calcium salts
- Carbon
- Trace amounts of heavy metals and dioxins

It is hazardous due to lime content, and requires disposal at suitable facility.

About 40 kg of APC residue is generated for every tonne of waste burned.

## Operation – Waste to be burned

The waste to be burned would be primarily municipal waste, with some similar commercial waste.

A consistent burn is achieved by:

- Mixing of waste in the bunker.
- Visual inspection by the operators to remove undesirable objects.
- Ensuring that the grate is large, so that each waste load is small in comparison.
- Monitoring of the process and complex computer control of combustion air.
- The provision of a large combustion chamber to give time for complete burnout.



## Operation – Emissions Monitoring (1)

Continuous Emissions Monitoring System (CEMS) will monitor:

- Oxides of nitrogen
- Sulphur dioxide
- Particulate Matter
- Hydrogen Chloride
- Volatile Organic Compounds
- Carbon monoxide
- Ammonia

Certified under EA scheme and European Standard EN 14181

Periodic monitoring at least six monthly, and three-monthly initially:

- Dioxins and furans
- Heavy metals
- Hydrogen fluoride

Carried out by certified personnel.



## Operation – Emissions Monitoring (2)

### MCERTS

- Environment Agency's Monitoring Certification Scheme
- All monitoring equipment needs to be certified
- All monitoring personnel need to be certified

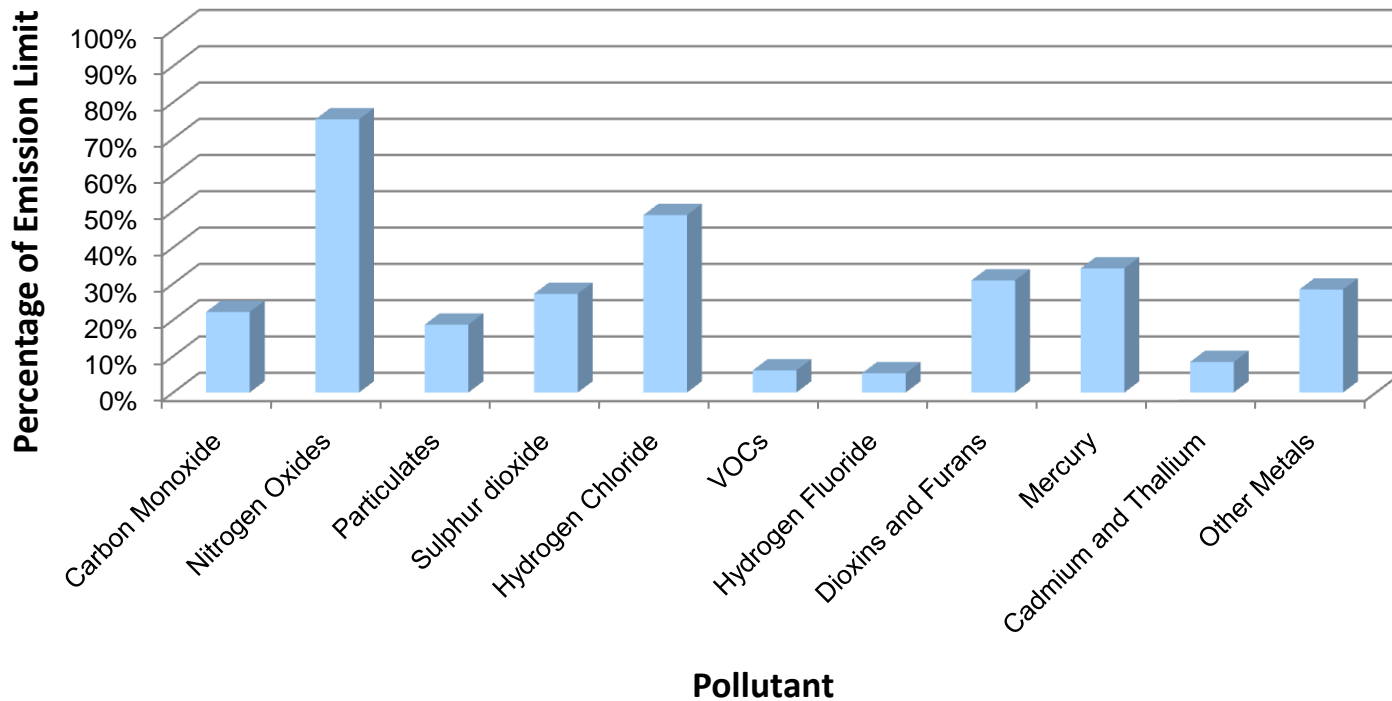
### European Standard EN14181

- Monitoring standard for large combustion plants and incineration plants
- Four stages:
  - QAL1 – certify the equipment in a laboratory
  - QAL2 – certify performance of whole installation by comparing with standard method – 15 repeated tests.
  - QAL3 – calibration checks throughout operation, collecting statistical data.
  - AST – Annual confirmation of QAL2 – 6 repeated tests.

## Operation – Compliance Records (1)

UK Energy-from-Waste Plants operate consistently below emission limits.

**Average Emissions Performance of UK Energy-from-Waste Plants**



## Operation – Compliance Records (2)

There are occasional exceedences of emission limits, due to disturbances.

- In 2006, there were a total of 157 exceedences across the UK
- In 2007, there were 28 exceedences
- In 2008, there were again 28 exceedences

This is across 30 incineration lines, each of which records 90,000 halfhourly averages in a year, giving 2.7 million readings.

Hence, the compliance rate is more than 99.99%.



## Operation – Track Record

Technology to be used is proven across many installations.

- Eighteen in the UK
- Hundreds across the EU

While the precise grate technology varies, the concepts are similar.

The technology selected will have a large number of reference plants.



## Assessment of Impact

1. Identify air quality standards.
2. Estimate background levels of pollutants.
3. Use atmospheric dispersion modelling to predict ground level concentrations.
4. Compare ground level concentrations with standards, applying standard criteria for evaluation.
5. For persistent pollutants, assess accumulation of pollutant and carry out Human Health Risk Assessment.
6. For agricultural impact, assess concentrations in soil, crops and livestock and compare with regulatory standards.

## Assessment of Impacts - standards

Improvement in air quality driven by EC directives and the National Air Quality Strategy

UK Government set Air Quality Objectives (AQOs), most based on EC Directives which are legally binding.

- Nitrogen dioxide, sulphur dioxide, carbon monoxide, lead, PM10, PM2.5

EC Directives also include “target values” which are less onerous.

- Cadmium, arsenic, nickel, benzo(a)pyrene

Other pollutants have Environmental Assessment Levels (EALs) set by the EA, the WHO and EPAQS.

Standards are set at levels where the risk to human health is very low.

## Assessment of Impacts - criteria

Important to set assessment criteria in advance.

Environment Agency states that emissions are “insignificant” if:

- Long term contributions at ground level are less than 1% of standard; and
- Short term contributions are less than 10% of standard

Environmental Protection UK sets a matrix of criteria. Emissions have a “negligible” impact if:

- Contribution is less than 5% of standard; and
- Contribution plus background is less than 75% of standard



## Assessment of Impacts – dispersion modelling

Plume from stack is released into atmosphere and gradually mixes with ambient air.

Plume has upward momentum (due to fans and due to temperature) but gradually drops towards the ground.

Speed of mixing depends on the turbulence in the air.

Turbulence is caused by the wind and by thermal currents.

Dispersion modelling takes weather data for every hour over five years and uses this to predict the mixing of the plume in the air and the speed and direction of travel.

Model predicts concentration at ground level across a grid of points and at specific points.



## Assessment of Impacts – results of modelling

All short term concentrations are predicted to be insignificant. (i.e. less than 10% of standard)

Most long term concentrations are predicted to be insignificant. (i.e. less than 1% of standard)

Exceptions are:

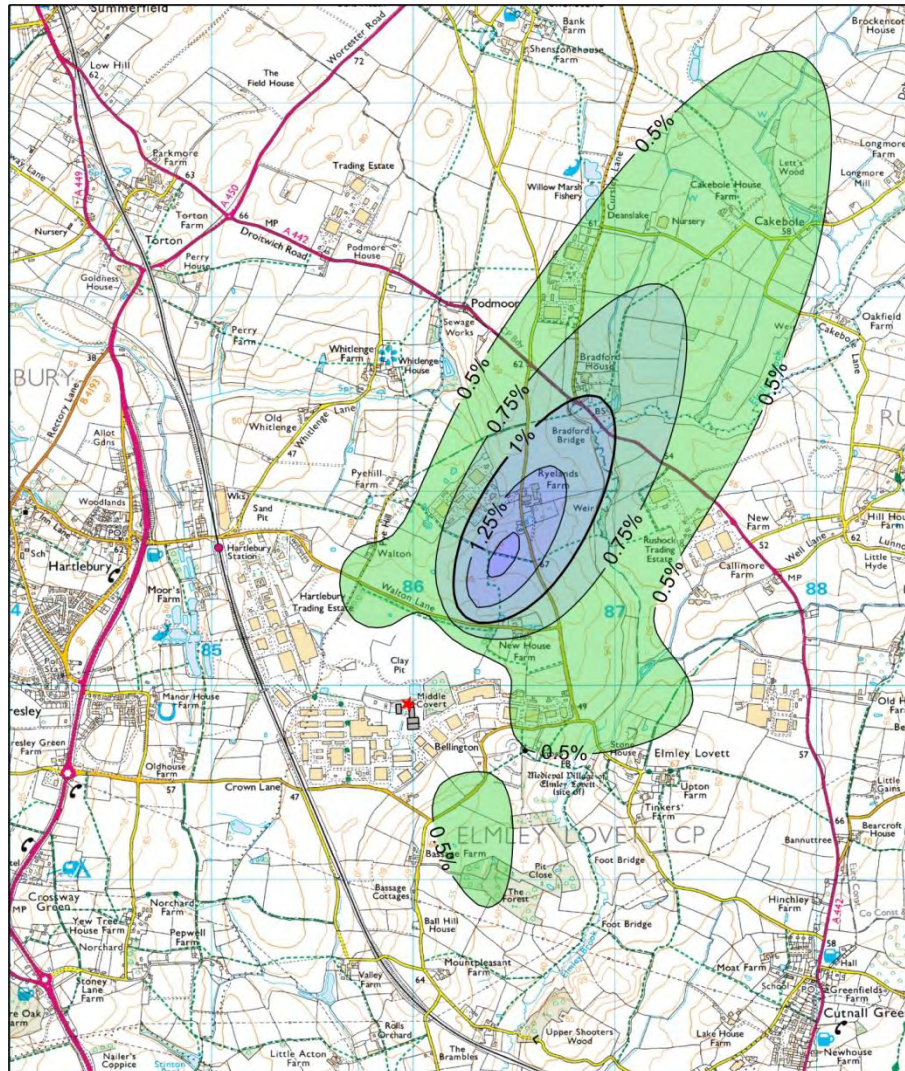
- Nitrogen dioxide      1.6% of EC Objective
- 1,3 butadiene      2% of UK Objective
- Cadmium      2.2% of EAL
- Benzo(a)pyrene      3.6% of UK Target (0.9% of EC Target)

These exceptions only happen over a small area and only include one residential property (Rylands Farm)

When combined with background levels, all impacts are “negligible” everywhere. (i.e. total concentration less than 75% of standard)



# Assessment of Impacts – results of modelling (1)



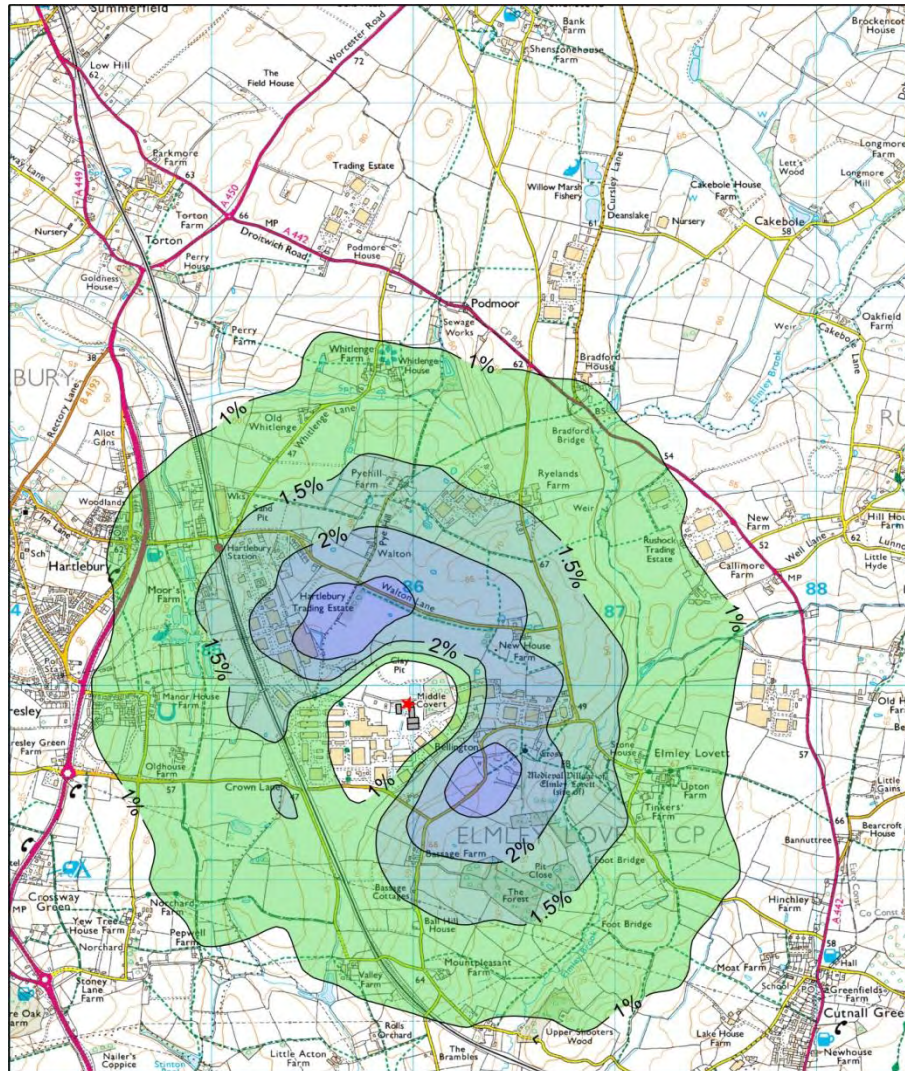
Nitrogen Dioxide

Annual Average Ground Level Concentration

Shown as percentage of standard



# Assessment of Impacts – results of modelling (2)



Nitrogen Dioxide

Hourly Ground Level  
Concentration

Shown as percentage  
of standard



## Assessment of Impacts – Human Health Risk Assessment (1)

Dioxins and furans and heavy metals can accumulate in the environment.

There are a number of pathways for these pollutants to reach humans by ingestion.

- Deposition on soil and ingestion of soil by humans.
- Deposition on soil and leaves, absorption by plants and ingestion of plants by humans.
- Deposition on soil and leaves, absorption by plants, ingestion of plants by livestock and ingestion of livestock by humans.
- Inhalation by humans in the atmosphere.

These are all considered in the Human Health Risk Assessment Protocol, developed by the US EPA (equivalent of the EA) and included in a computer programme called IRAP.



## Assessment of Impacts – Human Health Risk Assessment (2)

Ingestion rates by humans are predicted using IRAP and used to calculate two results.

Cancer risk – increased chance of cancer over a lifetime.

- Acceptable risk is 1 in 100,000 for a single compound.
- Highest predicted risk is 1 in 200,000, for a child living at Rylands Farm and consuming mainly farm-produced food.
- Predicted risk in Hartlebury is more like 1 in 10 million

Hazard Quotient – non-cancer health risk.

- Indicates risk compared to standard exposure levels
- Highest predicted value is 0.02.

Also, total intake of dioxins is 0.6% of the Tolerable Daily Intake



## Assessment of Impacts – Agriculture

Main agricultural uses identified by survey.

Concentrations in soil, crops and livestock predicted using IRAP.

Predicted concentrations of metals and dioxins were less than 0.2% of the regulatory limits from EC Regulations.



## Persistent Organic Pollutants

Stockholm Convention on POPs aims to:

- Reduce or eliminate releases of POPs from intentional production; and
- Reduce or eliminate releases of POPs from unintentional production

In order to achieve the second aim, the use of Best Available Techniques is promoted. These will be employed.

The Stockholm Convention has been considered at a number of public inquiries into Energy-from-Waste plants and all have concluded that there is no breach.



## Conclusions

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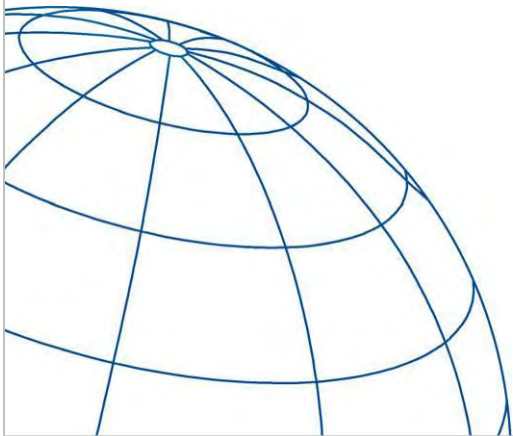
Proposed technology is proven, with multiple examples across Europe.

Emissions will be monitored using certified systems.

Assessment of air quality impacts carried out. Concludes that impact on human health is negligible.



**Thank You for Listening**



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