

IDENTIFYING DIRECTIONS FOR FREIGHT TRANSPORT RESEARCH

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ABSTRACT:

A joint ARRB-Monash University study has been conducted to identify possible directions for further road freight transport research in Australia. This involved an extension to the existing procedures at ARRB for formulating research proposals and programs. The paper describes the four-step investigation procedure, showing how it systematically develops research proposals. It's use in identifying issues and research needs, relating to freight transport objectives, and formulating specific research proposals is then shown. The list of research topics and the aims of the research proposals are included. The paper concludes by considering the next steps in formulating freight research proposals in other areas of the transport field.

INTRODUCTION

Freight transport research in Australia has been sustained at a relatively low level in Australia in recent years (Ogden, 1983). There are a number of possible reasons for this. It is sometimes argued that there is very little that can be done to influence freight activities, that there is no political or public pressure to tackle freight issues ("if it doesn't itch, don't scratch it"), and that there are few international precedents indicating "successful" freight research. The essential point that these arguments reflect is that there is uncertainty as to the value of further freight transport research.

In the recognition that such uncertainty exists, the Australian Road Research Board (ARRB), together with the Transport Group in the Department of Civil Engineering at Monash University, has conducted a study with the broad aim of assessing the desirability of further road freight transport system research, and the likely payoffs from such research. The specific aims of this study were to:

- (a) Assess the need for further research to satisfy information requirements in the road freight transport field;
- (b) Formulate research project statements and identify the nature and order of costs and benefits for particular research projects and/or programs; and
- (c) Develop recommendations for ARRB involvement in further road freight transport research.

The scope of the study and the level of investigation was constrained in two important ways. Firstly, it applied primarily to road freight transport, although road's interface with other modes is also considered. Secondly, it applied to transport system research. The road technology side, which includes the design of pavements, structures, or vehicles, was considered to be outside the scope of the study.

This paper has two primary purposes. The first is to report the research findings from this investigation and take a further step in the ongoing process of formulating freight transport research proposals and programs. The Forum provides a suitable vehicle for the next step, which is timely given the call for further research by the National Road Freight Industry Inquiry (May, et. al. (1984)). The second purpose is to stimulate discussion of procedures for identifying research needs and formulating research programs.

With these purposes in mind, the paper describes the investigation procedure employed in the study and demonstrates its use in developing road freight transport research proposals.

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INVESTIGATION PROCEDURE

ARRB has well established procedures for formulating research programs (ARRB, 1983). These include open forums for discussion on selected research topics and executive committees to formulate recommendations on priorities for research proposals. The proposals are typically generated external to the committee process. The experiences of developing freight transport research through this open forum and committee process in recent years have revealed that whilst lists of possible research topics can be readily formed, the determination of research priorities and the total level of freight research effort have proven much more difficult. A primary reason for this appears to be that the forms of information available to the open forums and the committees have not enabled a clear consensus freight research priorities to be determined.

In the light of this experience, it was seen that the established procedures needed to be complemented by a more comprehensive investigation of freight transport issues and research needs, to determine desirable directions for freight transport research.

Delphi techniques are one means of shaping opinions or gauging variance on opinions relating to the likelihood of future events or the desirability of future actions. Typically, the procedure involves the alternative use of a questionnaire to elicit and influence participants' opinions. There have been several reported uses of them in the transport field in Australia (for example, Lane(1976),BTE(1782)) and in the education field (Weaver 1972). Consideration was given to using Delphi techniques in this study. However, a necessary input is a definable set of alternative possible research directions. Such a set did not exist at the commencement of the study and it was seen that a more open investigation procedure was required. An Interactive procedure was considered desirable, to elicit opinions and aid the formulation of desirable research proposals. Thus, an investigation procedure, which might be considered a 'partial-Delphi', was adopted. It comprised the following primary stages and tasks,

- (a) Stage 1. Develop a statement on issues and research needs. This was based on a literature review and a framework which relates issues and research needs to freight transport objectives.
- (b) Stage 2. Conduct a series of small discussion sessions. These refined the statement on issues and research needs and identified research topics.
- (c) Stage 3. Draft research proposals. These address the research topics which are of common interest in the road transport sector.
- (d) Stage 4. Conduct a workshop. This considered the draft proposals and possible priorities with the aim of developing positive recommendations for further research. This provided input to the ARRB research executive committees.

The balance of this paper demonstrates the use of this procedure to identify freight transport needs and formulate specific proposals.

IDENTIFYING ISSUES AND RESEARCH NEEDSInvestigation Framework

A preliminary, though comprehensive review of Australian freight transport research was conducted as a means of focussing upon issues of current concern (Ogden, 1983). This revealed that freight research was being undertaken in several broad subject areas, but that such a review in itself could not tell much about the current issues and emerging research priorities.

It was thus considered that a systematic investigation framework, based essentially upon identifying issues in relation to freight transport objectives, was necessary to aid identification of research needs.

The investigation framework recognises three distinct, though related, components of freight research, namely:

- (a) The freight issues, which are related to the objectives and constraints of the freight system.
- (b) The actions which may be taken to resolve one or more of the issues. These may be thought of as broad policy options (e.g., regulation) or specific schemes (e.g., traffic management).
- (c) The research tasks, which are needed to either
 - investigate the issue, or
 - appraise the application of action(s) in response to some issue(s).

These three components are related, but quite distinct, and the challenge is to determine how research can be applied to either the issue or to assessing possible actions in relation to it. Their relationship may be demonstrated as in Fig 1 where X is the appropriate research project to appraise the effect of action P on issue A. Without loss of generality, X may also be considered as an analysis of issue A, or an appraisal of action P, without any cross-reference between A and P being involved.

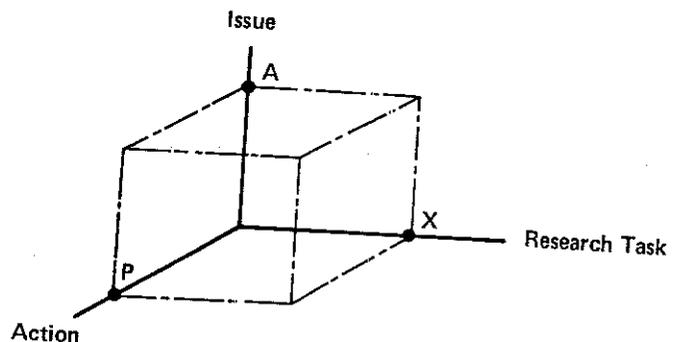


Fig 1 - Investigation Framework

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Objectives and Constraints

The desirable starting point for any consideration of freight transport research is the identification of the objectives which the freight system is intended to serve and the constraints on the system.

This immediately raised the question of "who's objectives?", since the objectives of different participants in the freight process will be different, and in many cases will be in conflict with those of other participants. Without wishing to be flippant, it may be said that the analysis of the objectives of these participants could be a major research activity in itself. However, for the purposes of this study, it was taken that the primary viewpoint would be that of government (given ARRB's interest groups).

Objectives are not always set down or made explicit by government. Rather, they can be identified by implication, by examining such aspects as resource allocation, or areas where policy formulation is occurring. Objectives may be complemented by constraints, e.g., objectives concerning the operational efficiency of the freight sector are of importance because there are constraints on national resource allocations to freight, in terms of such things as investment, energy, etc.

A number of primary objectives and constraints relevant to freight transport in Australia were identified, based upon the literature, a priori reasoning, and preliminary discussion. The objectives can be broadly stated as:

Service Quality. The freight system should provide the freight needs (in terms of forms and standards of service) desired by the community, now and in the future.

Economic Efficiency. Freight is a derived demand, and thus the requisite level of freight service should be provided for a minimum level of resource input.

Environmental and Safety Impacts. The detrimental effects of the freight system upon the natural and human environment should be minimised.

Distributional Effects. The freight system should feature an acceptable balance between societal and commercial (private) benefits and costs, and it should not hinder (and where possible contribute to) regional development.

Cost Recovery. The taxes and charges paid by the freight sector to government should meet required levels of recovery of public costs (especially infrastructure costs).

Energy. Appropriate energy resources should be supplied to the freight transport sector and these should be efficiently used within the sector.

Possible Actions

Governments have available a range of possible actions which can be taken in pursuit of the above objectives or to satisfy the constraints (Ogden, 1984). These options include:

- (a) Regulations - of the industry structure
 - of the activities of the industry
 - of the driver
 - of the vehicle
 - of vehicle use
 - of land use.
- (b) Subsidy and taxation
- (c) Traffic management
- (d) Infrastructure - investment
 - maintenance
- (e) Training and education
- (f) Consultative mechanisms
- (g) Public ownership or divestment
- (h) Demonstration projects
- (i) Technology and design (especially vehicles, pavements and structures).

Research Tasks

As depicted in Fig 1, research may be directed either at specific issues (which arise in relation to the objectives and constraints) or at particular actions (i.e. the application of particular schemes or policy options to those issues). The following list is considered indicative of the sorts of research which might be necessary to assist in the resolution of particular issues, or to appraise particular actions which have been taken in practice.

- (a) development of analytical techniques - supply models
 - demand models
 - impact models
- (b) costing analysis
- (c) development of information bases, and monitoring techniques
- (d) basic or exploratory investigation (i.e. assessment of the nature of an issue and its importance)
- (e) market research (especially in the commercial sector)
- (f) development of general procedures methodology
 - planning
 - evaluation
 - impact assessment
 - forecasting

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Determination of the appropriate research tasks and specification of the research method are major tasks in the research proposal development stage.

Statement on Issues and Research Needs

Using the investigation framework outlined above, a discussion note was prepared which included details of the framework itself and statements which represented an initial attempt to define current freight transport issues and research needs. To facilitate the conduct of discussion sessions, this initial set of issues and needs were related to the objectives which were stated in the previous section. These are concerned with:

- . service quality
- . economic efficiency
- . environmental and safety impacts
- . distributional effects
- . cost recovery
- . energy

DEFINING RESEARCH TOPICS

Process

The statement on current issues and research needs constituted a working document, to assist in determining the perceptions of others in the freight transport field on issues and research needs, specifying relevant research topics and indicating the nature of possible pay-offs.

To facilitate this process, a series of discussion sessions were arranged, in which the authors led a loosely-structured discussion on the general topic of freight research. The discussion note was pre-circulated, to stimulate response and to guide discussion.

A total of seventeen discussion sessions were conducted with persons from several Australian State Road Authorities (4), from State and Federal Government Transport agencies (7), railway systems (2), and particular individuals with knowledge and expertise in the freight transport field (4). Sessions were held in Sydney, Brisbane, Canberra, Perth and Melbourne and typically lasted for 1.5 hours.

It is of interest to note that, while in many cases the views of persons involved in the discussions was "predictable" given their affiliation, this was by no means universally so. In some sessions, opinions varied significantly between individuals from the same organisation, reflecting the varying perspectives of freight issues and research needs within an organisation. This experience demonstrates the value of the discussion sessions in bringing to light different perspectives and opinions, in a professional environment in which most individuals can feel free to express personal views, not necessarily "organisational" views.

Freight Transport Issues

A primary outcome of the discussion sessions was a clearer statement on current freight transport issues and their relationship to the broad transport objectives outlined above. These are summarised below.

Service quality

Three specific issues relating to service quality were identified:

(a) Performance Criteria and Standards. It is generally recognised that the requirements from the freight transport system vary across user segments and thus the importance of particular performance criteria varies across segments. Three such criteria are price, service frequency and the reliability of time of delivery. These criteria also have importance for road infrastructure and urban structure planning, since they could influence the amount of travel and the value placed on travel time. However, little hard information exists on either the relative importance of criteria or their inferences for road planning.

(b) Industry Structure and Viability. The ability of the industry to deliver a desired service is influenced by its structure, as is its ability to conform with community expectations relating to such factors as safety, environmental protection and cost recovery. Just as the freight market comprises numerous sub-markets, so the freight sector is characterised by specialised activities and functions (e.g., forwarders, line haul operators, local delivery firms, owner drivers, loading agents, ancillary carriers, etc.). It is a necessary prerequisite to informed policy and planning for freight that the role and contribution of each section of the industry (and indeed of the industry as a whole) be known and understood. Moreover, as freight movements can be a good indicator of wider economic performance, more attention to monitoring the freight sector could have wider benefits. This has also been recognised by the National Road Freight Industry Inquiry, May et. al.(1984).

(c) The Freight Task. An increased understanding of the size and patterns of freight movement, and of the factors affecting demand, is necessary to aid transport planning. Also, there are major deficiencies in current techniques for modelling the generation and flow of commodities and vehicles, modal split analysis, and freight forecasting.

Economic efficiency

Four specific issues were identified here, as follows:

(a) Economic Growth. Although it is known that transport costs are a significant component of the costs of production, it is not known whether savings in these costs would contribute to economic growth, i.e., the extent to which such savings are really transfer payments. This is particularly significant in the context that improving "efficiency" might lead only to a growth in unemployment. This does not negate the importance of efficiency objectives (especially where export traffics are concerned), but it emphasises the importance of considering distribution effects.

(b) Industry Productivity. Transport costs are part of the costs which affect final prices of commodities. Their significance varies considerably from item to item. There is very little comprehensive Australian data which would show how important physical distribution management (pdm) costs are in relation to other costs of production, nor of transport costs within pdm costs.

(c) Urban Transport Network Effects. That urban traffic congestion, terminal delays, and certain restrictive operating practices effect freight costs is axiomatic. What is not understood however is the effect which these costs have upon such aspects as truck productivity (e.g., number of deliveries per day), the viability of industry in the locality, choice of mode or form of operation (including ancillary operation).

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(d) Freight System Efficiency. A periodic review of the suitability of the various industry parameters (e.g., vehicle mass and dimension limits) and related investment needs should be undertaken. Technological advances in road and vehicle design, or changes in the relative importance of production factors (e.g., labour, energy) mean that a revised set of conditions may be "optimum".

Environment and safety

In this case, four issues were seen to be important, as follows:

(a) Significance of Truck-Related Road Safety. Although trucks are involved in some 15 per cent of accidents in Australia involving fatalities, they are over-represented relative to vehicle-km of travel, and most fatalities are not participants in the road freight industry, but 'innocent' outsiders, including private motorists and pedestrians. There is a level of research activity on truck-related safety issues at present, but it would probably be true to say that these issues have not been pursued as vigorously as other aspects of safety research. Thus, there is a need for improved understanding of the nature of the truck accident problem (also recognised by the National Road Freight Industry Inquiry, May et al. (1984)).

(b) Development of Truck Accident Countermeasures. This issue follows from (a) above, the difference being that this one is focussed upon development of countermeasures as a follow-on from the analysis of the accident patterns conducted in (a). Again, work is progressing in this area elsewhere.

(c) Noise, Emissions and Vibration. These three environmental issues represent probably the three most noticeable forms of environmental problems associated with trucks, and in each case, trucks are significant (or are perceived to be significant) contributors to the overall problem.

(d) Intrusion into Residential Streets. Concerns related to the intrusion of extraneous vehicles in residential street networks have come into prominence in Australia in recent years and in some cases trucks figure in those concerns. A range of measures to tackle traffic intrusion have been developed, but it is probably fair to say that trucks have not been treated as comprehensively as cars in these developments. Three aspects are involved: firstly, the development of means of keeping extraneous trucks out of residential neighbourhoods; secondly, how best to cater for trucks which have a legitimate business in the area; and, thirdly, the problem of truck parking.

Distributional effects

The two current issues of concern in relation to this objective were:

(a) Equity: Beneficiaries of Subsidies. Within an objective that the freight system should provide an acceptable balance between societal and private benefits, an issue of current concern is that of who benefits from existing freight subsidies. The presence of rail deficits and (perhaps) less-than-full road cost recovery implies subsidies, and it is not known to whom these subsidies are benefits, or what the social and economic effects of these subsidies might be.

(b) Regional Development. The issue here is the extent to which the availability and quality of freight services within a region (including a metropolitan region) contribute to the amount and location of economic growth, and rearranging the location of a given level of growth by transport system attributes.

Road freight cost recovery

The primary issue was:

(a) Contribution of Heavy Vehicles. It was generally agreed that the market place is the best determinant of mode use provided that the correct signals on true costs are transmitted to the market. If heavy road freight vehicles are not paying their way, the market may receive inappropriate signals. Moreover, governments are concerned, for financial reasons, that such vehicles should pay their full share of costs of infrastructure provision and maintenance. For both of these reasons, road freight cost recovery is important. However, at the moment there is little consensus as to whether heavy commercial vehicles "pay their way". There is lack of agreement on both sides of the ledger; on the cost side, concerning the proportion of road costs allocatable to trucks, and on the revenue side, as to which taxes should be regarded as "charges" for the use of roads.

Energy consumption

Two issues were regarded as significant here:

(a) Energy Consumption Audit. Knowledge of the fuel consumption patterns in the road freight sector is essential to the formulation of policies relating to energy consumption. While broad estimates of total fuel consumption by the road freight sector do exist, there is little knowledge of consumption patterns within the sector. That is, the relative contributions of interstate freight, local urban deliveries, etc., are not known.

(b) Fuel Conservation. Although there is currently no "oil crisis", the memory of past "shocks" remains. Thus strategies for conserving fuel within the freight transport sector and ensuring its availability to this vital sector remain important requirements.

Research Topics

The second outcome of the discussion sessions was a lengthy list of specific research topics and indications of the areas in which pay-offs might accrue from research into them (these topics are listed in Appendix A). The major pay-offs from the research in the immediate term are likely to be in the public sector, through improved understanding of freight transport systems and techniques to aid consideration of freight transport in transport planning and management. These improvements should, in the longer term, lead to economic and social benefits in the freight industry and the wider community.

This information provided the basis for selecting the most desirable topics and formulating specific research proposals to address these.

DEVELOPING RESEARCH PROPOSALS

The list of research topics (Appendix A) were examined critically with a view to the development of specific, desirable research proposals. This involved both the implied prioritizing of research topics, and in some cases, related topics into a single research proposal.

The prioritizing of projects reflected the implicit or explicit importance attached to them by the participants in the previous phase, the extent to which they were judged to be capable of producing worthwhile output within an acceptable time and budget, and their potential relevance to ARRB's interest groups (primarily State Road and Traffic Authorities).

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In this way, five research proposals were prepared. The aim of each, and the links to the research topics listed in Appendix A are as follows:

- (a) Freight System Data and Information Needs. The aim of this project would be to assist decisions relating to road policy development, and road planning design and maintenance by establishing the forms and sources of freight transport information appropriate to assist such decision making. This proposal addresses research topics (g), (h) and (i) relating to Service Quality (Appendix A).
- (b) Freight Transport in Urban Road Investment. The aim of this project would be to develop techniques to specifically evaluate freight-related benefits in urban road investment decisions. This proposal addresses research topics (b) and (p) relating to Economic Efficiency.
- (c) Criteria for Management of Trucks in Urban Areas. The aim of this project would be to develop guidelines for explicit consideration of trucks in urban traffic management schemes, to both facilitate freight flow and to reduce the adverse environmental impact of trucks. This proposal addresses research topic (k) relating to Economic Efficiency.
- (d) Heavy Vehicle Considerations in Traffic Signal Design. The aim of this project would be to refine those parts of the Australian traffic signal design guides which are affected by trucks (in particular, settings for yellow and all-red), and to develop guidelines for the explicit inclusion of truck factors in area traffic control systems. This proposal addresses research topic (k) relating to Economic Efficiency.
- (e) Audit of Cost Recovery Studies. The aim of this study would be to improve the information base for consideration of financial cost-recovery in the transport sector by conducting a technical audit of network studies to establish a benchmark for further research or policy development. This proposal addresses research topic (g) relating to Road Cost Recovery.

RESEARCH RECOMMENDATIONS

The final phase of the project involved conducting a one-day Workshop at the Australian Road Research Centre in Melbourne to critically appraise, refine and prioritise the above research proposals. The invitees were, in the main, persons who had participated in the earlier round of discussion sessions, and the Workshop provided an opportunity for interaction between people with different backgrounds and perspectives.

The research proposals were refined and modified as a result of the Workshop deliberations, and three of the proposals were recommended to the executive committees for inclusion in ARRB's 1984/85 research program. These were:

- freight system data and information needs;
- freight transport in urban road investment; and
- heavy vehicle considerations in traffic signal design.

The workshop also indicated that the other two proposals and several of the research topics in Appendix A were relevant to other traffic and transport agencies. Liaison with these agencies is continuing with a view to implementation of research to address these topics.

CONCLUSIONS

The study has proved to be an effective means of investigating directions for freight transport research in Australia. It enabled:

- identification of a range of issues which relate to current freight transport objectives;
- definition of a set of possible research topics and, based upon those, development of draft research proposals;
- refinement of these drafts into detailed research proposals;
- information exchange between persons from a range of organisations and an increase in awareness of the importance of freight issues within transport planning agencies.

The information derived from the study, particularly the set of research topics, should also provide a useful input to the future considerations of freight transport research.

Finally, the procedures used in this study to elicit opinions, define research topics and formulate research proposals are likely to be relevant to other areas of the transport field. Some refinement of the procedures might be productive, particularly in the phase of determining opinions as to the desirable set of research topics.

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APPENDIX A IDENTIFIED FREIGHT TRANSPORT RESEARCH TOPICS

Those topics which led to research proposals are indicated by *.

A.I Service Quality

- (a) Relationships between freedom of entry and perceived problems (accidents, overloading, bankruptcies, etc.)
- (b) Effect of a quality licensing system on number of entrants to the industry, price, level of service, safety, etc.
- (c) Effects on the industry, and on users, of "full", "correct" cost recovery (see (e) also)
- (d) Relationships between freight activity and other indicators (including lags and leads)
- (e) Effect of structural economic change on demand for freight
- (f) Historical trends in service quality, interstate and intrastate
- (g)* Identification of freight system data needs
- (h)* Better knowledge of the urban freight task
- (i)* Better knowledge of the rural freight task (flows, axle loads, commodities, etc.)
- (j) Determinants of mode use
- (k) Futures study: role of modes
- (l) Health and stability of segments of the road freight industry.

A.II Economic Efficiency

- (a) Resource costs of urban traffic congestion causing delay to trucks
- (b)* Truck benefits and costs in appraisal of urban road investment proposals
- (c) Relative benefits of investment in transport viz-a-viz other sectors
- (d) Case study involving appraisal of upgrading a route (or new route) in an urban corridor
- (e) Resource costs of "poor" non-urban roads
- (f) Benefits and costs of allowing new technology (e.g., doubles, triples)
- (g) Means of funding road maintenance
- (h) Costs of regulatory restrictions; of non-harmonious regulations; of limits on use of technology, etc.
- (i) Truck considerations in geometric design (climbing lanes, lane widths, grades, sight distances, etc.)

- (j) Effect of urban network (e.g., truck routes) on truck operations.
- (k)* Traffic management techniques directed at urban trucks.
- (l) Efficiency in resource allocations between modes
- (m) Efficiency of terminal operations (including modal interchanges)
- (n) Analysis of effects of past road freight deregulation
- (o) Effects of transport efficiency on economic growth
- (p)* Development of methods of incorporating freight considerations in urban transport planning
- (q) Benefits and costs of large combination vehicles.

A.III Environment and Safety

- (a) Relationship between truck-driver-location-environment-etc (if accident data permits)
- (b) Effect of quality licensing on safety
- (c) Feasibility of public truck parks and bans on on-street truck parking
- (d) Analysis of culpability in truck-involved accidents.
- (e) Effects of enforcement (loads, speeds, maintenance, etc.) on accidents
- (f) Truck braking (especially LCV's)
- (g) Truck noise

A.IV Distributional Effects

- (a) Effect of transport system efficiency on level and location of economic activity in a city or region
- (b) Effects of freight subsidy, deregulation, etc. on viability and social structure of country towns

A.V Road Freight Cost Recovery

- (a) Technical and constitutional feasibility of introducing a NZ-type road user charges system
- (b) Equity in road taxes between passenger and freight
- (c) Development of an efficient, equitable method of collecting road user charges from trucks
- (d) Deterioration of roads under load and overload
- (e) Determination of "correct" level of charges for trucks
- (f) Technology of road pricing for trucks

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(g)* "Audit" of literature and studies on cost recovery

(h) "Social" cost component in roads expenditure

A.VI Energy

(a) Dissemination of energy research results to truck operators, in the form of guidelines, etc.

(b) Contingency planning against sudden energy shortfall

(c) Fuel economy performance of large combination vehicles