APPENDIX 4 THE SPECIFICATION OF THE TRANSPORT MODULE

A4.1 Model specification

The purpose of the transport module is not to model decisions about transport use based on the characteristics of the different transport options facing transport users, in the way that large-scale transport models do. Rather, the purpose is to allow views about transport use to be reflected in REEIO's energy use and air emissions outcomes. The outputs of transport models may provide useful inputs for REEIO's transport assumptions. The module models transport use by mode using the equations set out below.

Passenger and freight transport are handled separately, but in similar ways. Firstly, the demand for total passenger kilometres or freight tonne kilometres to be transported in a given year is determined by a simple relationship with the region's GDP [not yet programmed].

$$(A4.1)\quad SPK_t = SPKC_t \times GDPO_t$$

$$(A4.2)\quad STK_t = STKC_t \times GDPO_t$$

where

SPK(t)	passenger kilometres (all passenger modes) in year t
STK(t)	tonne kilometres (all freight modes) in year t
GDPO(t)	level of GDP in the region in year
SPKC(t)	passenger kilometres per unit iof GDP in year t
SPTC(t)	freight tonne kilometres per unit of GDPin year t

Next, the way in which these demands are satisfied by mode are determined, according to assumptions for the share of each mode. The model user enters assumptions for the trend over time in these shares (so that, for example, a trend towards substitution of car use for rail use or vice versa can be entered).

$$(A.4.3)\quad TMPK_{i,t} = TMPC_{i,t} \times SPK_t$$

$$(A4.4)\quad TFTK_{i,t} = TFTC_{i,t} \times STK_t$$

where

TFTC(i,t)	tonne kilometres by freight mode as share of all tonne kilometres
TFTK(i,t)	freight movements by freight mode
TMPC(i,t)	passenger kilometres by mode as share of all passenger kilometres
TMTK(i,t)	passenger movements by passenger mode
SPK(t)	passenger kilometres (all passenger modes)
STK(t)	tonne kilometres (all freight modes)

For each mode of transport, the implications for vehicle kilometres are then calculated, by applying assumptions for passengers per vehicle or freight tonnes per vehicle. The model user enters assumptions for the trend over time in these ratios (so that, for example, a trend towards higher or lower vehicle occupancy can be entered).

(A4.5) $TMVK_{i,t} = TMPK_{i,t} / TMVC_{i,t}$

(A4.6) $TFVK_{i,t} = TFTK_{i,t} / TFVC_{i,t}$

where

TFVC(i,t)	freight kilometres per freight vehicle kilometre by freight mode
TFVK(i,t)	freight vehicle movements by freight mode
TMVC(i,t)	passenger kilometres per passenger vehicle kilometre (ie 'vehicle occupancy') by freight mode
TMVK(i,t)	passenger vehicle movements by passenger mode

Finally, assumptions for vehicle fuel use by fuel for each mode of transport are applied, to determine fuel use. The model user enters assumptions for the trend over time in these ratios (so that, for example, a trend towards greater fuel efficiency or substitution of fuels can be entered).

(A4.7) $TMJ_{i,j,t} = TMJC_{i,j,t} \times TMVK_{i,t}$

(A4.8) $TFJ_{i,j,t} = TFJC_{i,j,t} \times TFVK_{i,t}$

where

TFJ(J,t)	energy use by freight mode and fuel
TFJC(i,j,t)	energy use by freight mode and fuel per freight vehicle kilometre
TMJ(J,t)	energy use by passenger mode and fuel
TMJC(i,j,t)	energy use by passenger mode and fuel per passenger vehicle kilometre

A4.2 The Classifications Adopted

The model identifies seven modes of passenger transport, four modes of freight transport and 14 fuels as listed below:

Passenger transport modes

- 1 Motorcycles
- 2 Cars
- 3 Buses
- 4 Rail
- 5 Light rail
- 6 Air
- 7 Water

Freight transport modes

- 1 Road
- 2 Rail
- 3 Air
- 4 Water

Fuels

- 1 Coal and coke
- 2 Motor spirit
- 3 Derv
- 4 Gas oil
- 5 Fuel oil
- 6 Other refined oil
- 7 Gas (natural gas, coke oven gas and town gas)
- 8 Electricity
- 9 Nuclear electricity
- 10 Landfill gas (renewable-obligation)
- 11 Waste (Renewable-obligation)
- 12 Other Renewable-obligation renewables
- 13 Other renewables
- 14 Heat sold