



# PLANNING SUSTAINABLE TRANSPORT



BARRY HUTTON



earthscan  
from Routledge

---

# Planning Sustainable Transport

---

Transport choices must be transformed if we are to cope with sustainability and climate change, but this can only be done if we understand how complex transport systems work. Straightforward choices are never made between one transport mode and another; door-to-door movements of both people and freight use combinations of different modes of transport.

This book offers a cross-disciplinary overview of transport systems and the ways in which they interact with urban and regional planning decisions and environmental issues. It offers a thoughtful critique of existing methodology and policy, raising issues, providing facts, explaining linkages and, particularly, stimulating debate. The book methodically explores the definitions, trends, problems, objectives and policies of transport planning. In particular the author looks at land use as a major determinant of the nature and extent of the demand for transport, concluding that the management of land use has to be a key element of any sustainable transport policy.

*Planning Sustainable Transport* will be essential reading for today's transport specialists, planners and property developers. It will also be useful to postgraduate students in planning and related disciplines.

**Barry Hutton**, now retired, was the founding Head of the Department of Town and Country Planning at the University of the West of England. In parallel with his academic work, he was a consultant appearing as a professional witness at many planning inquiries. As a member of the design team for Mosborough, Sheffield, he wrote a computer simulation of gridded road and public transport networks that was to be selectively adapted for Milton Keynes. He went on to help establish the Egyptian National Institute of Transport, was part of a project researching and creating a computer prediction of the speed-sensitive fuel consumption rates of cars in Edinburgh, and accepted an invitation from the United Nations to prepare a 'Sustainable, Multi-Modal Transport Plan' for Kosovo.

This page intentionally left blank

---

# Planning Sustainable Transport

---

Barry Hutton

 **Routledge**  
Taylor & Francis Group  
LONDON AND NEW YORK

**earthscan**  
from Routledge

First published 2013  
by Routledge  
2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

Simultaneously published in the USA and Canada  
by Routledge  
711 Third Avenue, New York, NY 10017

*Routledge is an imprint of the Taylor & Francis Group, an informa business*

© 2013 Barry Hutton

The right of Barry Hutton to be identified as author of this work has been asserted by him in accordance with sections 77 and 78 of the Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this book may be reprinted or reproduced or utilised in any form or by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying and recording, or in any information storage or retrieval system, without permission in writing from the publishers.

*Trademark notice:* Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

*British Library Cataloguing in Publication Data*

A catalogue record for this book is available from the British Library

*Library of Congress Cataloging-in-Publication Data*

Hutton, Barry.

Planning sustainable transport / Barry Hutton.

pages cm

Includes bibliographical references and index.

1. Transportation-Planning. 2. Transportation-Environmental aspects.

3. Transportation and state. I. Title.

HE193.H88 2013

388'.049-dc23

2012044459

ISBN13: 978-1-84971-390-0 (hbk)

ISBN13: 978-1-84971-391-7 (pbk)

ISBN13: 978-0-203-43606-6 (ebk)

Typeset in Baskerville by  
Keystroke, Station Road, Codsall, Wolverhampton

---

# Contents

---

|                                                            |     |
|------------------------------------------------------------|-----|
| <i>List of figures</i>                                     | vii |
| 1 The definitions: sustainability                          | 1   |
| 2 The definitions: transport                               | 19  |
| 3 The definitions: planning                                | 29  |
| 4 The trends: travel and haulage                           | 48  |
| 5 Fuel consumption and emissions of greenhouse gases (GHG) | 68  |
| 6 Location and land use                                    | 89  |
| 7 The problems: congestion                                 | 101 |
| 8 The problems: interchanging and trans-shipment           | 141 |
| 9 The problems: the space budget                           | 153 |
| 10 Transport costs                                         | 159 |
| 11 Sensing success and failure                             | 175 |
| 12 Managing the environmental impacts                      | 185 |
| 13 Mobility and accessibility                              | 202 |
| 14 Controlling costs                                       | 219 |

|    |                                                          |     |
|----|----------------------------------------------------------|-----|
| 15 | Supporting the economy                                   | 239 |
| 16 | Road vehicle design                                      | 256 |
| 17 | Public transport                                         | 261 |
| 18 | Tolls, taxes and tariffs: fares, fines and fees          | 321 |
| 19 | Transport demand prediction                              | 339 |
| 20 | The need for a new methodology to estimate travel demand | 379 |
| 21 | Planning sustainable transport: the agenda               | 392 |
|    | <i>Bibliography</i>                                      | 412 |
|    | <i>Index</i>                                             | 421 |

---

# Figures

---

|      |                                                                                                                                     |    |
|------|-------------------------------------------------------------------------------------------------------------------------------------|----|
| 1.1  | CO <sub>2</sub> equivalent (CO <sub>2</sub> -e) conversion factors                                                                  | 6  |
| 1.2  | A selection of the 'strategy indicators'                                                                                            | 13 |
| 2.1  | Transport rhythms in a hypothetical freight case                                                                                    | 26 |
| 3.1  | Traffic flows on the M25                                                                                                            | 35 |
| 3.2a | Edinburgh, west and northwest suburbs (1928)                                                                                        | 38 |
| 3.2b | Edinburgh, west and northwest suburbs (1964)                                                                                        | 39 |
| 3.2c | Edinburgh, west and northwest suburbs (2000)                                                                                        | 40 |
| 3.3  | The linear, end-state planning process                                                                                              | 44 |
| 3.4  | The recursive, flexible planning process                                                                                            | 47 |
| 4.1  | The growth of personal travel, freight, traffic and real GDP per head (1953–2009)                                                   | 48 |
| 4.2  | The growth in the vehicle population (1953–2009) (as an index to show relative growth)                                              | 49 |
| 4.3  | The percentages of households with or without the use of a car (1951–2009)                                                          | 50 |
| 4.4  | Number of households in Great Britain (1951–2010)                                                                                   | 51 |
| 4.5  | Descriptive statistics drawn from the 2001 census for examples of typical developments illustrated in Figures 4.6, 4.7, 4.8 and 4.9 | 52 |
| 4.6  | Scottish tenement housing (1890s)                                                                                                   | 53 |
| 4.7  | 1930s housing                                                                                                                       | 54 |
| 4.8  | Housing on previous farmland: the virtual city                                                                                      | 55 |
| 4.9  | New flatted development on vacated industrial land within the city                                                                  | 56 |
| 4.10 | Personal travel: total distance travelled, trip length, trip speed and total travel time                                            | 57 |
| 4.11 | Freight: tonnes shifted – tonne-kilometres by major mode                                                                            | 59 |
| 4.12 | Freight: tonnes lifted – tonnes loaded on to the major modes                                                                        | 59 |
| 4.13 | Freight: mean carry distance                                                                                                        | 60 |
| 4.14 | The overall capacity of the lorry fleet                                                                                             | 64 |
| 5.1  | Emissions of CO <sub>2</sub> equivalent (CO <sub>2</sub> -e) by various fuels                                                       | 70 |
| 5.2  | Emissions of CO <sub>2</sub> -e released by the petrol burnt in an average car as a function of its speed                           | 71 |
| 5.3  | The European standard fuel consumption test (80/1268/EEC)                                                                           | 72 |
| 5.4  | Fuel consumption by a 1.8-litre petrol car during the EU test cycle                                                                 | 73 |
| 5.5  | Emissions of CO <sub>2</sub> -e as a function of speed                                                                              | 74 |

|      |                                                                                                                          |     |
|------|--------------------------------------------------------------------------------------------------------------------------|-----|
| 5.6  | Emissions of CO <sub>2</sub> -e by heavy goods vehicles as a function of speed                                           | 75  |
| 5.7  | Lorry and container capacities                                                                                           | 75  |
| 5.8  | Emissions of CO <sub>2</sub> -e per kilometre by average buses as a function of speed                                    | 76  |
| 5.9  | Rail freight case studies                                                                                                | 79  |
| 5.10 | Out-turn performances of some British passenger trains                                                                   | 83  |
| 5.11 | Emissions of CO <sub>2</sub> -e per passenger-kilometre by an average bus as a function of the number of passengers      | 85  |
| 5.12 | Emissions of CO <sub>2</sub> -e by a 44-tonne gross weight articulated lorry (OGV2) at differing speeds and load factors | 86  |
| 7.1  | An intuitive, but incorrect, speed–flow relationship for an urban street                                                 | 103 |
| 7.2  | Space-headway related to speed                                                                                           | 104 |
| 7.3  | Time-headway related to speed                                                                                            | 105 |
| 7.4  | The general relationship between speed and flow                                                                          | 106 |
| 7.5  | Density of traffic in vehicles per kilometre of road related to traffic speed                                            | 107 |
| 7.6  | Speed–flow relationship reported by the Road Research Laboratory (1965)                                                  | 108 |
| 7.7  | An example of the ‘official’ relationship between flow and speed                                                         | 109 |
| 7.8  | Passenger car unit factors                                                                                               | 110 |
| 7.9  | Space-headways associated with the speed–flow relationships shown in Figure 7.7                                          | 110 |
| 7.10 | The general relationship between speed and flow                                                                          | 112 |
| 7.11 | The hybrid speed–flow relationship                                                                                       | 114 |
| 7.12 | The nominal capacities of rural roads                                                                                    | 118 |
| 7.13 | The nominal capacities of urban roads in vehicles per hour                                                               | 119 |
| 7.14 | Types of conflicting movement                                                                                            | 121 |
| 7.15 | Simple crossing conflict on two one-way roads                                                                            | 122 |
| 7.16 | Complex crossing conflict                                                                                                | 122 |
| 7.17 | Crossing and merging conflicts                                                                                           | 123 |
| 7.18 | Conflict points at an uncontrolled four-legged crossroads                                                                | 124 |
| 7.19 | Conflict points at a simple roundabout                                                                                   | 125 |
| 7.20 | Conflict points at a junction controlled by simple traffic signals                                                       | 125 |
| 7.21 | Gaps accepted by 50 per cent of drivers at a minor road junction                                                         | 127 |
| 7.22 | The supply of five-, six- and eight-second gaps as a function of flow                                                    | 129 |
| 7.23 | Time taken to travel one kilometre                                                                                       | 131 |
| 7.24 | Indices of change in personal transport in London                                                                        | 134 |
| 7.25 | Growth in traffic (measured in vehicle-kilometres) in London and southeast England compared with country-wide growth     | 135 |
| 7.26 | Mean trip lengths and speeds                                                                                             | 135 |
| 7.27 | Overall growth in traffic in Great Britain                                                                               | 136 |
| 9.1  | Indicative modal capacities (persons per hour)                                                                           | 153 |
| 9.2  | Space-hours required and relative productivity                                                                           | 154 |
| 9.3  | A sample train diagram showing two trains with dwell times at a station stop                                             | 157 |

|       |                                                                                                                                    |     |
|-------|------------------------------------------------------------------------------------------------------------------------------------|-----|
| 10.1  | Car costs for a petrol car priced new at £14,000 and driven 24,000 kilometres per year                                             | 161 |
| 10.2  | Depreciation of a car with a purchase price of £14,000, a life of 10 years and zero salvage value                                  | 162 |
| 10.3  | The financial costs per year of the ownership of a car with a purchase price of £14,000, a life of 10 years and zero salvage value | 163 |
| 10.4  | Amortisation: sample annual repayment on a loan of £1000                                                                           | 165 |
| 10.5  | Mode capacity, costing and emissions                                                                                               | 166 |
| 10.6  | Time budget for a hypothetical bus operation                                                                                       | 169 |
| 10.7  | The allocation of the 8760 annual life-hours of the hypothetical bus working as in Figure 10.6                                     | 170 |
| 10.8  | Distribution of total annual costs for the hypothetical bus operation shown in Figure 10.6                                         | 171 |
| 12.1  | Vehicle excise duty charged as a function of CO <sub>2</sub> emission rate (2012)                                                  | 191 |
| 12.2  | The modelled impacts of long-term emissions of CO <sub>2</sub> -e                                                                  | 192 |
| 12.3  | Greenhouse gas emissions (2006)                                                                                                    | 199 |
| 13.1  | Hansen accessibility: journey 'costs' (kilometres)                                                                                 | 214 |
| 13.2  | Hansen accessibility: deterrence values = ('costs') <sup>1.3</sup>                                                                 | 215 |
| 13.3  | Hansen accessibility: accessibility factors = population/('costs') <sup>1.3</sup>                                                  | 215 |
| 14.1  | Estimated annual costs for a 17-tonne two-axle truck                                                                               | 226 |
| 14.2  | Estimated costs per vehicle-kilometre for a 17-tonne two-axle truck                                                                | 227 |
| 14.3  | Estimated marginal and average costs per vehicle-kilometre for a 17-tonne two-axle truck                                           | 228 |
| 14.4  | Estimated cost per tonne-kilometre as functions of the load factors for three sample trucks                                        | 230 |
| 14.5  | Work and subsidy on British Railways, 1994 and 2010                                                                                | 235 |
| 15.1  | Flow chart for a Land-Use Transport Interaction Model                                                                              | 247 |
| 15.2  | National Trip End Model: zones and study areas                                                                                     | 250 |
| 17.1  | Total cost per horse tram-kilometre (1880 prices)                                                                                  | 266 |
| 17.2  | Maximum distance between service stops as a function of top speed                                                                  | 275 |
| 17.3  | Person-kilometres (billions) by bus and rail                                                                                       | 277 |
| 17.4  | Percentage of travelled person-kilometres by mode                                                                                  | 278 |
| 17.5  | Route workings and passenger boardings for a selection of local government areas                                                   | 279 |
| 17.6  | Census data showing use of mode for the journey to work for the examples given in Chapter 4                                        | 280 |
| 17.7  | The vicious circle                                                                                                                 | 284 |
| 17.8  | The Nottingham Zone and Collar experiment (1975–1976)                                                                              | 287 |
| 17.9  | Comparative journey times and costs from Bilborough/Wollaton to Nottingham city centre                                             | 289 |
| 17.10 | Passenger journeys and distances on British railways                                                                               | 308 |
| 17.11 | Numbers (thousands) commuting to the City of London in the morning peak in 2009, by main mode of travel                            | 313 |

|       |                                                                                                                                                                  |     |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 17.12 | Trends in commuting mode used to access the City of London (1996–2009)                                                                                           | 314 |
| 18.1  | Supply and demand for trips                                                                                                                                      | 332 |
| 18.2  | Effects of capacity changes                                                                                                                                      | 335 |
| 19.1  | The hypothetical traffic at a simple four-legged, two-way road junction                                                                                          | 340 |
| 19.2  | The origin and destination (O+D) matrix from Figure 19.1                                                                                                         | 341 |
| 19.3  | The origin and destination zone structure for Kington                                                                                                            | 342 |
| 19.4  | The original but flawed origin and destination (O+D) matrix for Kington                                                                                          | 343 |
| 19.5  | The Kington road network, including O+D zones, dummy links and road proposals                                                                                    | 345 |
| 19.6  | Comparison between flows estimated from the Kington O+D matrix shown in Figure 19.4 and the actual flows measured by moving car observer                         | 346 |
| 19.7  | Numbers of car trips from the house per household per 24 hours                                                                                                   | 347 |
| 19.8  | A demonstration O+D matrix showing the number of trips starting and finishing in each of four zones                                                              | 349 |
| 19.9  | A demonstration O+D matrix by gravity model showing the distances in kilometres between zones                                                                    | 350 |
| 19.10 | The effective deterrent distance = (the ground distance) <sup>N</sup>                                                                                            | 350 |
| 19.11 | A demonstration O+D matrix by gravity model showing the effective deterrent distance = (distance in kilometres between zones) <sup>1.3</sup>                     | 351 |
| 19.12 | A demonstration O+D matrix by gravity model showing the ‘likelihoods’ of making a journey from one zone to another                                               | 351 |
| 19.13 | A demonstration O+D matrix by gravity model showing the ‘relative likelihood’ of making a journey from each origin zone to one or other of the destination zones | 352 |
| 19.14 | A demonstration O+D matrix by gravity model showing the final synthetic O+D matrix                                                                               | 352 |
| 19.15 | Theoretical diversion curves                                                                                                                                     | 358 |
| 19.16 | The classic economic theory of supply and demand curves                                                                                                          | 369 |
| 21.1  | A recursive, flexible planning process                                                                                                                           | 393 |

# The definitions

## Sustainability

---

### The Brundtland Report

The Brundtland Report (1987) defined sustainability as:

Ensuring that development meets the needs of the present without compromising the ability of future generations to meet their own needs.<sup>1</sup>

This definition implied a continuous process rather than an event or a quality. It acknowledged the need to use the earth's resources to meet the basic human needs of shelter, food and warmth for an increasing number of people. Brundtland did not suggest a reversion to a primitive life to ensure that the inventory of the earth's resources is left more or less as we find it but it did urge that the minimum impact should be made upon the resource stock. The Report emphasised four sustainable policies to ensure that the needs of future populations are not compromised:

- 1 Resources are used efficiently to minimise the depletion of finite resources.
- 2 Any wastes are disposed of with minimal damage to the environment so that the continuing natural renewal of the resource base is unimpeded.
- 3 The growth in world population is slowed.
- 4 'Development' is spread more evenly around the global population.

'Development' in this context means expanding global production, partly to even out standards of living across the world, and partly to satisfy the needs of an expected increase in global population. This expansion of production may only be achieved by more factories consuming more raw materials, backed by more offices, shops and transport, trends which Brundtland accepts as unavoidable but which should be kept to a minimum. This implies that damage must be recognised and quantified; otherwise its management and minimisation would be impossible.

The Brundtland Report did not hide the fact that some 'painful choices' would have to be made. Massive, unsustainable increases in production and consumption would be needed if the inequalities between the developed and the developing world were to be removed by bringing global consumption per head up to the levels now enjoyed by highly developed countries. Consequently, one plank of the sustainable policy suggested by Brundtland must be to ensure that current standards of living are

spread more evenly. The Report argued that if this were not done, countries with lower living standards would strive to raise them by copying the economies of the richer countries, forcing up prices of energy and raw materials and then raising their consumption to unsustainable levels. It is arguable that this assertion, now a quarter of a century old, is becoming true. China, striving to emulate the West, is consuming more energy and raw materials, forcing global prices up and tending to create the very unsustainability feared by Brundtland.

Brundtland stressed that sustainability is more complex than a focus upon the reduction of pollution or even avoiding excessive environmental damage, intricate though these problems may be. If the headlong increase in the use of raw materials and energy is to be slowed, then existing production must be spread more evenly: that may well be seen to be a moral issue – an injustice – with some societies hogging more than their ‘share’ while others strive to keep pace. But Brundtland argues that it is more than a moral argument – it is in the interests of the richer nations to curtail their consumption in order to damp down the aspirations of poorer countries and so slow the rate of exploitation of the finite global resources. The ‘painful choices’ to which Brundtland draws attention are therefore painful to those who may have to forgo continuing increases in their standards of living but they are also painful to political leaders who have to run the risk of being pilloried and then rejected for placing the interests of the planet above the immediate interests of their own electorate.

This conflict between the long-term interests of future generations all over the world and the short-term interests of the existing inhabitants of the richer countries is, perhaps, the core problem facing us and it is important to recognise that it is not a problem of science or technology but of politics, attitudes and aspirations.

### **The Rio Conference**

The Brundtland Report was published in 1987 under the auspices of the United Nations and, after a gap of three years to enable each national government to establish a response, the UN organised a summit conference in Rio de Janeiro to address sustainability. The product was ‘Agenda 21’, an international protocol defining global sustainable policy. Although few dared to say so, the problems and policies outlined in Brundtland required a global response but global political cooperation was not up to the challenge and, although Agenda 21 was the product of an unprecedented international conference, and although many nations signed up to the protocol, implementation was left to individual countries. Agenda 21 was recognised more in posture rather than in practice.

At the Rio Conference the international community made the problem of sustainability more tractable by shifting the emphasis away from the broad problems of poverty and the global disparities in standards of living, towards the issue of climate change. In effect it redefined ‘sustainability’, abandoning the broad Brundtland meaning, and concentrating on pollution, greenhouse gases and climate change. Clearly, this is a very important global problem and is one element of sustainability as defined by Brundtland, but climate change is much less politically sensitive than moving wealth from the advantaged to the disadvantaged.

The British government responded to Agenda 21 with *Sustainable Development: The UK Strategy* (1994).<sup>2</sup> The report was the first sign that the British government were more conscious of the immediate political dangers of reining in growth than of the long-term problems of sustainability. The Foreword, written by John Major, the then Prime Minister, made it very clear that the intention was to attempt to be all things to all men:

150 states committed themselves at the Rio conference to make future development sustainable – not to turn their backs on growth – but to ensure that the price of growth did not become an intolerable bill for future generations.

This was to become a common theme that actions to promote sustainability and climate change need not restrict growth, a theme reiterated by successive governments and articulated and expanded at length 12 years later in Stern's 'Review of the Economics of Climate Change' – not, it will be noticed, the 'Economics of Sustainability' but 'Climate Change': by 2006, 'sustainability' had been politically morphed into 'climate change'.

John Major's Foreword carried another message that was to repeat itself:

The Agenda 21 was not just for government but for business, for organisations and for individual men and women.

A flag that the government intended to lead from the back, responding to public concern rather than setting a clear agenda for itself.

The Minister for the Environment, John Gummer, wrote an introduction with a completely different tone and intent, pointing out:

that man lived on earth as a conqueror, dominating, controlling and exploiting the natural environment and that this could not go on without irretrievable damage since effects we could ignore when they were confined to the actions of a few, became intolerable when they were spread more and more widely.

He was also at pains to point out the effectiveness of the Clean Air Act (1956), hinting at the distinction between this decisive and effective legislation, an example of a government governing rather than establishing a camouflage net of committees and advisory groups.

*Sustainable Development: The UK Strategy* provoked a cloud of objectives and policies. Those for development were concerned in the main with satisfying the demand for new housing:

- promote attractive and convenient extensions to urban areas;
- in locations which minimise energy consumption;
- encourage brownland development;
- sustain the rural environment;
- engage developers.

And those for transport:

- influence the rate of traffic growth;
- provide a framework for individual choice in transport which enables environmental objectives to be met;
- increase the economic efficiency of transport decisions;
- improve vehicle design to minimise harmful emissions.

In the UK, as in many other countries, Agenda 21 appeared as ‘Local Agenda 21’ (LA21) to be set and implemented by local councils adopting the above targets rather than by national legislation. Devising LA21 policies was encouraged and supervised by the Sustainable Development Commission, a company limited by guarantee and effectively a wholly owned, arm’s-length subsidiary agency of the British government. Although no doubt the Sustainable Development Commission would object to the suggestion that their arm’s-length agency status was a way of taking sustainability out of the direct responsibility of Her Majesty’s Government, there can be no doubt that it removed sustainability from the list of front-line political issues. The detachment of the Sustainable Development Commission from government was completed on 31 March 2011 when it was abolished, the related website dismantled and the documentation buried in the national archive.

In Britain the focus on pollution was emphasised by a second document published in 1994, this one by the Royal Commission on Environmental Pollution.<sup>3</sup> (The current political urgency of sustainability is indicated by the abolition of the Royal Commission on 1 April 2011, 24 hours after the Sustainable Development Commission was disbanded.) The objectives set by the Commission were to:

- ensure that an effective transport policy at all levels of government is integrated with land-use policy and gives priority to minimising the need for transport and increasing the proportion of trips made by environmentally less damaging modes;
- achieve standards of air quality that will prevent damage to human health and the environment;
- improve the quality of life, particularly in towns and cities, by reducing the dominance of cars and lorries and providing alternative means of access;
- increase the proportions of personal travel and freight transport by environmentally less damaging modes and to make best use of existing infrastructure;
- halt any loss of land to transport infrastructure in areas of conservation, cultural, scenic or amenity value unless the use of the land for that purpose has been shown to be the best practicable environmental option;
- reduce carbon dioxide emissions from transport;
- reduce substantially the demands which transport infrastructure and the vehicle industry place on non-renewable materials;
- reduce noise nuisance from transport.

In line with this general policy, LA21 set these explicit objectives for local councils:

- reducing fuel consumption;
- reducing the use of other finite resources;
- reducing the irreversible change in climate due to the emission of greenhouse gases;
- reducing other pollutions which cause long-term, irreversible damage;
- reducing the risks of damage to human health and quality of life;
- reducing the impacts upon natural and semi-natural habitats and upon areas of cultural and amenity value;
- promoting land-use patterns which depend for their viability on transport systems which will have one or more of the above effects.

Both of these lists, although ambitious, concentrated upon aims that may be delivered locally or nationally; they are local components of the global issue and much less politically contentious than dealing with global disparities in standards of living. That is not to say the lists were devoid of contention: today there is considerable scepticism about the nature, causes and relevance of climate change and about the impacts of policies designed to deal with them. Local councils lost their enthusiasm for LA21 policies, although many retained their concerns with rubbish, landfill and recycling: Brundtland had been diluted to less contentious, although still undeniably important issues. Despite sustainability and climate change being phased out of mainstream political concern, the issue is still an important one: Brundtland's stance is still appropriate and all the subsequent words, policies and postures, although now in the background, still have validity. Much of the content of this book is focused on just how the above two lists of objectives, taken directly from the Report on Transport and the Environment published by the Royal Commission on Environmental Pollution, might be delivered.

## The Kyoto Protocol

The Kyoto Protocol<sup>4</sup> was signed in December 1997 and was to come into force in February 2005. Although ambitious, it confirmed the selection of climate change as a more tractable abstraction from the broader concerns of Brundtland and of the Rio Protocol. It also relied on the principles of market forces, perhaps because price mechanisms were seen to be the best or even the only way of delivering global policy. Even then, it was ratified by only 37 countries and so was both narrower by subject and weaker in political drive than the Rio Protocol.

The Protocol was concerned with 'greenhouse gases' (GHG), those gases which are thought to cause global warming by preventing some of the energy received from the sun from being reflected back into space, causing the earth's atmosphere to heat up in exactly the same way as the inside of a greenhouse. There are a number of greenhouse gases, some occurring naturally such as carbon dioxide (CO<sub>2</sub>), and others which are by-products of industrial and other human activity. The total volume of greenhouse gas in the earth's atmosphere is rising due mainly to the burning of fossil

fuels to create energy, but partly because new, potent synthetic greenhouse gases have been added to the atmosphere, gases such as those escaping from air-conditioning and refrigeration units.

The Kyoto Protocol, in common with many other documents and reports, uses 'CO<sub>2</sub> equivalent' (CO<sub>2</sub>-e) as a measure of a mixture of greenhouse gases. This gives the number of grams of CO<sub>2</sub> which would have the same effect on solar irradiation, global warming and climate change as one gram of one of the other GHGs. Figure 1.1 shows the standard tariff of factors published by the British government.

The stated objective of the Kyoto Protocol was 'to promote sustainable development'<sup>5</sup> but the prime focus was actually to reduce the global emission of GHG, seen as a necessary, although incomplete, step towards a sustainable future. The protocol set out to achieve this by setting targets for the reduction of emissions of GHG by each country. These targets were in terms of a percentage reduction in CO<sub>2</sub>-e from a nominated base year.

| <i>Greenhouse gas (GHG)</i>    | <i>Chemical formula</i>                                            | <i>Factor to convert GHG to CO<sub>2</sub>-e (grams of CO<sub>2</sub> creating the same warming effect as 1 gram of GHG)</i> |
|--------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Carbon dioxide                 | CO <sub>2</sub>                                                    | 1                                                                                                                            |
| Methane                        | CH <sub>4</sub>                                                    | 21                                                                                                                           |
| Nitrous oxide                  | N <sub>2</sub> O                                                   | 310                                                                                                                          |
| HFC-23                         | CHF <sub>3</sub>                                                   | 11,700                                                                                                                       |
| HFC-32                         | CH <sub>2</sub> F <sub>2</sub>                                     | 650                                                                                                                          |
| HFC-41                         | CH <sub>3</sub> F                                                  | 150                                                                                                                          |
| HFC-125                        | CHF <sub>2</sub> CF <sub>3</sub>                                   | 2800                                                                                                                         |
| HFC-134                        | CHF <sub>2</sub> CHF <sub>2</sub>                                  | 1000                                                                                                                         |
| HFC-134a                       | CH <sub>2</sub> F <sub>2</sub> CF <sub>3</sub>                     | 1300                                                                                                                         |
| HFC-143                        | CH <sub>3</sub> CF <sub>3</sub>                                    | 300                                                                                                                          |
| HFC-143a                       | CH <sub>3</sub> CHF <sub>2</sub>                                   | 3800                                                                                                                         |
| HFC-152a                       | CF <sub>3</sub> CHF <sub>2</sub> CF <sub>3</sub>                   | 140                                                                                                                          |
| HFC-227ea                      | CF <sub>3</sub> CH <sub>2</sub> CF <sub>3</sub>                    | 2900                                                                                                                         |
| HFC-236fa                      | CHF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>                   | 6300                                                                                                                         |
| HFC-245fa                      | CH <sub>3</sub> CF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>    | 560                                                                                                                          |
| HFC-43-10mee                   | CF <sub>3</sub> CHFCH <sub>2</sub> CF <sub>2</sub> CF <sub>3</sub> | 1300                                                                                                                         |
| Perfluoromethane (PFC-14)      | CF <sub>4</sub>                                                    | 6500                                                                                                                         |
| Perfluoroethane (PFC-116)      | C <sub>2</sub> F <sub>6</sub>                                      | 9200                                                                                                                         |
| Perfluoropropane (PFC-218)     | C <sub>3</sub> F <sub>8</sub>                                      | 7000                                                                                                                         |
| Perfluorocyclobutane (PFC-318) | c-C <sub>4</sub> F <sub>8</sub>                                    | 8700                                                                                                                         |
| Perfluorobutane (PFC-3-1-10)   | C <sub>4</sub> F <sub>10</sub>                                     | 7000                                                                                                                         |
| Perfluoropentane (PFC-4-1-12)  | C <sub>5</sub> F <sub>12</sub>                                     | 7500                                                                                                                         |
| Perfluorohexane (PFC-5-1-14)   | C <sub>6</sub> F <sub>14</sub>                                     | 7400                                                                                                                         |
| Sulphur hexafluoride           | SF <sub>6</sub>                                                    | 23,900                                                                                                                       |

Figure 1.1 CO<sub>2</sub> equivalent (CO<sub>2</sub>-e) conversion factors

Source: Reproduced from Department for the Environment, Food and Rural Affairs (DEFRA) (2010).

Two policy strands were arranged to achieve this:

- 1 Each national government was to establish a raft of policies designed to reduce pollution by GHG emissions.
- 2 Market forces were to be mobilised imposing an additional cost upon firms emitting GHG: that cost was set by creating a nominal price per tonne of CO<sub>2</sub>-e.

Market force is an important mechanism to discuss since it reoccurs in a number of guises in transport policy-making, as a proposal to charge for using roads, as the underpinning principle in awarding franchises to operate trains, in providing bus services and in ‘the polluter pays’ policy.<sup>6</sup> The principles are discussed at more length in Chapter 18, ‘Tolls, taxes and tariffs: fares, fines and fees’ but for now it should be noted that there are wide differences between real markets, like those for cornflakes or overcoats, and a contrived market such as that developed at Kyoto for CO<sub>2</sub>-e. The official website of the United Nations Framework Convention on Climate Change (UNFCCC), the body under whose auspices the Kyoto Conference and Protocol were arranged, declared: ‘*Carbon – a new commodity is born.*’ In this case ‘carbon’ was being used as shorthand for ‘one tonne of CO<sub>2</sub>-e’, not the element carbon itself. The new ‘commodity’ born in the Kyoto protocol was actually a licence to emit one tonne of CO<sub>2</sub>-e, not the gas itself, a licence that firms could buy and sell. Such a licence is not ‘a commodity’, something that people would find useful and beneficial, like overcoats or cornflakes. This breaks two fundamental principles of a ‘market’. First, the function of price in a true market is to ensure near equilibrium between supply and demand, rising prices tending to choke off demand while simultaneously increasing supply, and falling prices tending to increase demand while reducing supply. The supply and price of licences to emit CO<sub>2</sub>-e by the tonne is fixed by a bureaucracy charged with the long-term aim of restricting pollution by reducing the number of certificates, not to respond to the market signal carried by changes in price. Second, the emission of a tonne of CO<sub>2</sub>-e is a disbenefit – it is an anti-commodity – a benefit to nobody. Polluting is a form of antisocial behaviour, and licensing antisocial behaviour seems to be a strange piece of legislation. Some years ago the smoke from domestic coal fires in Great Britain was seen to be harmful to public health, and Clean Air Zones were imposed by law in which coal fires were banned: the government of the day would have been justly criticised if they had auctioned off certificates legitimatising the smoky fires lit by those who could best afford to buy the necessary certificate.

Nevertheless, the Kyoto Agreement established the number of tonnes of GHG to be emitted by each of the countries signing the Protocol. This tonnage was arbitrary. Each country was then entitled to sell permissions to pollute to industrialists through a national ‘market’: the supply was initially fixed within the protocol and countries were obliged to progressively reduce the supply over time in order to creep towards the long-term objective of preventing the worsening of climate change due to GHGs: that mechanism is, of course, the complete opposite to the workings of a normal market. This suggests that carbon trading is not a market at all but is a method of rationing a finite, limited ability by selling it to the highest bidders. In times of great

shortage, such as food and petrol in the Second World War, it would have been inconceivable to sell petrol or food coupons to the highest bidder.

A 'carbon credit', namely a permit to emit one tonne of CO<sub>2</sub>-e, was priced at €17.12 on the European Union market at the end of March 2011 and was on the rise due to the problems with nuclear powered generating plants in Japan and the expected repercussions throughout the world: the need to generate electricity from burning fossil fuels was anticipated to drive up the demand for carbon credits.

This book argues that the Kyoto Protocol, together with many other objectives used by the British governments (among others), are little more than postured aspirations, since there are no technical methodologies to measure the effectiveness of policies and actions supposed to deliver them. Much of the following content points to the weakness or absence of measures to assess the potential and the actual effects of 'sustainable' policies and actions. To set aims and to then design policies to deliver those aims, without the means of assessing whether the aims have been delivered or not, is not so much a matter of poor management as a complete absence of management. Without sensing the potential outcomes of actions, decision-makers are working in the dark, driven by hope, by guesswork and, all too often, by an ideology based on a faith in the efficacy of market forces.

### **The shifting balance between government and business in delivering policy**

The gap between aspirations and the lack of ways in which policies and actions may be seen to deliver those aspirations, both before and after decisions are taken, is well illustrated by the British government's major policy statement on sustainability, *Securing the Future*.<sup>7</sup> This was thought to be important enough to have ranked a Foreword from the Prime Minister, Tony Blair, the final paragraph of which read:

We have spent a long time getting to grips with the concept of sustainability. I want to declare a moratorium on further words. I want this new strategy to be a catalyst for action to secure our future.

Sustainability is a global issue, demanding a global approach. There is a fundamental dichotomy behind creating a global approach, a dichotomy that appears in many issues and at many scales. It is usually characterised as the difference between 'top-down' and 'bottom-up' approaches but, more accurately, it is the distinction between composing a large-scale strategy by a combination of a number of smaller scale, often individual, decisions or, alternatively, applying an overarching large-scale decision to smaller scale component areas. One example is the difference between creating the budget for an organisation by simply combining the budgets of its component departments or, alternatively, setting the overall budget and then dividing it among the departments. A resolution of this conundrum is discussed in Chapter 3, on the definition of planning, in which it is argued that decisions should be made and progressively refined by oscillating between scales – between the 'top' and the 'bottom'.

The difficulty with global issues such as sustainability is that there is no global authority with the power to implement policy: there is no ‘top’. Therefore any strategy is perforce no more than the sum of the decisions and actions of individual states. The only readily available global process to convert policy into action is the market with individual behaviours being driven by price and cost rather than edict. This is in contrast to each national jurisdiction where market forces are modified by government creating and managing a currency, imposing taxes, making and enforcing law, in addition to itself taking action. In recent years there has been considerable debate about the extent to which state administrations should intervene in their local markets, but the debate has never extended into the possibility of interventions being made by a global administration. There is a body of international law but it is a compendium of bilateral and multilateral treaties rather than a body of law applying to every country and enforced by an international agency. This leaves market forces as the sole universal mechanism, a reliance which is clearly related to the now almost universally held belief, not only in the power of market forces, but in their ability to deliver the wisest of decisions.

A belief in the power of the market has come to dominate the world, gathering strength between the two World Wars and now suffusing nearly every culture and activity. There are two major components:

- 1 That decisions are best made by individual people and firms driven by their own self-interests. This is usually presented as individuals making ‘choices’ – ‘choice’ being an extremely important word in modern culture. This emphasis upon individual choices is supported by a theory that the sum of individual choices creates the best possible outcome: human behaviour is likened to that of bees and ants, and claims abound that modern electronic social networking facilitates wise individual decisions by providing a plethora of information.<sup>8</sup> It is as though twittering is able to replicate both the dance routines of bees and the pheromones of ants and, ultimately, to generate the sorts of political pressures achieved in storming the Bastille or the Winter Palace.
- 2 That choices are best presented and marshalled by price and market force.

These twin notions are threaded through modern sustainable and transport policy-making: they are the frame for this book. The implementation of British policy on sustainability, when stripped of the posturing and rhetoric, rests upon two propositions:

- 1 That individuals and firms should make their own decisions on whether to restrict their consumption of energy or recycle their waste, etc.
- 2 That the task of government is, first, to proclaim policy objectives and then to expect firms and individuals to make choices which, when taken together, will deliver those objectives. The myriad choices made by individuals and by firms is driven in the desired direction by adjusting the cost either by taxation to increase the cost of behaviours deemed to be undesirable (e.g. the tax on petrol), or by subsidy to reduce the cost of the choices which will serve to deliver the government’s set objectives (as with solar panels).

The government is effectively withdrawing from making difficult, accountable decisions and is constructing frameworks within which the decisions by firms and individuals will be merged into a desirable collective action. This disperses responsibility and accountability and has shifted the nature of government away from governing, often by edict, towards a more 'business-driven' approach in which policy is delivered by the hidden hand of price and cost; business style has invaded state administration to such an extent that the task of government is often referred to as the management of 'UK plc'.

That the combination of the manipulation of price and cost, together with competition between private companies is a universal way of creating efficient systems, is now so strong that it is almost impossible to gainsay it – questioning the power of market forces is virtual heresy. The other side of the same coin is the powerful belief that government and all its activities is inherently inefficient and undesirable and should be minimised.<sup>9</sup>

This was not always the case, and the shifting balances between a government style setting and enforcing law, and a business style assessing value by comparing cost and revenue, has been particularly strong in transport. Public transport by rail, tram and bus was originally established by private companies but the Victorians were troubled that competition might not deliver the most efficient systems – there was an implicit query as to whether the objectives of private companies were coincident with wider national interests. The fear of prices being set by monopolies led to the control of fares, tolls and freight rates by successive Acts of Parliament stretching right back to the Statute of Winchester (1285).<sup>10</sup> The legal concept of the King's Highway, mentioned *en passant* in the Statute of 1285, is of continuing importance:

[A] highway is a way over which there exists a public right of passage by all Her Majesty's subjects at all seasons of the year, freely and at their will to pass and repass without let<sup>11</sup> or hindrance.

'Let or hindrance' included the setting up of gates and the imposition of tolls: the right to pass and repass over the whole highway network free of tolls or charges has existed for over 700 years. It may only be varied by a very specific Act of Parliament<sup>12</sup> which not only enables the imposition of a toll but also fixes how much it should be.

The Victorians were also very concerned about safety and stringent rules, and procedures were imposed covering the structure and operation of vehicles. For example, the Tramways Act of 1870 (a Public Act) established the terms of individual Private Acts, each giving the right to a nominated private tramway company to construct tram tracks along specific public roads but only under the strict supervision of the local magistrates who had the power to license the trams and the operating staff, and also to set the fares. The Act also made it compulsory, after 20 years in the ownership of the tramway companies, for their tracks and cars to be offered for sale to the local council. The implicit assumption was that if there were to be a monopoly, then it would be best managed by local magistrates or councils in the public interest rather than a company in the interests of its shareholders. Factories, mines, railways and shipping were all heavily regulated and many city authorities themselves owned and operated gas,

electricity, water and sewerage systems, all utilities with a natural monopoly. None of these crucial urban infrastructures was initiated solely by private companies but they were driven by Victorian government at both local and national levels.

During the 1914 to 1918 War, the British government took the operation of the railways under its direct control, anticipating that private companies would not best serve the national interest and found that rivalry between companies had not created an efficient, profitable service. In consequence, over 120 private railway companies were forcibly amalgamated in 1921 into four major groups. This was not nationalisation: the assets of the railways remained private property but it was an acknowledgement that the objectives of private companies did not comfortably map on to the public interest. The preamble to the Railways Act (1921) made it quite clear:

With a view to the reorganisation and more efficient and economical working of the railway system of Great Britain railways shall be formed into groups in accordance with the provisions of this Act.

The concern that rivalry did not automatically deliver an efficient transport system was emphasised by the London Transport Act of 1933 which established the London Passenger Transport Board. The Act stated that the general duty of the Board was to:

[E]xercise their powers under this Act as to secure the provision of an adequate and properly coordinated system of passenger transport for the London Passenger Transport Area, *while avoiding the provision of unnecessary and wasteful competitive services* (emphasis added).

In the Second World War the major elements of the transport system were once again taken into state control, confirming the view that private businesses (even those established under the 1921 Act) were unlikely to meet the needs of a country at war. After the war, it was recognised that the railway system could not be profitable and the shares became almost worthless. The shareholders were put out of their misery by the whole system being taken into state ownership.

Transport history shows that transport (and much else) was facilitated by the state passing the necessary enabling and regulating legislation, with the subsequent control contrived by a sometimes complex combination of public and private ownership and management: today's emphasis upon the superiority of lightly regulated business rather than government to deliver transport services was not evident for much of the past.

Market forces have very considerable merits but they are not omnipotent, and their role in delivering sustainable transport, even in the simplified form of reducing climate change rather than the wider objectives set out in the Brundtland Report, is questionable. There are two massive stumbling-blocks:

- 1 Many of the qualities bound up in sustainability are not saleable commodities with a proper market to balance supply and demand through price.
- 2 Attempts to create a false market, such as that for carbon credits, are inherently ineffective and open to manipulation. The strength of market forces is to bring

demand and supply into equilibrium but the objective of sustainable policies is to reduce the harmful impacts of some particular human behaviours by edict, ration or taxation and to do so at minimal expense. There is no equilibrium to be struck unless, that is, the harmful impacts can be quite artificially ‘priced’ so that the cost of sustainable policies may be weighed against a nominal price of disbenefits such as poor health, flooding, droughts, crop failures and all the other prospective results of climate change. In addition, false markets tend to be ill disciplined and prone to fraud due to prices having to be set not by a properly functioning market but by administrators. Their manipulations are not always in the public interest. Recent (2012) evidence of the manipulation of energy and financial markets may not have been conclusively proven but it is, at the least, discomfiting.

*Securing the Future*, the then Government’s policy published in 2005, listed no fewer than 68 ‘Strategy Indicators’: a selection of them is shown in Figure 1.2. The indicators were measures of year-on-year changes to be detected as the presumed consequences of ‘Public Service Agreements’ (PSA): these were bundles of policies and actions to which various government departments had committed themselves (these ‘Agreements’ were abandoned, some in 2007 and the rest in 2010, evidence enough of their worth) but their existence for 10 years illuminates how the then government sought to address sustainability.

Although *Securing the Future*, the ‘Public Service Agreements’ and the ‘Strategy Indicators’ are all history, they represent a style of government that is still with us. It is a style borrowed from management theory, a subject developed in the 1970s with many schools of management established in universities and polytechnics, all offering Masters degrees in Business Administration (MBA) and hosting conferences and short courses, many sponsored by large firms. This work was supported by myriad publications: the National Library of Scotland catalogue has 5201 book titles with ‘management’ in them, the vast majority of which were published in the past 40 years.

This flood of departments, courses and books disseminated a style which seems to have two primary roots: first, the use of computers, especially, spreadsheets,<sup>13</sup> and, second, market theory, and the use of the price mechanism. Harvey<sup>14</sup> suggests that the emphasis on the use of price mechanisms (e.g. the carbon trading instituted in the Kyoto Protocol) was promulgated by the Mont Pelerin Society, including Milton Friedman and Friedrich von Hayek, the fathers of neoliberalism, with a commendable emphasis on ‘freedom’ but an emphasis taken to excess. Not only did they argue that the individual should be ‘free’, meaning subject to minimal restriction by law, but that this freedom should extend to ‘legal persons’ including all firms, even the global companies able to manage the markets in which they sit and also able to manage their own taxation.

The theory of management has focused on the use of spreadsheet numbers in management, very often the use of monetary measures such as profit or unit cost but also using numerical ranking and scoring. Such scoring and ranking, often dubbed ‘performance indices’ or, as in *Securing the Future*, ‘Strategy Indicators’, is frequently used to assess managerial performance: examples are the OFSTED assessments of

*UK government strategy indicators**Related Public Service Agreements (PSA) and other relevant policy statements*

**1 Greenhouse gas emissions:** Kyoto target and CO<sub>2</sub> emissions  
**2 CO<sub>2</sub> emissions by end user:** industry, domestic, transport (excluding international aviation)

**4 Renewable electricity:** renewable electricity generated as a percentage of total electricity  
**5 Electricity generation:** electricity generated, CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>2</sub> emissions by electricity generators and GDP

**6 Household energy use:** domestic CO<sub>2</sub> emissions and household consumption

**7 Road transport:** CO<sub>2</sub>, NO<sub>x</sub>, PM<sub>10</sub> emissions and GDP  
**8 Private vehicles:** CO<sub>2</sub> emissions and car-km and household final consumption expenditure  
**9 Road freight:** CO<sub>2</sub> emissions and tonne-km, tonnes and GDP

**24 Land use:** area used for agriculture, woodland, water or river, urban (contextual indicator)

**25 Land recycling:** (a) new dwellings built on previously developed land or through conversions; (b) all new development on previously developed land

**26 Dwelling density:** average density of new housing

**Defra PSA 2, DTI PSA 4, DfT PSA 8**  
 To reduce greenhouse gas emissions to 12.5% below 1990 levels in line with our Kyoto commitment and move towards a 20% reduction in carbon dioxide emissions below 1990 levels by 2010, through energy efficiency and renewables

**Defra PSA 2, DTI PSA 4**  
 To reduce greenhouse gas emissions to 12.5% below 1990 levels in line with our Kyoto commitment and move towards a 20% reduction in carbon dioxide emissions below 1990 levels by 2010, through measures including energy efficiency and renewables

**DTI White Paper: *Our Energy Future – Creating a Low Carbon Economy***

**DfT PSA 6, Defra PSA 8**  
 Improve air quality by meeting the Air Quality Strategy targets for carbon monoxide, lead, nitrogen dioxide particles, sulphur dioxide, benzene and butadiene

**DfT PSA 7, Defra PSA 2, DTI PSA 4**  
 To reduce greenhouse gas emissions to 12.5% below 1990 levels in line with our Kyoto commitment and move towards a 20% reduction in carbon dioxide emissions below 1990 levels by 2010, through measures including energy efficiency and renewables

**ODPM PSA 6**  
 The planning system to deliver sustainable development outcomes at national, regional and local levels through efficient and high-quality planning and development management processes, including through achievement of best value standards for planning by 2008

Figure 1.2 A selection of the 'strategy indicators'

Source: Department for the Environment, Food and Rural Affairs (DEFRA) (2005), ch. 7.

| <i>UK government strategy indicators</i>                                                                                     | <i>Related Public Service Agreements (PSA) and other relevant policy statements</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>32 Economic output:</b> gross domestic product                                                                            | <p><b>HMT PSA 1</b><br/>Demonstrate by 2008 progress on the government's long-term objective of raising the trend rate of growth over the economic cycle by at least meeting the Budget 2004 projection</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>33 Productivity:</b> UK output per worker                                                                                 | <p><b>HMT PSA 1</b><br/>Demonstrate by 2008 progress on the government's long-term objective of raising the trend rate of growth over the economic cycle by at least meeting the Budget 2004 projection</p> <p><b>DTI PSA 1, HMT PSA 4</b><br/>Demonstrate further progress by 2008 on the government's long-term objective of raising the rate of UK productivity growth over the economic cycle, improving competitiveness and narrowing the gap with our major industrial competitors</p> <p><b>DTI PSA 6</b><br/>Build an enterprise society in which small firms of all kinds thrive and achieve their potential, with an improvement in the overall productivity of small firms</p> <p><b>Defra PSA 4</b><br/>Reduce the gap in productivity between the least well-performing quartile of rural areas and the English median by 2008, demonstrating progress by 2006, and improve the accessibility of services for people in rural areas</p> <p><b>DCMS PSA 4</b><br/>By 2008, improve the productivity of the tourism, creative and leisure industries</p> |
| <b>36 Households and dwellings:</b> households, single-person households and dwelling stock (contextual indicator)           | <p><b>ODPM: Housing Policy Statement, The Way Forward for Housing</b></p> <p><b>ODPM PSA 5</b><br/>Achieve a better balance between housing availability and the demand for housing, including improving affordability, in all English regions while protecting valuable countryside around our towns, cities and in the Green Belt and the sustainability of towns and cities</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>55 Mobility:</b> (a) number of trips per person by mode; (b) distance travelled per person per year by broad trip purpose | <p><b>DfT PSA 3</b><br/>By 2010, increase the use of public transport (bus and light rail) by more than 12% in England compared with</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

Figure 1.2 Continued

| <i>UK government strategy indicators</i>                                                                                                                                                                           | <i>Related Public Service Agreements (PSA) and other relevant policy statements</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>56 Getting to school:</b> how children get to school</p> <p><b>57 Accessibility:</b> access to key services</p>                                                                                              | <p>2000 levels, with growth in every region</p> <p><b>DfT:</b> 'Walking and cycling: an action plan'</p> <p><b>ODPM PSA 4</b></p> <p>By 2008, improve the effectiveness and efficiency of local government in leading and delivering services to all communities</p> <p><b>Defra PSA 4</b></p> <p>Improve the accessibility of services for people in rural areas</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <p><b>58 Road traffic accidents:</b> number of people and children killed or seriously injured</p>                                                                                                                 | <p><b>DfT PSA 5</b></p> <p>Reduce the number of people killed or seriously injured in Great Britain in road accidents by 40% and the number of children killed or seriously injured by 50%, by 2010 compared with the average for 1994–98, tackling the significantly higher incidence in disadvantaged communities</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p><b>67 UK international assistance:</b> Net Official Development Assistance: (a) per cent of gross national income (comparison with selected countries); (b) per capita (comparison with selected countries)</p> | <p><b>DfID PSA 3</b></p> <p>Improved effectiveness of the multilateral system, as demonstrated by:</p> <ul style="list-style-type: none"> <li>• a greater impact of EC external programmes on poverty reduction and working for agreement to increase the proportion of EC official development assistance (ODA) to low-income countries from its 2000 baseline figure of 38% to 70% by 2008</li> <li>• ensuring that 90% of all eligible heavily indebted poor countries committed to poverty reduction that have reached decision point by end 2005 receive irrevocable debt relief by end 2008. Joint with HMT PSA 8</li> <li>• international partners working effectively with poor countries to make progress towards the United Nations 2015 Millennium Development Goals. Joint with HM Treasury</li> <li>• improved effectiveness of United Nations agencies and the humanitarian aid system</li> </ul> |
| <p><b>68 Well-being:</b> (well-being measures to be developed)</p>                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

Figure 1.2 Continued

schools, the counting of gifts of flowers, chocolates and of thank-you letters to nurses and the performance indices behind the payment of banking bonuses.

Two major spin-offs are apparent from such performance indices. First, the setting of 'targets', usually arbitrary values of a performance index which may be used to proclaim success. The second is equally pernicious: the development of computer models to predict and even manipulate future performance indices.

Targets in practice are particularly vulnerable to manipulation. Railway operating companies are set targets for the number of trains that arrive on time but the data are notoriously and blatantly fixed. Arrival times at intermediate stations are discounted entirely, so a train may be late at every station along its route but still be scored as 'on time' because it is not late in arriving at the final destination: to help achieve this, trains are calculated to have arrived 'on time' if they terminate within five minutes of the scheduled time and, to provide a little extra comfort, timetables often provide extra time along the final leg of the route. The setting of any target will inevitably cause managers to identify ways in which the data may be manipulated to achieve a good score. When this is done the effect of target setting is not what was intended and targets may have a reverse effect.<sup>15</sup>

The second spin-off is the use of computer models to forecast future performance by the use of:

Pseudo-mathematical formulae providing models of behaviour that never quite fit what actually happens, in a way which resembles the physical sciences gone wrong: instead of equations describing reality, equations are used which describe ideal conditions and a theoretical reality of a type which never occurs in practice. Many disciplines suffer badly from envy of the physical sciences, of a world in which  $f = mv$  means exactly what it says: academic economics has a particular case of physics-envy. Assumptions of rationally modelled behaviour are a big part of this wrong turn.<sup>16</sup>

## Conclusion

The burden of this chapter is that the basic concept of sustainability is simple and the definition proposed in the Brundtland Report is succinct and clear:

Ensuring that development meets the needs of the present without compromising the ability of future generations to meet their own needs.

However, it is a global objective, and there is no effective global authority providing the necessary leadership and initiative to drive the global policies necessary to reach this objective. Consequently, policy and its implementation must be left to national governments either acting alone or in consortia bound by agreement. The consortia may be broadly based, as with the European Union, or specific, as with Rio and Kyoto. In any event, the task is substantial and the means of addressing it limited, not by technology but by the confused political will. A combination of unwillingness and inability has led governments to resort to two levers:

- 1 market forces using prices and costs which are manipulated by taxation or set by a bureaucracy;
- 2 management theory based on scoring, targets and performance indices.

Given the limitations of these levers in setting and delivering objectives which have no true market value, the definition of sustainability has been made more deliverable by rendering it down to climate change, and within that, to the management of greenhouse gases.

So far as transport is concerned, the amount of GHG is largely a function of the energy used. In the main this is the petrol and diesel burnt in internal combustion engines but there is some consumption of electricity sourced from nuclear or renewable sources. Otherwise the energy comes from burning fossil fuel. This suggests the possibility of using the reduction in energy use as an acceptable objective, not only in its own right but also as a proxy for other objectives. For example, if the reduction of the conversion of land from agricultural to urban use is to be an objective, as has been identified in a number of past reports and policies, then if the measures taken to do that are successful, it will result in mean journey length being held in check which will partially stem the increases in vehicle kilometres which will, in turn, cut energy consumption. The relationship is a chain of rather indeterminate consequences but using fuel consumption as an indicator of the effectiveness of overall policy does seem to be a viable objective.

It is therefore suggested that the minimisation of the total transport fuel burn should be the inclusive objective of the efficacy of sustainable policy in the diluted form as it now stands, rather than the full Brundtland definition.

## Notes

- 1 World Commission on Environment and Development (1987, p. 8). This report is usually referred to as the Brundtland Report, named after the Commission's Chairman.
- 2 HM Government (1994).
- 3 Royal Commission on Environmental Pollution (1994).
- 4 United Nations (1998).
- 5 United Nations (1998), *Article 2*.
- 6 See e.g. Department of Transport (1994), Para 1.11.
- 7 Department for the Environment, Food and Rural Affairs (DEFRA) (2005).
- 8 As an introduction to a considerable literature, see Surowiecki (2004); Lal (2006); Leadbeater (2009); and, for absolute prejudice, Goldberg (2007).
- 9 The nature and source of these ideas are explained in Harvey (2005).
- 10 Webb and Webb (1913).
- 11 *Oxford English Dictionary*: Old English 'let' meant to hinder or prevent.
- 12 Since 1797 British Acts of Parliament have been divided into Public General Acts which apply to everybody, everywhere, and Private Acts which apply only in specified circumstances: they are therefore commonly used to waive the prohibitions of Public Acts in particular circumstances. The King's Highway, defined before Parliament even existed, works as if it were a General Act capable of being waived by a Private Act (to legitimise a toll bridge, for example).
- 13 The most popular of the original spreadsheets, LOTUS 1-2-3, precursor of Microsoft's Excel, was published in 1983.

- 14 Harvey (2005).
- 15 Witness the famous example of a target maximum time for hospital emergency admissions to be left on trolleys before being moved to a proper bed. Managers took the wheels off the trolleys and called them beds.
- 16 Lanchester (2010, p. 117).

## Chapter 2

---

# The definitions

## Transport

---

The *Oxford English Dictionary* offers a very restrictive definition of ‘transport’:

To take or carry (people or goods) from one place to another by means of a vehicle, aircraft, or ship.

This definition is restricted in two undesirable ways:

- 1 Walking, the fundamental means of transport, would be excluded if movement were confined to mechanical means of transport, be they vehicles, aircraft or ships. Although escalators, conveyor belts, lifts and a panoply of mechanical handling equipment are not seen as ‘vehicles’, they transport people and goods for important, if not lengthy, distances. Transport should be defined to include all movement by all means.
- 2 The definition should not be restricted to the movement of people or goods. In Victorian times the source of domestic energy was carried by train and coal carts but is now brought to most homes by gas pipes and electricity cables: an obvious means of transport has been replaced by the less obvious. Similarly, most information now surges electronically through a global web of wires and cables, leaving a minority to be carried from place to place by messengers, postmen and commercial travellers. The definition of transport therefore needs to include the movement of:
  - people;
  - commodities (including raw materials, part-finished goods and liquids);
  - information;
  - energy;
  - waste.

The essence of transport is movement to a more desirable location.

### The transport system

The transport system enabling this desirable movement is a collection of networks, vehicles and hardware all working in some sort of concert. The component networks are combinations of:

- Tracks, including footpaths, pipes, wires, air- and sea-ways as well as roads and railways.
- Vehicles, including anything with wheels.
- Interfaces between one method of transport and another.
- Power supplies, including on-board energy sources and their replenishment as well as external sources linked to vehicles by cable.
- Control systems, both formal (air-traffic control, railway signalling, mandatory traffic controls) and informal (conventions and ‘rules of the road’).
- Systems of ownership, regulation and management.
- Mechanical handling equipment, including escalators, cranes, conveyors, fork-lifts, even wheelbarrows.
- Hardware enabling commodities to be bundled into unit loads so they may be handled more efficiently. These include:
  - Pallets: small, simple platforms roughly a metre square, often made of wood, which may be loaded with goods and which are designed to be lifted by fork-lift trucks. Pallets are not stackable because the upper loaded pallets would weigh directly upon the loads below.
  - Stillages: small, sturdy metal cages with four legs, the feet of which are designed to make them stackable. Stillages must be moved and stacked by fork-lift trucks.
  - Cages: these are wheeled so may not be stacked but they may be pushed by hand or towed in trains by a small tractor.
  - Crates: usually small and light enough to be lifted and carried by hand when filled. Stackable and often designed for particular products as with beer crates.
  - Boxes and cartons: boxes are strong enough to be stacked but not very high.
  - Drums, barrels, etc.: to hold liquids. May be rolled but more usually are moved by fork-lift truck.
  - Containers: this used to be a generic term but it now means a large metal box designed to be stacked on-board container ships. Containers have to be extremely strong because at sea the sometimes violent movement causes a loaded container to exert considerable dynamic force upon those underneath it. Containers are consequently very heavy, even when empty. This makes them comparatively inefficient when being carried on land.

It is useful to view many freight consignments as a sort of Russian doll structure: inside an international container there may be a number of pallets. Shrink wrapped on to each pallet may be a number of boxes; each box may contain a number of cartons; each of the cartons may contain a number of similar commodity items. Therefore any unit load may well be an amalgamation of sub-units. Shippers go to the expense of creating unit loads from sub-units just in order to make physical handling, checking and accounting easier: this advantage is particularly apparent if mechanical handling equipment is deliberately matched with the size, shape and weight of the unit loads it has to handle.

This list of network components is complex but the complexity is necessary. In

Chapter 1 it was argued that the minimisation of the energy used in transport and of the consequent CO<sub>2</sub> was the touchstone of a sustainable transport policy: reaching this objective depends upon an understanding of the complexities of the transport system. As a demonstration, it is often argued that a major step towards sustainability would be a policy to switch freight from road to rail, a suggestion driven primarily by the known lower costs and pollutions per tonne-kilometre for freight on rail rather than on road. Two levels of complexity throw doubt upon this policy as a general proposition:

- 1 The vast majority of freight consignments are moved between locations which cannot be directly served by rail, presenting a stark choice between:
  - either*
  - loading the consignment on to a lorry;
  - hauling it for the entire movement from origin address to the destination;
  - unloading;
  - or*
  - loading the consignment on to a lorry;
  - hauling to a railhead;
  - trans-shipping on to a rail wagon;
  - hauling the wagon to another railhead;
  - trans-shipping on to another lorry;
  - hauling to the destination;
  - unloading.
- 2 The second level of complexity lies in the nature of the trans-shipments from lorry to railway wagon. At its simplest, this may just be a matter of manhandling:
  - a labourer has to lift one unit load from within the overall consignment;
  - it has to be carried the relatively short distance from lorry to wagon;
  - placing it in the railway wagon;
  - the labourer has to return to the lorry.

The time taken between lifting one unit and the next is called the cycle time and this determines the productivity of the labourer and so the cost of the trans-shipment. Even so, the productivity depends upon the consignment being in an easily handled form: labourers are able to work all day lifting about 50 kg and nearly all societies have a unit of weight at about this size (the Imperial, pre-metric unit was a hundredweight (cwt = 112 lb = 50.8 kg): sacks and bags of many products commonly conformed to this weight).

It may be possible to reduce the cost of trans-shipment through slick, efficient handling but that depends upon the use of effective handling equipment and compatible unit loads, such as a combination of pallets and fork-lift trucks. If this is to be done, loads have to be unitised at the very beginning of the journey. Handling equipment costs money to acquire and operate, costs which must be spread over the loads handled. The additional cost will depend upon the total throughput – high and consistent volumes will justify the purchase of specialist handling equipment and will minimise the handling cost per unit shifted.

There are two conclusions which are important as generalisations:

- 1 The costs per metre shifted over the micro-distances covered in loading, unloading and handling are far greater than the haulage costs over the major stages of the journey and may well be the tipping factor in the choice of transport. For example, the cost of moving a sea-going container from the dockside on to a ship is approximately the same as that container being carried 5000 kilometres at sea.
- 2 An entire end-to-end movement is composed of a chained sequence of handling and of haulage but the handling itself also consists of mini-sequences of lifting, movement and placing. The entire end-to-end sequence and its component mini-sequences are inherently complex, and any transport policy, sustainable or not, must take this into account.

This subtle complication was demonstrated by some research into the possible development of the south side of the Humber estuary.<sup>1</sup> A factory making agricultural fertiliser used a granular raw material imported through the Port of Immingham, just 8 kilometres away. Power for the factory came from an on-site plant burning coal brought in from the Yorkshire coalfield, about 120 kilometres to the West. To the researchers' surprise, the granular raw material was moved the 8 kilometres from the dock to the factory by rail and the coal was hauled 120 kilometres by lorry. This was in direct contradiction to theory, which suggested that the low cost per tonne-kilometre by rail would make it the natural choice for the coal's long journey but the savings per tonne-kilometre by rail over lorry for the short distance from dock to factory would be insufficient to offset the costs of loading and then unloading the railway wagons. It transpired that the comparative haulage costs by road and rail were irrelevant: the crucial difference was in handling costs. The imported granular material could be craned out of a ship's hold and dropped into a hopper poised over the railway track. Railway wagons could then be loaded by gravity – the cheapest form of energy. Gravity was also used to unload the trucks; they were shunted over a pit and the doors in the bottom of the truck were opened and the granules fell into a chute feeding a conveyor belt.

The coal was quite different. The throughput was not sufficient to warrant anything more than a stockyard surrounded by a concrete wall within which the coal was stored as an extensive, flat heap about 2 metres high. It could then be retrieved as required by a modest, tractor-mounted shovel. This arrangement meant that each 20-tonne load of coal arriving from Yorkshire had to be delivered to a point 3 or 4 metres from the previous delivery. That could be done easily by eight-wheeled tipper lorry but not by railway wagon. It would have been possible for wagons to deliver their loads by gravity at a specific point as was done with the imported granules and, with some additional equipment, their loads could be pushed out to pile up along the flanks of the railway track, but it was impossible to deliver the coal by rail to the stockyard, each wagon-load just 3 or 4 metres from the previous one. That fact alone made the choice of tipper lorry rather than train inevitable. The case was a parable showing why transport policy cannot be based upon simplistic analysis of the comparative costs of movement over the major haul distances: the micro-distances involved in handling are very significant, and sometimes commanding.

## Transport ‘modes’

In the transport literature there is an almost universal distinction between ‘modes’ of transport: for example, the National Transport Model divides personal travel into journeys by car drivers, car passengers, rail, bus, walking and cycling,<sup>2</sup> distinctions that are both confusing and crude for three major reasons:

- 1 It confuses between tracks and vehicles: railways are a combination of specialist vehicles and very particular tracks, a combination that is clear and almost justifies rail being called a ‘mode’. Nonetheless, a confusion remains between passenger and freight trains, each requiring different terminals and operating conditions, problems which may be solved by creating specialist lines: metro systems and the French TGV carry passengers only but the great majority of the North American railways are freight only.
- 2 Roads are a network of tracks with pedestrians and cyclists threading their way through a complex mixture of freight and passenger vehicles of very different performances. Some road capacity is lost to parked and stopped vehicles and to road-works accessing the sub-surface pipes and wires. Overall there is little definitive linkage between the track and the vehicles or between traffic and the people and commodities being moved. Hence neither the road network nor the flow of traffic on it may sensibly be seen as a ‘mode’. The melange of different activities makes it difficult to separate them out, in turn making it very difficult to reach logical and effective decisions about how to manage the road network: the bickering about the need for bus lanes is an example.
- 3 The distinction between modes is not only confused but also crude. The National Transport Model and the official statistics use these definitions:
  - *Trip*: a one-way course of travel with a single main purpose.
  - *Mode and main mode*: trips may include more than one mode of transport, and each mode is recorded as a stage within that trip. When ‘main’ mode is used in the title of a table or chart this allocates information for the whole trip to the stage used for the greatest length (in distance) of the trip. When ‘mode’ is used this refers to information for individual stages of trips.

In fact most of the data in the National Travel Survey are for trips by ‘main’ mode, the mode used for the longest segment of the journey: the remainder of the journey is ignored.

Assigning a journey to the ‘main’ mode has led to the crude fiction that people make travel choices based solely upon the relative qualities of the available modes for the lengthiest, ‘major’ part of the trip, ignoring all the other aspects of the journey. This is completely at odds with the way in which people actually use the transport system. With the two exceptions of trips undertaken entirely by foot and by taxi, no trips are made end-to-end by a single mode: even car trips require an element of walking from a parking place to the destination. As a minimum, public transport trips involve a walk to a bus-stop or station and another walk to the destination. Contrary to the official statistics, nobody, but nobody, travels anywhere solely by bus – to do

so, one would have to live at one bus-stop and work, shop and go to school at others. When planning or making journeys people have to consider the relative merits of alternatives which are all strings of segments including walking, interchanging, waiting and/or finding, capturing and retaining a parking space. People have to assess the risks of congestion and delay, how to cope with baggage, children and buggies, how to make sense of timetables, fares and booking, where to find somewhere to padlock a bike, or buy refreshments. The actual driving or riding along the 'main' mode is the easy part, just as sitting in an aircraft, not knowing or caring exactly where you are, is a relief after having to cope with checking in, departure boards and so on.

This official fiction that choices are made between 'main' modes on the simple criterion that one 'main' mode is better than another runs deep: the government's sustainable transport policies are based on promoting 'smart choices' between using public transport rather than a car as the 'main' mode.<sup>3</sup> Chapter 19 discusses the computerised models based upon this premise, models which predict travel demand and so influence policy decisions. For the time being, a short reflection upon how one's own personal travel choices are made will make it obvious that anticipated walking and waiting times within a complete end-to-end trip weigh heavily upon travel choices. One's own perceptions of entire end-to-end journeys influence the choice of destination as well as how to get there. The commercial success of the major supermarket chains rests upon easy parking to attract business away from shops where parking is difficult. Our personal choices clearly include parking problems and getting our shopping home, not just the balance between the actual journey by car or by bus. In general, the ease of travel on the 'main' mode itself is one contributory element in travel decisions but it is far from decisive.

Interfaces at which movements switch between one means of transport and another are a crucial part of any transport system. If the transport system is seen as a collection of 'main' modes there is an inevitable tendency to overlook the interfaces at which one mode inter-connects with another. This then fails to recognise the crucial importance of the delays and difficulties of interchanging as a powerful determinant of travel choices.

## **Inter-modal and multi-modal movement**

It is very common for freight movements to involve trans-shipments: much of global production relies on international, sea-going containers to move semi-finished and finished products around the world. The containers and the matching handling equipment are designed to reduce trans-shipment costs between the ship and the landward transport of road, rail and inland waterway. This use of containers as a unit load common to more than one journey segment is termed 'inter-modal transport' and is characterised by the use of more than one 'mode' to move freight along the complete journey from start to finish, including the handling at trans-shipments by using containers with standard dimensions and handling characteristics to minimise handling costs. The fundamental characteristic of inter-modal freight is that the modes are complementary rather than competitive.

This very obvious, sensible idea of movement by combinations of mode has failed to take root in passenger transport theory. The basic problem has been quite obvious for over 40 years (Chapter 19 identifies 1968 as the date when it became apparent). Perversely, the passenger transport system is perceived as a set of self-contained, semi-autonomous rail, bus and road sub-systems, all mutually competitive, rather than complementary. A search of the Department for Transport website or a trawl of their publications over the past five decades will show document after document focused upon the problems and policies of particular modes. In 1998 the then government published what was intended to be a pivotal White Paper on transport policy: *A New Deal for Transport: Better for Everyone*.<sup>4</sup> It was supported by a string of 'Daughter Documents' on buses, walking, railways, ports and pedestrians, one for each of the individual 'modes'.

The failure to understand that the transport system is seen by its users as a single entity composed of complementary modes is due to inertia among the professionals responsible for creating the methodology used to predict personal travel. They have failed to see that all movement, not just freight movement, is 'inter-modal'. Personal travel is called 'multi-modal' rather than 'inter-modal', indicating that travel choices are perceived to be made between multiple competitive 'main' modes rather than combining modes into end-to-end journeys. This has been disastrous since the mistaken prediction of the amount of personal travel and of the conditions and subsequent costs of that travel has been driving transport policy and investment, resulting in poor decision-making and creating difficulties in addressing sustainability or any other coherent policy. For a while, politicians talked about 'joined-up policy-making' but there is no methodology by which this may be achieved.

## Transport rhythms

All methods of transport have implicit rhythms, the combination of frequency and load size. This concept may be demonstrated using the example of shifting freight from road to rail. Let us assume a traffic consists of standard-sized pallets loaded with cartons which are stabilised on the pallet by shrink-wrapped polythene sheeting. They are taken from a warehouse by a single fork-lift truck and loaded on to a lorry with a floor area able to take 26 pallets. Let us assume it takes an average of two minutes for the fork-lift truck to locate the next pallet, lift it, take it to the lorry and place it, and then another 30 seconds to return: that gives a cycle time of 2.5 minutes. It will take  $26 \times 2.5 = 65$  minutes to load the lorry.

Now let us presume it is a 50 km drive to the railhead and the lorry can achieve an average speed of 40 km/h. That gives a drive time of 75 minutes in both directions. We will also assume it takes another 65 minutes to transfer all 26 pallets to a rail wagon. The cycle time of the lorry is 65 minutes' loading time + 75 minutes' drive time + 65 minutes to unload + 75 minutes' return drive time = 280 minutes. If there are 60 pallets per rail wagon and 10 wagons, that is 600 pallets per train load. It will take 23 return journeys by the lorry to fill the train and that will take a total of 6440 minutes or 4.5 days. The three rhythms are shown in Figure 2.1.

Of course these rhythms are merely the product of the assumptions and if the assumptions had been different, so would the rhythms. However, irrespective of the

| <i>Method</i> | <i>Load (pallets)</i> | <i>Frequency</i>         |
|---------------|-----------------------|--------------------------|
| Fork-lift     | 1                     | 1 load every 2.5 minutes |
| Lorry         | 26                    | 1 load every 280 minutes |
| Train         | 600                   | 1 load every 4.5 days    |

*Figure 2.1 Transport rhythms in a hypothetical freight case*

precise arithmetic, there are three important generalisations common to any set of assumptions:

- 1 The throughput is the same by all methods – in the above contrived example, all three methods carry 600 pallets in 4.5 days, the train in just one movement, the lorry in 23 return trips and the fork-lift truck in 600 separate movements.
- 2 All methods of transport have a rhythm: some, such as conveyors and escalators, run continuously and carry small incremental loads; others, like lifts and cars, run intermittently but frequently, carrying quite small loads, and still others, like trains, aircraft and ships, run infrequently but with large loads.
- 3 Wherever there is an interface between two methods of transport there is inevitable waiting – this is not evidence of inefficiency but an unavoidable consequence of disparate rhythms. In the above example, the fork-lift truck moves one pallet every 2.5 minutes' cycle time. The other 25 pallets which make up the lorry-load have to wait. As the loading proceeds, the place in which the pallets are forced to wait will be progressively moved from the warehouse to the lorry. The lorry itself will have to wait for the entire 65 minutes it takes to load it. Meanwhile the entire train of 10 wagons is doing nothing, waiting to be loaded: it will wait for 4.5 days.

For the journey from warehouse to train each pallet will be on the move, either by fork-lift truck or by lorry, for just 77 minutes: that is just over 1 per cent of the total time it takes to load the train – for 98.8 per cent of the time pallets will be unmoved, waiting to be loaded.

Goods in transit cost money: they are owned by somebody, having been bought or manufactured at some expense. They represent a capital investment using money borrowed from shareholders or lenders who will expect a return on their investment. The waiting time is therefore costly and the higher the value of the goods the more costly waiting time becomes. It is a truism that the speed of movement and the minimisation of waiting time is increasingly important as the value of consignments increases. In the above example, if the pallets were loaded with computers, the 4.5 days' transit time would be damning, but tins of chopped tomatoes could dawdle without crippling expense.

This problem of the inherent delay at interfaces between disparate rhythms affects passenger travel as well as freight. People walk to bus-stops and arrive in an intermittent dribble but the bus takes them away en masse. Consequently, bus-stops, a numerous but comparatively minor component of the transport system, are interfaces

at which some waiting is inevitable. That waiting may be extended if the service is infrequent or unreliable – the rhythm of the buses is either slowed down or disrupted. The impact of the wait is commonly mitigated by providing a shelter, and the opportunity is often taken to combine this with advertising. This is taken one stage further at railway stations and airports in which more people spend more time: there, shops and cafés to soak up waiting times have become common.

As with freight handling, some interchanges are so complex and busy that micro-modes and micro-movements became important. Escalators, travelators and lifts all have their own intrinsic rhythms and associated interfaces: ancillary hardware in the form of trolleys and small electric vehicles for mobility-impaired people are often provided. At airports there are shuttles serving parking places and, at some airports, mobile lounges to serve the aircraft. The interface relies on passenger-handling equipment not dissimilar to the freight-handling equipment in inter-modal freight.

Interfaces between rhythms, coupled with the associated waiting and micro-movements, can be even more complex. In some instances the rhythms are so disparate that very extended waits are unavoidable. For passengers this is soaked up in hotels: airports have numerous related hotels and in the railway era all the mainline stations had an associated hotel – railway companies used to build and operate them. Even small railway stations often had a nearby pub called The Railway Arms or The Station Inn, reflecting the fact that waiting time was expected when changing from the pedestrian to the railway rhythm.

For freight, the disparate rhythms were accommodated in warehousing, goods sheds, etc. Ports with goods arriving and departing by ship with their inherent very slow, steady rhythms out of step with the quicker, shallower, landward rhythms of train, cart or lorry, needed massive floor space for warehousing.

Both hotels and warehousing, acting as the necessary buffer stores between rhythms, need still more micro-movements from the incoming method of transport into store and out again. For passengers this is usually by hotel shuttle, although in some places it is by travelator or a short walk. For freight it is an extra handling micro-segment. These hotels and warehouses acting as buffer stores are elements in the cost of movement and they are therefore an element in the overall transport system.

As the above example of an inter-modal traffic by lorry and train shows, long waits are not confined to the passengers and goods-in-transit. The handling equipment and vehicles themselves have periods of idleness forced upon them. For over four days the railway wagons are part-filled, waiting for the remainder of the load. The same is true of the lorry; it sits there being progressively loaded for a total of 23 times 65 minutes = 25 hours and another 25 hours being unloaded: that is, 46 per cent of the total lorry time spent on the task. (Again, the crucial point is not the seemingly exact figure of 46 per cent but the principle that loading and unloading creates significant lorry waiting time.)

Sometimes the waiting time during which goods are stacked in stationary vehicles can be deliberately extended, using the vehicles as small warehouses. Retaining a vehicle to be used as storage attracts an additional charge called demurrage. In today's cost-conscious world vehicles are turned around as quickly as possible to avoid demurrage but on the pre-Beeching railways it was common. Domestic coal was

delivered by coal wagons to stations and held in the wagons for days, sometimes weeks, while the coal was gradually bagged and delivered. Clemens (2007) mentions the single weekly wagon from Nottingham to Lyme Regis carrying the stock replenishment for the Boots store there: much of the load was left in the wagon to be taken to the shop as and when the shelves needed refilling, something that must have been quite common for many small branch shops.

There is one final twist in the story of the interfaces between different rhythms. Before containers and unitisation came to dominate international freight transport, the break in rhythm was called a 'break of bulk', the place at which large but not necessarily homogeneous loads were broken down into smaller loads compatible with landward transport. Typically, then as now, manufacturing is best managed as a continuous process but the inputs of raw materials and components are delivered in surges, creating the need for operational storage to smooth out the intermittent deliveries into the continuous needs of production. Similarly, the continuous output cannot be delivered to customers in an unremitting, continuous trickle but has to be temporarily stored before being delivered in surges. Operational storage is an inherent part of all manufacturing.

It made sense to combine the operational storage needed to smooth manufacturing and the buffer storage needed to marry up the differing transport rhythms: then handling and the goods held in store could both be reduced. It thus made sense for many manufacturing plants to be sited in or near transport interchanges: the most obvious was 'port-related' industries in which flour mills, sugar refineries, etc. were set up in or near ports. The trend is less obvious now but it is still there: much of the electronics industry is sited near airports since their high-value goods need minimal transit times and are commonly air-freighted.

The historical patterns of land use, of industry and of transport interchanges were intertwined. Many towns and their trade were sited at points where trans-shipment was cheapest and easiest, not just at ports but at road bridges at the heads of the navigation of rivers, for example. It was common to site warehouses at such points in which to store goods as one rhythm melded into another. Today, the lower disparities of rhythm associated with consignments by lorry being so much smaller than by trainload, interchange warehousing is more related to the logistics centres sited at or near motorway junctions. The issue is presented in more detail in Chapter 8.

## Notes

- 1 Harris *et al.* (1966).
- 2 Department for Transport (2009).
- 3 Cairns, Goodwin *et al.* (2004).
- 4 Department for the Environment, Transport and the Regions (1998).

# The definitions

## Planning

---

The *Oxford English Dictionary* offers two definitions of the word ‘plan’:

- 1 *A large-scale, detailed map of a small area.* In common perception this is often a drawing of the layout of an existing building or, more commonly, a proposed development, perhaps just one building or, more likely, a larger area. The area may be quite complex; for example, the line of a proposed road.
- 2 *A scheme for accomplishing a purpose proposed.* This is essentially a list of actions which, when completed, will achieve a defined purpose.

These two definitions, although quite different, one a drawing and the other a series of actions, are clearly related. The drawing of a proposed development encapsulates the purpose of the plan and implies a set of actions, digging the foundations, building the walls, etc., which will accomplish that purpose.

The nub of planning of any sort, be it planning a town, planning one’s own career or planning the economy, is the definition of purpose: without clearly defined objectives, the necessary actions cannot be sensibly arranged; nor can it be known whether the plan is being implemented effectively, or even at all.

The definition of objectives is absolutely crucial to effective planning: without them, actions are merely blind fumbles in an attempt to do something, no matter what, or, much more likely, to be seen to be doing something. This essentially purposeless action often has a hidden agenda: the real objective is for decision-makers to be seen to be active; moreover, the lack of an explicit, achievable objective has the very attractive, additional merit of hiding any failure to make a worthwhile difference – no explicit objectives, no sense of failure to meet them!

This rather cynical approach has already been hinted at in Chapter 1. The Brundtland Report set the sustainability agenda very widely, including an aspiration to address poverty by redistributing production and consumption rather than expanding it. But the subsequent Rio and Kyoto international conferences, while paying lip-service to the objective of global sustainability, actually redefined the problem by, first, making it a local rather than a global problem and then by massaging the broad Brundtland objectives down to an emphasis on the one issue of climate change and greenhouse gases. This effectively pushed the larger, thornier problems of the global inequalities of wealth and of the depletion of natural resources into the background.

Many people will argue that this selection of a component, tractable issue, rather than the less tractable problems of the global disparities of wealth, may have been undesirable but, nonetheless, inevitable: they will quote the dictum that ‘politics is the art of the possible’,<sup>1</sup> and that there is no sense in inviting failure by attempting the impossible, particularly no political sense, where so much now rests upon reputations and postures polished by press releases and the media.

## **Town and country planning**

In Britain, ‘planning’ is often used as a shorthand for ‘town and country planning’, a comprehensive, country-wide system of land-use planning created by the Town and Country Planning Act of 1947. The objectives were set out in a preceding White Paper and were breathtakingly ambitious:<sup>2</sup>

Provision for the right use of land in accordance with a considered policy, is an essential requirement of the Government’s programme of post-war reconstruction. New houses, whether of permanent or emergency construction; the new layout of areas devastated by enemy action or blighted by reason of age or bad living conditions; the new schools which will be required under the Education Bill now before Parliament; the balanced distribution of industry which the Government’s recently published proposals for maintaining active employment envisage; the requirements of sound nutrition and of a healthy, well-balanced agriculture; the preservation of land for national parks and forests; and the assurance to the people of enjoyment of the sea and countryside in times of leisure; a new and safer highway system better adapted to modern industrial and other needs; the proper provision of airfields – all these related parts of a single reconstruction programme involve the use of land, and it is essential that their various claims on land should be so harmonised as to ensure for the people of this country the greatest possible measure of individual well-being and national prosperity.

These aims were debated in Parliament while the Second World War was still raging and far from being won.<sup>3</sup> The White Paper and the consequent 1947 Act bore traces of past concerns over public health, housing, unemployment, social security, preservation and conservation, agriculture, transport and public welfare. This comprehensive approach had been prompted by the two major public traumas of the recent past: first, the economic privations of the 1930s, and second, the continuing World War of the 1940s. But the mood and style of the day had been caught three years earlier during Britain’s darkest hour: the issue of *Picture Post*<sup>4</sup> of 4 January 1941 was a blueprint for the Welfare State. The issue was quite remarkable: totalitarian governments reigned over the whole of Europe; every centimetre of the coastline from the north of Norway to the Pyrenees was held by the Nazis; the United States was aggressively neutral; Germany and Russia were bound together in a non-aggression pact; the British Army had been evacuated from Dunkirk leaving most of their armaments behind; and, although the Battle of Britain had been won and had put a

stop to daylight raids and the immediate threat of invasion, the night-time blitz continued. As this issue of *Picture Post* was being written, Bristol was reduced to a smoking ruin. Enemy bombers droned overhead at night and enemy submarines prowled British territorial waters. Britain was isolated and vulnerable. Despite all that, here was a popular magazine publishing a plan to be put into effect once the War had been won: it was audacious, defiant confidence.

Among sections in *Picture Post* on health, unemployment, education, agriculture, housing and leisure there was an article on town planning that listed objectives which were to appear, after some redrafting, in both the 1944 White Paper and, subsequently, the 1947 Act:

- everyone to live in cheerful, healthy conditions;
- slums to be demolished and replaced;
- civilise the industrial towns;
- plans to build housing, schools, hospitals, industry and transport.

*Picture Post* asserted that all this could not be achieved by haphazard, piecemeal actions but would have to be overseen by government. This is totally at odds with modern policy implementation which relies on a confusing mixture of budgets, initiatives, agencies and contracted private companies, but it was very understandable for its time. Wars of the devastating complexity of the Second World War cannot be waged, let alone won, by uncoordinated decision-making: to ask individuals to fight the Nazi threat in the hope that the sum of their decisions would be successful is a fanciful idea. Government was everywhere, directing industry; deciding who should be in the military and where the others should work; rationing food, clothing, fuel and raw materials; controlling the transport system and managing the 'War Effort'. Government was 'planning' and controlling the entire economy. Today's fight against global warming and pollution does not have the sense of urgency, nor the coherence driven by the pressing need for survival that dominated the 1940s.

This poses the question why that wartime intrusion into daily life was acceptable; why the restrictions upon personal and corporate freedoms did not spark widespread dissent. The answer is found not so much in the text of *Picture Post* as in the advertisements:

- 'Doubtless you already own a radio – make do with it for the time being. If you really need a new one you will be glad to know a few new instruments are trickling through but government contracts take precedence.'
- 'Food is a munition of war. Don't waste it.'
- 'Don't let coughs keep you off duty: take Kay's cough mixture.'
- 'Yesterday it was an office block: today a mass of rubble, but HP sauce is always the same.'

There was palpable sense of common purpose, some of it a simple, unthinking wish to survive, but much of it was a realisation that, if the country were to survive, society

had to work in concert, not in competition: ‘pulling one’s weight’ or ‘doing one’s bit’ was a constant personal concern. ‘Keep calm and carry on’ was more than a passing giggle; and, of course, such socially cohesive concerns were used to assess the behaviour of others.

The conclusion should be not just that ‘planning’ must have clear objectives but that those objectives need to be embraced by enough people to create a common purpose in delivering them. Therein lies a paradox: the emergence of a sense of ‘common purpose’ is not dependent exclusively upon coincident thinking by a significant number of individuals: it must be more than that. There must be a core agreement, not only about objectives, but about the actions needed to achieve those objectives and that concurrence will only gel given an element of leadership. A collection of like-minded individuals may provide the seed-bed for action but the cooperation and mutually supportive actions necessary to deliver such common aspirations must be orchestrated. In the Second World War there was a very clear common objective but the actions required to reach it were choreographed and articulated by leaders such as Churchill, Eisenhower and members of the government, Parliament and the military.

This adds a further crucial component to a planning process: there must be a system to define and then implement objectives. The 1947 Town and Country Planning Act did this by creating mechanisms which are still in use today, although, after some modification, not all of it constructive:

- Those wishing to ‘develop’ land had to obtain planning permission from the local planning authority (the local council). ‘Development’ was comprehensively defined as:

The carrying out of building, engineering, mining or other operations in, on, over or under land or the making of any material change in the use of buildings or other land.<sup>5</sup>

To make the need for permission quite unambiguous, the Act had two supporting regulations:

- 1 *The Use Classes Order*. A list of defined uses enabling the definition of ‘a material change of use’ to be a change from one class to another: permission was not needed for a change of use within a class. The order has been almost continuously tinkered with, tinkering that, for example, enables petrol filling stations to be local convenience shops as well.
- 2 *The General Development Order*. This was a particularly clever piece of legislation. There are many trivial changes in use – the erection of a garden shed or loft conversion – but, instead of exempting these trivialities from the need for permission (which would have made the Act itself applicable in some instances and not in others, creating possible legal disputes over the distinction), the Act required everything to acquire planning permission, but then gave automatic, deemed permission for any trivialities listed in the General Development Order. It was a very neat way of turning a negative

process (these trivialities are exempt from the need for permission) into a positive one (these trivialities do need permission but it will be given automatically).

- Legal persons (meaning individuals, firms or other organisations) may apply for planning permission but permissions are granted to the property, not to the applicant. Hence if a property changes hands, any granted permissions will go with it and not be retained by the seller.
- Applications must be quite specific, showing a plan of the exact site and of what is being proposed.
- Applications may be granted, or granted subject to specific conditions or refused, but a refusal or the imposition of conditions must be supported by explicitly stated reasons.
- Those reasons must refer to the provisions of an approved plan, itself composed of a map or maps, coupled with a statement of policies; such as that all proposed buildings must be no higher than x metres, or no nearer than y metres to another building. This ensures that applications are not determined on whimsy but are clearly related to a known plan which must have been subject to public consultation and approval by the local planning authority.
- Refusal to grant permission or to impose conditions may be appealed with all the arguments and documents in the public domain.

## **The link between land-use planning and transport**

All movements start and finish at specific addresses at which there is a land use and, very probably, buildings with permission for the floor space to be used for particular activities. This sounds draconian but it does not imply that every square metre of floor space has to have a certified use: Town and Country Planning Law is concerned primarily with change of use, not with the use itself. With some minor, unimportant exceptions, a legal right exists to continue the current use of both land and floor space; permissions are only required for changes from the existing use, and even then only if there is to be a move from one use-class to another or if the proposal is not covered by an automatic 'deemed' permission.

The planning system is unable to control the demand for transport by edict but it can influence patterns of transport by managing the changes in land use. In the jargon, land uses are said to 'generate' movement. Some places, such as shopping malls, will generate much coming and going but others, such as individual homes, comparatively little. In some areas of dense development there may be a cluster of small generators which will collectively produce a lot of movement; some places may generate movements by a mixture of transport methods, including pedestrians, buses, lorries, bikes, cars, etc.; others, like petrol filling stations, may be quite limited in the range of transport methods. Some, such as 24-hour shops, will generate movement throughout the day, and others only intermittently or even seasonally (e.g. the Wimbledon tennis courts).

One quite common reason for refusing planning permission is because the expected number and style of movements could not be accommodated by the local transport

system, either because the local networks would be unable to cope with the extra flow or because the local configuration would be unsafe due to poor sight distances at the site accesses. For these reasons, for refusal to be legally valid there would have to be transgressions of the policies and criteria set out in the approved plan.

This posed, and still poses, a technical issue. For a refusal based on lack of capacity or poor access to be legally valid, there has to be some quantification of the problem: it is not sufficient to allege that a proposed development would generate too much traffic. For a refusal to withstand an appeal by the applicant against the refusal, there has to be, first, some sort of estimated generation by the proposed development and, second, a measure of how much extra traffic, if any, may be absorbed by the local network. The second issue, essentially about network capacity, is quite technical and complicated and will have to wait until Chapter 19. But estimating the movement generated by a proposed development may be done quite simply by using the TRICS<sup>6</sup> database or some other, similar tariff.

There also needs to be some reassurance that the capacity of the water, gas, electricity and sewerage networks will also be able to cope with the increased demand, and this too needs methods of calculating the extra loads and establishing that there is enough unused capacity to deal with them.

This gives a clue to another type of problem mentioned previously in Chapter 1. The additional demands for transport and utility services generated by one comparatively small development may be within the network capacity, but a combination of demands from a number of comparable developments might be overwhelming: this could be a tripwire if there is a discontinuous stream of separate but similar applications. This is another facet of the perception of whether a large issue is the sum of smaller issues or whether a small issue is a subdivision of a larger one. It may be epitomised by the raw sewage from one rural cottage being discharged into a stream having no terrible effect, but if a whole village does the same thing, the stream will be polluted beyond recall. For this reason planning cannot work on precedent: if permission is granted for one new house, it does not follow that subsequent applications should be given permission. In general, the aggregation of small issues may well create a problem which is not just of a different scale but of a different nature. It was once neatly encapsulated:

The aggregate of decisions made by individuals may produce a situation that has a feed-back effect upon the individuals who make them, modifying the satisfactions that they had hoped to achieve.<sup>7</sup>

## **The link between transport and land-use planning**

The causal relationship in which land use generates movement can be reversed. Permission to develop a site is unlikely to be sought unless it is served by all the necessary communications and transport services. It follows that if the transport, communications and utility systems are extended, opportunities to develop those sites with improved services may well be taken up. The classic case is the M25, the motorway which in 1986 completed the encirclement of London, enhancing the accessibility of a swathe of land through the Home Counties.