APPENDIX 5 THE SPECIFICATION OF THE AIR EMISSIONS MODULE

A5.1 Model specification

The module models air emissions by emissions type and by fuel user as follows.

Air emissions related to energy consumption

For each fuel consumed by each fuel user, a coefficient is applied which represents the air emissions per unit of energy consumed. The size of this coefficient reflects both the chemical characteristics of the fuel (for example, the CO2 per unit of coal consumed) and the application of end-of-pipe technology that would reduce the emissions to air (for example, the application of flue-gas desulphurisation in combustion plant to reduce SO2 emissions).

$$(A5.1)\quad EME_{i,t} = \sum_{j}^{NJ} \sum_{k}^{NFU} (FJEMC_{k,j,i,t} \times FUJ_{j,k,t})$$

$$(A5.2)\quad FUEM_{i,k,t} = \sum_{j}^{NJ} FJEMC_{k,j,i,t} \times FUJ_{j,k,t}$$

where

EME(i,t)	air emissions of type i from energy consumption in year t (in '000 tonnes)
FUEM(k,i,t)	air emissions of type i and user k from energy consumption in year t (in '000 tonnes)
FUJ(i,j,t)	use of fuel j by fuel user i in year t (energy units)
FJEMC(k,j,i,t)	air emissions of type i from per unit of energy consumption of fuel k by fuel user j in year t (in '000 tonnes per energy unit)
NFU	number of fuel users

Air emissions not related to energy consumption

There are two types of emissions not related to energy consumption:

1 Direct emissions

2 Chemical processes

Direct emissions

Certain categories of activities are identified as producing emissions in ways that are unrelated to energy consumption or through the production process. In these cases the model user enters assumptions for an indicator of the scale of these activities, and also coefficients that represent the level of each type of air emissions per unit of activity. The model does no more than incorporate these assumptions in the overall results for air emissions:

$$(A5.3)\quad EMDO_{i,t} = \sum_{j}^{ND} EMDC_{i,j,t} \times DA_{j,t}$$

where

DA(j,t)	a measure of activity in the relevant group (eg size of livestock herds, for methane emissions from agriculture)

EM(i,t)	emissions of type i in year t (in '000 tonnes)
EMD0(i,t)	emissions of type i from non-energy sources in year t (in '000 tonnes)
EMDC(i,j,t)	emissions of type i per unit of activity in activity group j in year t (in '000 tonnes per unit of activity)
ND	number of activities

Emissions from chemical processes

Certain production processes involve chemical processes that result in the production of gas emissions. These activities could range from food production (eg bread) or brewing to parts of the chemicals industry. In these cases the level of emissions is clearly related to the level of activity of each fuel user.

$$(A5.4)\quad FNEM_{i,t} = \sum_{j}^{NFU} FNEC_{i,j,t} \times JL_{j,t}$$

where

FNEM(i,t)	emissions of type i not from energy consumption in year t (in '000 tonnes)
FNEC(i,j,t)	emissions of type i not from energy consumption per unit of activity in activity group j in year t (in '000 tonnes per unit of activity)
Y(j,t)	activity in activity group j in year t (£1995m)

$$(A5.5)\quad EM_{i,t} = EME_{i,t} + EMO_{i,t} + FNEM_{i,t}$$

Derived results

The results for air emissions by type are converted into greenhouse gas emissions by type, simply by selecting the six categories of air emissions that are greenhouse gases, and applying standard conversion factors to change the units from '000 tonnes of each gas to '000 tonnes of CO2 equivalent. In addition, as a seventh category of greenhouse gas, a 'UK factor' could be applied to the region's electricity consumption to represent the implied greenhouse gas emissions associated with the power generation required to supply the electricity used in the region. Clearly it would be double-counting to include both this figure and the GHG emissions produced by power generation in the region. However, the category is included as a memo item for model users.

A5.2 The Classifications Adopted

The model identifies 50 fuel users, four direct sources of emissions, 13 types of air emissions and seven greenhouse gases as listed below:

Fuel users

- 1 Power generation
- 2 Other energy transformation
- 3 Energy industries' own use: electricity generation
- 4 Energy industries' own use: other

- 5 Basic metals
- 6 Mineral products
- 7 Chemicals
- 8 Pharmaceuticuals
- 9 Mechanical engineering
- 10 Metal goods
- 11 Electronics
- 12 Electrical engineering
- 13 Instruments
- 14 Motor vehicles
- 15 Aerospace
- 16 Other transport equipment
- 17 Food
- 18 Drink
- 19 Tobacco
- 20 Textiles
- 21 Clothing & leather
- 22 Paper, printing & publishing
- 23 Other mining
- 24 Wood & wood products
- 25 Rubber & plastics
- 26 Manufacturing nes & recycling
- 27 Water supply
- 28 Construction
- 29 Air transport
- 30 Rail transport
- 31 Road transport
- 32 National navigation and pipelines
- 33 Domestic use (households)
- 34 Public administration & defence
- 35 Education
- 36 Health & social work

- 37 Retailing
- 38 Distribution nes
- 39 Hotels & catering
- 40 Other transport services
- 41 Communications
- 42 Banking & finance
- 43 Insurance
- 44 Professional services
- 45 Computing services
- 46 Other business services
- 47 Agriculture
- 48 Waste treatment
- 49 Miscellaneous services
- 50 Miscellaneous

Direct (non-energy) sources of air emissions

- 1 Emissions directly from agriculture
- 2 Emissions directly from coal mines
- 3 Emissions directly from landfill

Air emissions

- 1 Carbon dioxide (CO2)
- 2 Sulphur dioxide (SO2)
- 3 Nitrogen oxides (NOx)
- 4 Carbon monoxide (CO)
- 5 Methane, (CH4)
- 6 PM10 (black smoke)
- 7 Volatile organic compounds (VOCs)
- 8 Nuclear emissions to air
- 9 Lead emissions to air
- 10 Nitrous Oxide (N2O)
- 11 Hydrofluorocarbons (HFCs)
- 12 Perfluorocarbons (PFCs)
- 13 Sulphur Hexafluoride (SF6)

It was considered including carbon sequestration in the specification (a negative emission). However, it was not incorporated as it is not typically allowed for when calculating the emissions from an economy.

Greenhouse gases

- 1 Carbon dioxide (CO2)
- 2 Methane, (CH4)
- 3 Nitrous Oxide (N2O)
- 4 Hydrofluorocarbons (HFCs)
- 5 Perfluorocarbons (PFCs)
- 6 Sulphur Hexafluoride (SF6)
- 7 Emissions implied by electricity consumption