The Floersheimer Institute for Policy Studies

The Trans-Israel Highway: Do We Know Enough to Proceed?

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About the Author

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About the Working Paper

This working paper examines the planning and evaluation of the Trans-Israel Highway project. Its main findings were first presented at a seminar held at the Floersheimer Institute for Policy Studies on April 17, 1997. The working paper format is intended to allow a timely way to initiate and inform rigorous debate on critical issues facing decision-makers. Comments are welcome and will be considered in the preparation of the study's final published format.

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THE GOALS OF THIS REPORT

On first appearances, the Trans-Israel Highway, "the largest transportation project undertaken since the establishment of the state of Israel,"[1] seems likely to have major geographic, environmental, economic, and social implications. The range and seriousness of the issues at stake are evident from the claims of both proponents and opponents to the Highway.

On the one hand, proponents of the project point to its contribution to the relief of crippling congestion, to improved access of the north and south of Israel to its center, and to the development of the rapidly urbanizing "Hill Axis" and "economic development" more generally.

On the other hand, opponents warn that if the Highway behaves at all like highway projects elsewhere in the world it will expand the "commuting-shed" of Tel-Aviv, encourage rapid uncontrolled development along a strip east of the city, and entrench car-dependent lifestyles and land-uses. These processes, they warn, are likely to have many negative consequences: increasing pressures to convert agricultural land and open space to residential and commercial uses; encouraging low-density land-uses at the city edge while undermining the city center--with attendant economic inefficiencies and social problems; leading to a rise in annual kilometrage while degrading or blocking the development of public transport; and increasing the externalities (pollution, road injuries) associated with private car travel.

Prompted by this fierce and continued battle between claims and counter-claims, and the project's massive scale, this paper asks some elementary public policy questions. Given the seriousness and complexity of the issues at stake, do we have enough information to proceed? Have the range of potential consequences one would expect of a major highway running the length of a small country--and alongside its major metropolitan area--been weighed thoroughly enough to embark on a massive and irreversible project? Are the functions the road is designed to fulfill pressing, and will it indeed fulfill them? Is it the best way to fulfill them? Were the issues pointed to by the claims of project opponents and proponents systematically examined during its conception, planning, and approval, and can this examination help us navigate among the claims and counterclaims? Were the procedures and tools used reliable, and were the result of evaluations clearcut enough to merit the project's approval?

"The long-term policy toward risks," says sociologist of technology Ulrich Beck, "should be: slowing down, revisability, [and] accountability."[2] By insisting on a reasonable level of confidence for a major project; by carefully examining the rationales given for it; and by opening up some of the technical "black boxes" on which the project's approval was based, this paper hopes to contribute to the goals of the policy Beck presents: "the ability for consent . . . [and] the expansion of democracy into previously walled-off areas of science, technology, and industry."

This paper begins with a chapter examining certain unique features of Israel that warrant special caution about further road investments, and questions common claims about the great potential for further growth in motorization, and the need to close the country's lag in highway infrastructure. The following three chapters then discuss a series of inadequacies in the project's planning and evaluation:

- The Highway's planning was not sufficiently guided by the recommendations on land-use and transport policy made by several key Israeli policy documents, and by the more recent findings and tools of international transport experience.
- Never systematically compared with other transport solutions, the project was advanced by default, rather than emerging as a superior option.
- The Highway's traffic forecasting and economic evaluation also lagged behind the best available practices, did not adequately consider significant social and environmental costs, and repeatedly relied on unrealistic assumptions that increased the project's apparent value.
- A preliminary reassessment of the Highway's possible induced traffic, a recomputation of the project's cost-benefit analysis, and a consideration of the growing list of government subsidies and guarantees to the road, show that it could cost the government far more than promised, and will probably be worth much less.

For these reasons it is important to reconsider the project's value, cost, long term impact on land use and the environment, and its priority with respect to other transport investments. Some of the procedures necessary to clarify these questions are presented in the paper's concluding chapter.

CHAPTER 1

RETHINKING ISRAEL'S TRANSPORT SITUATION

WHY ISRAEL'S SIZE MATTERS[3]

Israel's tiny size and high population density demand careful and scale-sensitive transport thinking. Caution is needed in applying measures developed for larger countries to Israeli circumstances.[4] Take for example two key transportation parameters, motorization rate and modal split.

Higher vehicle densities at lower motorization rates

It is common to hear talk of Israel's "low motorization rate" referring to an index of vehicles per thousand people that is low in comparison with other developed countries. A claim from the Trans-Israel Highway Company informational brochure is typical:[5]

> The motorization level in Israel is 247 cars per 1000 people, while the corresponding levels in other Western countries are 826 for the U.S., 666 for Switzerland, and 688 for a small country, such as Norway. These figures show that there is tremendous potential for growth in car ownership, especially with the continuing rise in the standard of living in Israel.

The meaning and implications of this "tremendous potential for growth in car ownership" must be carefully examined. It is true that motorization rate is a useful economic indicator that gives a sense of proximity to one plateau of market saturation (one car per adult) and an indication of the degree of personal access to/dependence on cars in a society. But the comparative use of the index in this and similar contexts is worrying in several ways.

First, it usually contains an implicit slide between the various senses of "potential": from portraying the gap as (1) statistical distance that could be closed, to (2) one that is likely to be closed, to (3) one that can be closed without much worry ("others have already reached this level and they're OK"), to (4) one that should be closed. In the discussion below I argue that only the first sense is justified.

The planners of the Trans-Israel Highway assume in very concrete ways that the "potential" for a rise in Israel's motorization rate will be realized soon and fully. A national saturation motorization rate of 500 vehicles per 1000 people is the basis for calculating the necessary dimensions (number of lanes, size of interchanges) and economic viability of the Trans-Israel Highway. As shown in Table 1, the projections used to calculate the travel demand that the highway is designed to meet anticipate a motorization rate of 382 in 2010 and 451 in 2020.[6] Given anticipated population growth the models project, this would yield a car and light commercial fleet of 1.7 million in the year 2000, 2.7 in 2010, and 3.6 million in 2020 (compared with 1.027 million in 1992).[7] Total annual kilometrage is forecast as rising at the rate depicted in Table 1.[8]

Table 1. Projections underlying the Trans-Israel Highway "Traffic Forecast and Economic Analysis"

(A national saturation motorization level of 500 vehicles per 1000 people is assumed)

	Motorization rate (vehicles per 1000 people)	**Fleet size** (thousands)	**Annual total kilometrage** (billion km)
1992	198[9]	1,027	16.75
2000	282	1,699	26.06
2010	382	2,675	37.00
2020	451	3,600	44.70
Increase (1992 to 2010)	193%	260%	221%
Increase (1992 to 2020)	228%	351%	267%

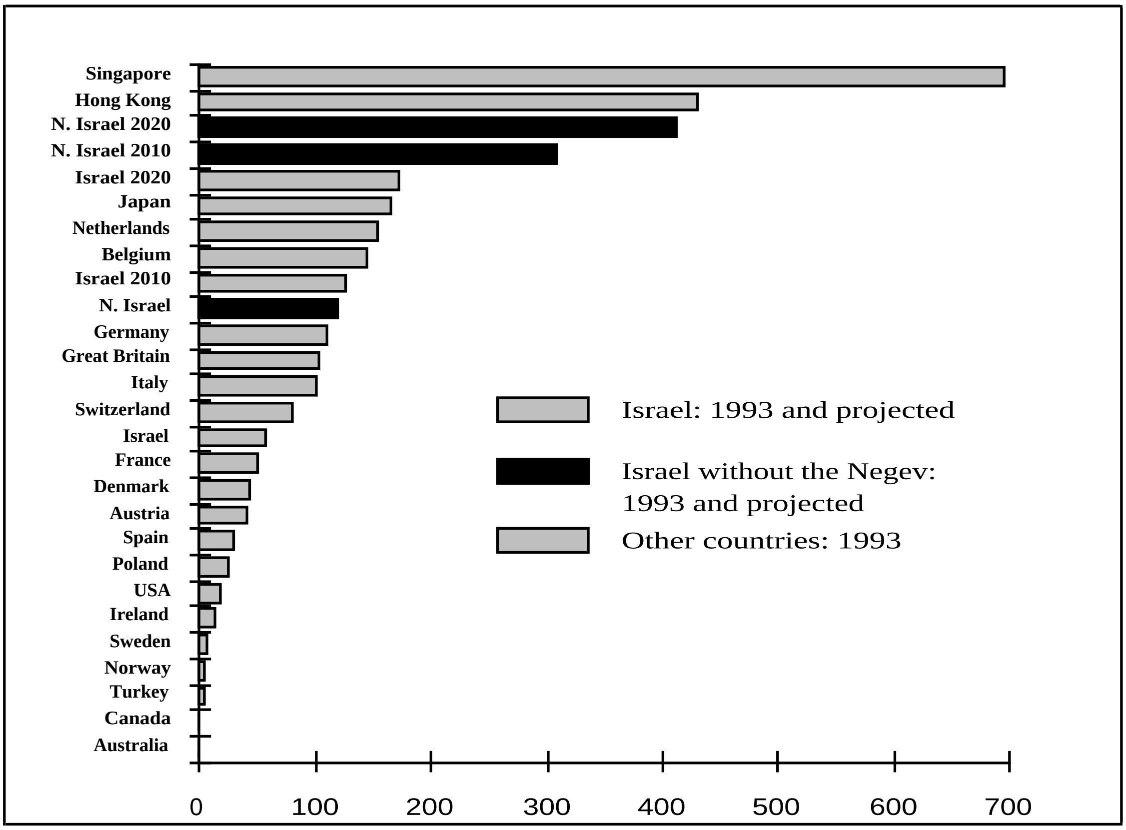
Source: Trans-Israel Highway Company, "Traffic Forecast and Economic Analysis," Final Report, 1995. All figures are for private car and light commercial vehicles.[10]

A second problem with the motorization index is that it does not reflect the density of cars in space, which more directly determines the worrisome effects of transportation: pollution, visual intrusion, community severance, noise, space use, etc.[11] This density--the number of cars (or even better the amount of car use) per unit area, rather than per person--would be a better guide to the impacts of a distributed activity such as transport. A motorization rate could be "low" in the sense of being less than the national averages elsewhere, but very high given population densities, both nationally but more especially locally. Thus in Israel, feedback from the ill effects of car density could (and probably should) restrain further growth in car fleets before other saturation effects take place.

If the assumptions used to determine the need for and benefits of the Trans-Israel Highway were to be realized, by 2010 the area in which 90% of Israel's population lives would be almost twice as car-dense as the small highly populated countries—and most car-dense—countries of Europe today (Netherlands, Belgium), and more than six times as car dense as today's Denmark.[12]

Beginning at a national level of comparison, Israel ranks fourth in its population density in the developed world: 248 people per square kilometer in 1994)[13]--less than The Netherlands, Japan, Belgium, and Britain, but not for long given Israel's much faster population growth rate.[14] Thus the statement cited above that Israel's motorization rate is low compared to a "small country, such as Norway," is somewhat misleading. If Israel's population (which is larger than Norway's) still own cars at a rate of only half of Norway's population, they do so in an area 1/16'th of Norway's size. The graph in Fig. 1, comparing Israel's current and projected car densities with those of other countries today, is a rough but suggestive indicator of this point.

Figure 1. Cars and light commercial vehicles per square kilometer



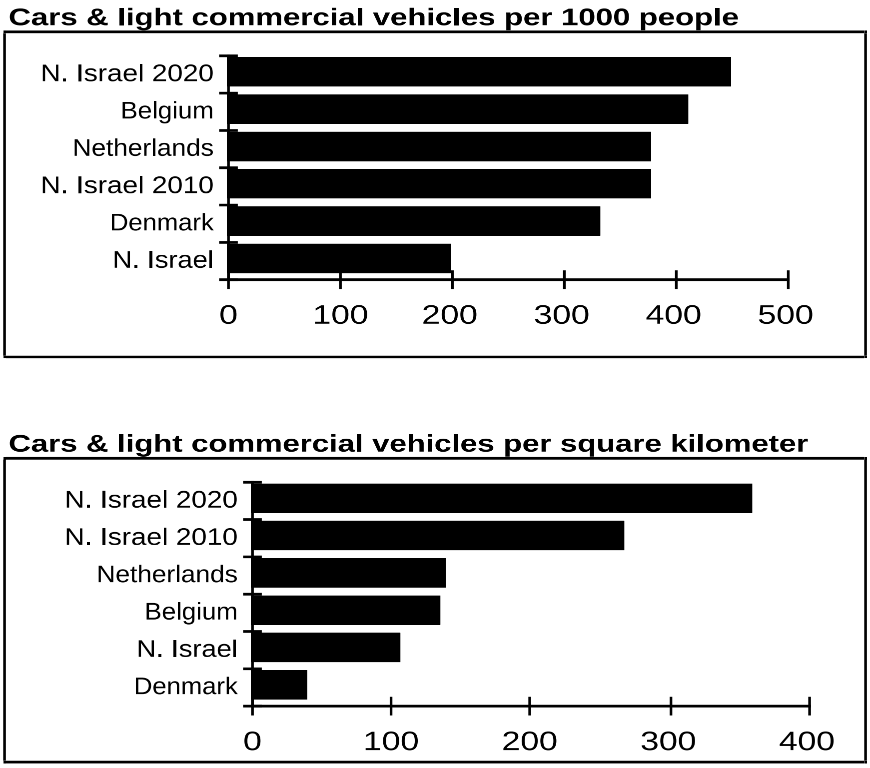
Sources: projections for Israel are from Trans-Israel Highway Company projections of fleet sizes, drawing on their calculations for each of 33 geographic "superzones." Areas are from 1994 International Road Federations statistics, as are figures for the current fleet (1993) fleets of other countries; these are adjusted to match the "car and light commercial" measure used for Israel by the Highway Company.

Here we see that currently, despite its low motorization rates, Israel is more car-dense at a national level than countries with far higher motorization rates. And if motorization rates grow at the rate proposed by the Highway Company projections, Israel in 2020 will be more car dense than any European country or Japan.

But while national-level comparisons show the problems with comparisons of national motorization rates, a more fine-grained analysis is needed. Regional and city-wide car densities will tell us more about the impacts where people live. The graph in Fig. 2, for example, compares the car density in the region in which over 90% of Israel's population is projected to live for the coming two decades (the area north of the sparsely-populated desert of Southern Israel[15]) with the area of small European countries with high and relatively uniform population densities.

Figure 2. High car impacts at low motorization rates

1993 and projected motorization levels and car densities in Israel without the Negev desert compared to 1993 levels in similar European countries (high population densities and little "hinterland.")



While Israel's motorization rate is well below current European levels, and is forecast to reach them only some time after 2010 . . . .

the density of vehicles is already close to that of the two most car-dense countries in Europe; by 2010 it will be almost double their density today, and by 2020 denser by a further 64%.

Sources: All current fleet and areas are for 1993 and from International Road Federations statistics. Projections for Israel are from Trans-Israel Highway Company projections of fleet and population sizes, calculated independently for each of 33 geographic "superzones" used in their models.[16]

Thus Israel today has car densities almost comparable to the Netherlands and Belgium, which are among the highest in Europe. However, as Table 2 below demonstrates, there are important differences. Israel has already "achieved" these high car impact levels at motorization rates of only 48-59% of these countries, and these impact levels are likely to grow between twice and ten times as fast given rapidly rising population and fleets.

Table 2. Transportation parameters of similar European countries

Transportation parameters of European countries similar to Israel (small, high population densities, little "hinterland.") expressed as a percentages of Israel's			
Country	Motorization rate (1992)	Annual average fleet growth (1989-1993)	Annual average population growth (1989-1993)
Belgium	209%	46%	14%
Denmark	169%	9%	9%
Netherlands	192%	37%	36%

Source: International Road Federation Statistics.[17]

These other countries, however, are notable for their relatively aggressive policies designed to limit further dependence on car use, whereas as Israel's (non)policies have no such restraints.[18] The projected growth in Israel's car and light commercial vehicles fleet will produce the densities shown in Table 3, compared with equivalent levels of 140, 135, and 40 in the Netherlands, Belgium, and Denmark today:

Table 3. Growth in car fleet and resulting densities

Growth in car and light commercial vehicles projected by the Trans-Israel Highway Company and the resulting densities

	Fleet (thousands)		**Vehicles per km^2**	
	Entire country	North of Beer Sheva	Entire country[19]	North of Beer Sheva[20]
1992	1027	970	47	106
2010	2674.5	2452	122	269
2020	3599.4	3278.9	164	360
Increase (1992 to 2010)	260%	253%	260%	253%
Increase (1992 to 2020)	351%	338%	351%	338%

Cars and light commercial vehicles per km^2 in small European countries today:

The Netherlands: 140
Belgium: 135
Denmark: 40

Sources: International Road federation Statistics; Trans-Israel Highway Company Projections.

In other words, by 2010, given projected motorization growth patterns, the number of cars per thousand people will be 193% that in 1992 , but the car density will be 260% the 1992 levels. The "low" motorization rates of 1992 already represent car densities levels among the highest in the industrialized world, with the area north of Beer Sheva surpassed only by Belgium, the Netherlands, and Japan; the Trans-Israel Highway is predicated on the assumption that these densities will more than triple--producing a remarkable intensification of car impacts in the region where 90% of Israelis live.

Table 4. Car use as function of ownership[21]

Ratio of vehicles to drivers	% of trips by private car
0	23
1 to 3	66
1 to 2	66
2 to 3	81
1 to 1	83

Source: MATAT (The Center for Transport and Traffic Planning), National Survey of Travel Habits, 1993.

Israel's already high comparative levels of cars per unit area and motorization levels in cities become even more consequential when actual use--especially in commute to work in cities--is taken into account. In contrast to some European cities (esp. in Germany and Italy, for example)[22] where high car ownership coexists with relatively low car use, in Israel car ownership is more or less equated with exclusive car use (see Table 4). The difference lies largely in the lack of convenient transport, especially rail, as well as the absence of car restraint policies in Israel's major cities. Thus any rise in Israeli motorization rates is likely to translate into increased peak-travel very directly.

The decision on whether to carry out projects that rely on and ensure this extrapolation of current trends--an enormously consequential social decision--must be carefully weighed. As will be discussed below, the rise of motorization rates on which the feasibility of the highway is based are not inevitable. They are drawn from an extrapolation of existing trends <u>in the absence of any altered policy regime</u>. Any number of demand management measures and the provision of travel alternatives would lead to lower motorization rates and less astonishing projected car densities.

The pressing problem: commuting to work in central Israel

A second example of the need for a scale- and locally-sensitive evaluation of Israel's transport prospects is evident from a more careful examination of modal split figures (designating the percentage of travel done using each transport mode). While Israel's core is not (yet) a single large city, in some respects this is the model that should be used in thinking about this area's transportation needs and prospects. And the modal split during commuting hours that are most important for determining highway capacity should be examined. By deriving central Israel's potential modal split from <u>average</u> figures in much larger countries, the potential for public and non-motorized transport use in Israel is downplayed.

For example, in calculating the portion of travel that would be taken up by a much expanded rail system, the traffic models for the Trans-Israel Highway refer to a predicted 12-14% of kilometrage during morning peak hours in 2010 as "high relative to the average daily percentage of rail travel found in Western European countries."[23] The conclusion derived from this comparison is that even an expansive rail system would have a small impact on the need for and use of the Highway.

But the typical Western-European modal split on which this prediction is based (of 6-10% of total passenger kilometrage) expresses country-wide and all-day average figures in much larger countries. In fact, the area served by the Highway's central portion is the size of many large European cities, and the potential levels for public transport use in central Israel might be better modeled on the considerably higher modal splits for intra-urban travel in such cities. It must also be remembered that in European countries the modal split for travel by public transport in peak hours (i.e. commuting to work) is considerably higher than the average modal split figures, and that the need for additional highway capacity is largely determined by traffic flows during these hours.

If the modal split appropriate for rush-hour travel in urban areas of similar densities to central Israel were used to model the traffic impacts of rail development, the need for the Highway might be substantially reduced. Goals of 30-50% of workers using public transport or 30-50% of passenger kilometers being on public transport, with more than half of this being rail-based, are not unattainable wishful thinking but simply a description of the currently prevailing situation in cities with low automobile dependence (such as Amsterdam, Frankfurt, London, Vienna, West Berlin, and Stockholm).[24]

Small country, big plans

More pragmatic aspects of Israel's size and economic isolation from neighbors further strengthens the need for caution in considering a transportation mega-project. In a country so small there have been few if any precedents for a single project the size of the Trans-Israel Highway. Predictably, the legal, planning and jurisdictional frameworks were not adequately prepared for it A small system is also more vulnerable to unevenness in the capacities of agencies. Thus, while the importance of a balanced transport system (emphasizing public transport) was repeatedly declared by planning authorities in Israel over the course of the late eighties and early nineties, the fact was that only the bodies responsible for road construction had the political clout to push their projects forward, while proposals for bus and rail improvements remained largely on the drawing boards.

Because of the Trans-Israel Highway's size relative to the country's resources, once financing and construction begins, the project will in practice lessen the resources available for any other large-scale transport project. This is because sources of capital (whether government, government loan guarantees, or private sector), and even some types of building equipment and supplies are limited. The recent freeze of almost all the immediate projects and long-range planning of the Israel Rail Authority for lack of budget, shows that despite declarations about the need for an integrated transportation system, in practice the modes tend to be substantially exclusive. A single interchange of the Trans-Israel Highway at Ben Shemen or Kesem, for example, will cost the government more than the entire 1997 annual national budget for rail (90 million shekel). Since Israel is likely to be able to make a concentrated infrastructure investment the scale of the Trans-Israel Highway only once a generation, it is critical that the project be carefully evaluated and prioritized with respect to the alternatives it excludes. As discussed later, the <u>sequence</u> in which different modes are developed is crucial.

ISRAEL'S "LAG" IN HIGHWAY CONSTRUCTION

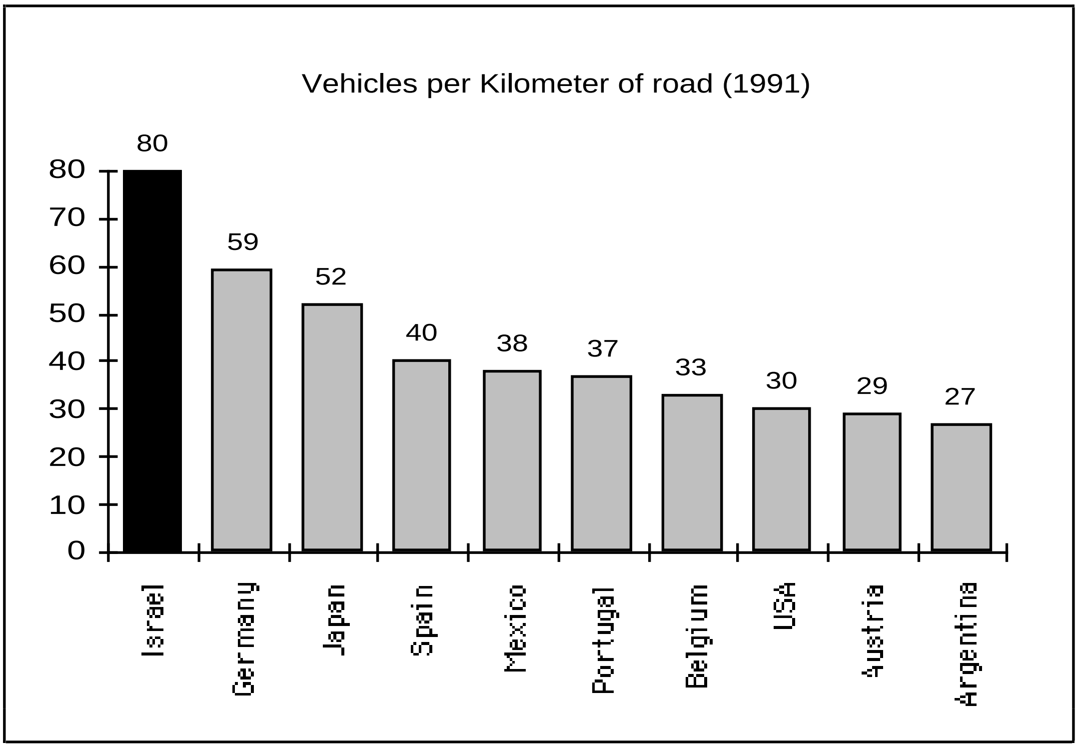
A sense of urgency accompanies the push for additional road infrastructure. Claims made to the public and to government officials about the urgent need for the Trans-Israel Highway have been based on arguments that Israel's lag in road infrastructure demands an emergency catch-up campaign. "Among Western countries," claims the Trans-Israel Highway Company, "Israel has some of the worst statistics for vehicle congestion, with 80 cars per kilometer of road."[25]. This statistic is the basis for a frightening scenario and obvious solution:[26]

> If we do not dramatically expand the existing road network, vehicle congestion will reach unbearable levels in the next few years.... Though extensive work is currently underway on roads throughout Israel, this work generally involves either widening existing roads or constructing interchanges, rather than constructing new roads . . . Since the number of vehicles on the road is constantly rising, hundreds of kilometers of road construction is needed to maintain the current density. . . The Cross Israel Highway will solve these and other problems.

Claims of this sort--too many cars, not enough roads--have an intuitive appeal to the average person caught in traffic jams. And they provide a useful entry into thinking carefully about transport infrastructure priorities. But they are problematic on several counts: (1) they are based on statistics for the entire road network, which doesn't tell us much about the need for highways; (2) even the most ambitious road-building can never keep up with fleet growth; (3) and "keeping up" with road development is not necessarily desirable.

Consider, for example, the graph in Fig. 3 that figures prominently in promotional literature for the highway.

Figure 3. Vehicles per kilometer of total road network



Source: Trans-Israel Highway Company/International Road Federation.

This graph does indeed seem to present a shocking picture of Israel's backwardness. But its implicit claims break down upon closer inspection.

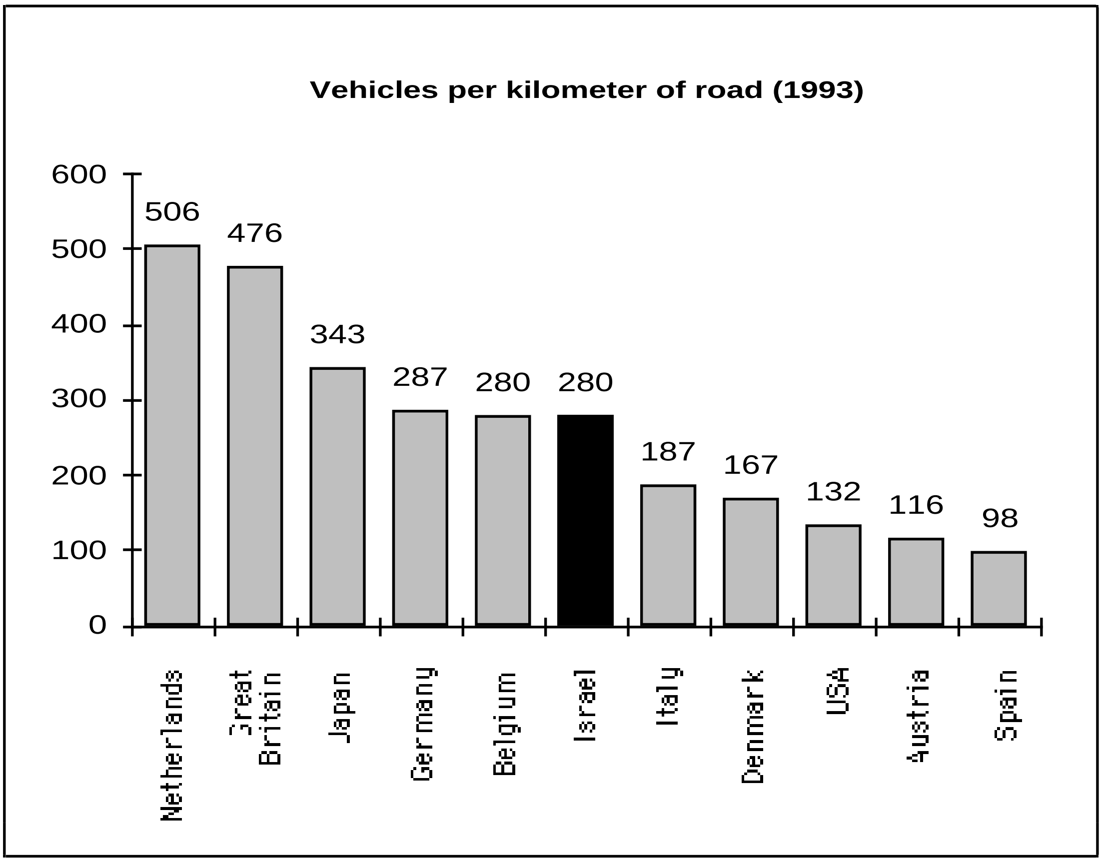
First, the figure implies that Israel should roughly double its amount of roads in order to approach a more "normal" figure of around 40 cars per kilometer, as in other advanced countries. Note, however, that the number of cars is itself increasing. According to the Highway Company projections that are the basis of the project's economic feasibility study

(Table 1), by 2020 the total number of vehicles in Israel will be three and a half times the 1991 level.[27] In order to correct the lag shown by this graph, therefore, Israel would need a 700% increase in kilometers of road over the next generation. Simply keeping the car/road ratio at current "unacceptable" levels would require a 350% increase!

Even the massive Trans-Israel Highway, therefore, which adds less than 3% to the length of Israel's roads,[28] will be insignificant compared to the massive road-building task implied by the logic of this graph. This *reductio ad absurdum* illustrates a basic lesson drawn by transport planners over recent decades: no feasible amount of added highway capacity can keep up with rapidly growing motorization/kilometrage levels.[29] This realization underlies what has been called the "New Realism" that has replaced the "predict and supply" model of transport planning: it is no longer possible or desirable to build roads to keep up with demand, so demand must be reduced by policy levers to match available supply.[30]

A **second** problem implicit in this graph is that it is based on the length of roads in the entire road network of each country.[31]: This network includes motorways, highways or main roads, secondary or regional roads, as well as the numerous small neighborhood and rural roads. In most countries, the latter category of small roads constitute the bulk of the road system, especially in large countries with extensive rural areas. In the U.S., for example, less than 60% of this entire road network is paved, and in Canada less than 40%.[32] A more appropriate basis for evaluating whether Israel is in urgent need of new highways, would be a comparison of national figures for vehicle/road ratios on the highways and secondary roads where congestion is a problem. The figures here are the following:[33]

Figure 4. Vehicles per kilometer of motorways, highways/main, and regional/secondary roads

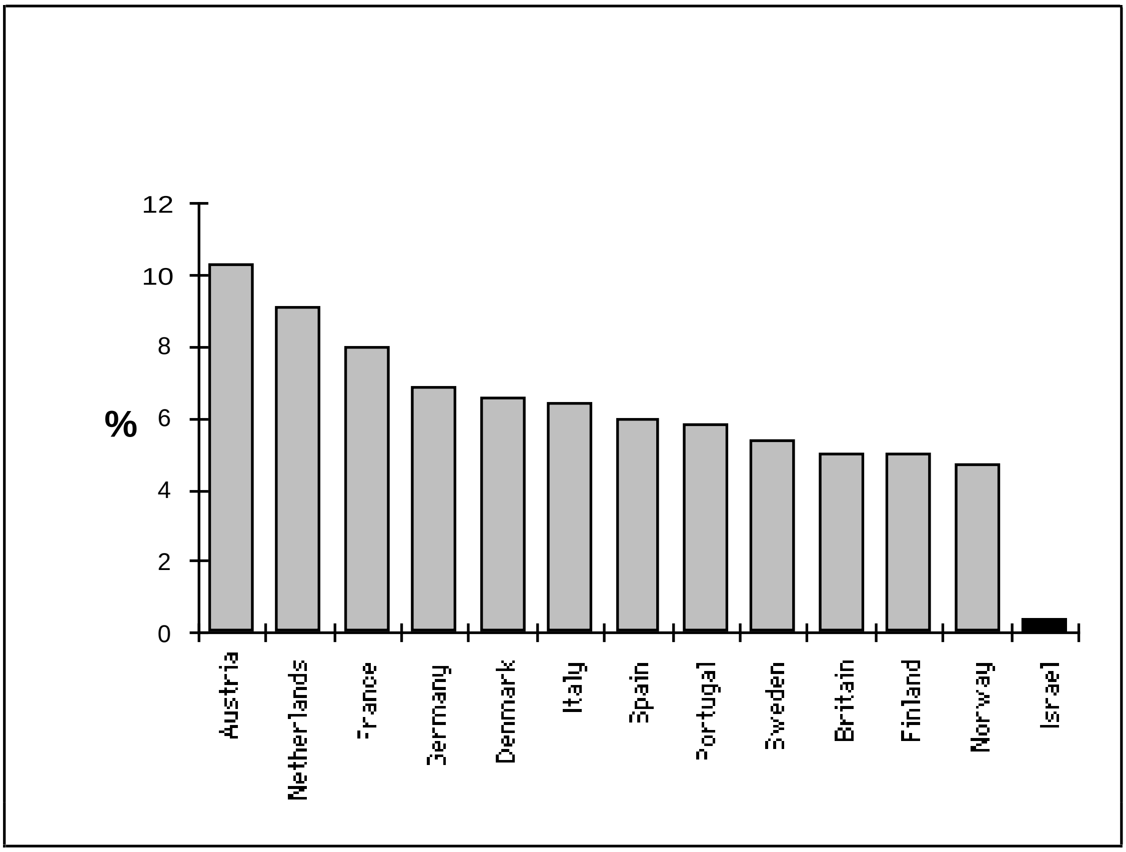


Source: International Road Federation (1994)

Using this measure we see that while Israel has more cars for each kilometer of these roads than the U.S., it has a lower ratio than many other countries. Importantly, according to this indicator of road "crowding," Israel is significantly better off than The Netherlands, and almost identical to Belgium (two countries whose area and population density are closer to Israel's). Yet these countries--with far less roads for each car--are not calling for more roads. In fact, The Netherlands is one of the most striking examples of a drastic recent reduction in national investments in road construction.

The two graphs suggest that despite the intuitive appeal of a "too many cars on too little road" message, the source of congestion and the public's discontent with the state of the roads is not a deficit in highways or main roads. More important factors might be the almost complete absence of non-road travel in Israel illustrated in Fig. 5, or the design and efficiency of the existing road system.

Figure 5. Percentage of passenger-kilometers on rail in 1993



Source: Shuki Cohen, Travel and Transport (1997).[34]

A **third** problem with the vehicle to road ratio graph is more fundamental. It is used to make "more roads for our cars" an investment priority, at a time when there is growing evidence of the tremendous social, economic, and environmental costs of a transport system too heavily based on private car use. Governments in developed countries and bodies such as the OECD European Conference of Ministers of Transport (comprising the Transport Ministers of 31 European countries) have declared the need to reduce their dependence on cars and roads through policies for managing travel demand and shifting transport infrastructure investments to other modes of travel. While implementation is still partial, and success has been mixed, the desired direction is clear.

Israel has the potential for becoming a leader in such reprioritization of transport priorities: it has more need and (for the time being) more latitude for alternatives. The county's extremely high population densities mean that even European-level motorization rates would make for intolerable car densities. At the same time, these high population densities, the still low per-capita motorization levels and reasonable levels of public transport use, and the possibility for directed planning allowed by fast-growing population, all could give Israel a head start in moving toward sustainable transport.

A sustainable transport/land-use policy would have different priorities: to support maximum access rather than increased mobility; allowing people to have a high quality of life without cars rather than being forced into increased car-dependence; the use of land for greening neighborhoods and inter-urban open space, rather than its consumption for roads, parking and suburban sprawl; a commitment to clean air, quiet, and safety rather than putting up with the loss of these through ever-increasing motorization.

If Israel is to move in this direction, rather than simply "catching up" with the mass motorization process of other countries, it must rapidly redirect its scarce resources to new goals. The increase in road length implicitly called for by the vehicles/road length graph then becomes an inappropriate and perhaps obsolete goal compared to the bolder priority of shaping a sustainable transport system. Other investments are more urgently needed: improving service on the existing bus system while creating serious suburban and intercity rail capacity; supporting the regional and local planning necessary to create or recreate medium density, mixed-use transit-oriented neighborhoods that reduce the need for travel and make public transport viable; getting the most out of the existing road system and integrating it seamlessly with other modes of travel.

Thus Israel's relative lack of dependency on cars is not a "lag" to be eliminated but a head start toward an enviable transport system. The next decade will decide whether this gift is seized or squandered. Under these special circumstances the best possible transportation planning and evaluation is a necessity. The following chapters examine to what extent this challenge was met in the planning of the Trans-Israel Highway.

CHAPTER 2

THE PLANNING PROCESS: A ROAD APART

INTRODUCTION AND OVERVIEW

A careful examination of the relation--and more interestingly, the frequent lack of relation--between the development of the Trans-Israel Highway and Israeli planning bodies and processes would well repay the effort.

Such a study would trace how the project moved from being a line on a 1:100,000 map marking a tentative future right-of-way[35] to become the country's largest ever infrastructure project. Key points to be examined in the project's evolution would include the following:

- its first formal mention in TAMA 3 (the national master plan released in 1976);
- its more elaborate appearance as a portion of a ring road in the study of long-range plans for the central region;
- its inclusion in TAMA 31 and subsequent updates;
- its institutionalization through two special laws;
- and the formation of the Trans-Israel Highway Company.

Such a study would need to examine the roles of influential bodies and agents—MA'ATZ (The Public Works Department), the Trans-Israel Highway Company, the National Planning Council, the Ministry of Finance, the community of transportation planning and research professionals)—as well as the surprisingly subdued roles of the Ministry of Transport, the Ministry of Environment, and municipalities in the Tel Aviv and central region. The opportunities for and the impact of input from the organization of residents along the right-of-way and of "green" organizations would deserve special attention, as would the gaps between declarative commitments to intermodal, integrative planning on the one hand and substantive progress on the other.

The overall picture is one in which a single road project grew in dimensions and solidity in the absence of—and at times in opposition to—a series of transport planning norms and recommendations, while other recommended transport solutions languished for lack of funds and leadership.

The concern of the present report, however, is a synchronic analysis of the Highway's evaluation and planning, rather than the kind of historical analysis of the planning and decision-making processes sketched above.[36] A review of the project's evolution and central documents underscores key areas of deficit in this process. The overall picture is one in which a single road project grew in dimensions and solidity in the absence of--and at times in opposition to--a series of transport planning norms and recommendations, while other recommended transport solutions languished for lack of funds and leadership.

Specifically, the project fell short of desirable standards for integrated transport planning in the following ways:

- It was not guided by national-level transportation goals or criteria such as might be found in a transport master plan.
- Though statutorily approved within the TAMA 31 National Outline Plan, the project strikingly contradicts its stated national transport and land-use policies.
- It was not genuinely integrated with other modes of transport (as opposed to after-the-fact accommodation) in the sense that:

  1) there was no systematic <u>comparison</u> of alternative ways to meet needs.
  2) there was no consideration of the highway's <u>negative impact</u> on other modes.
  3) there was no fundamental <u>integration</u> of the highway with other modes.
  4) rail development was considered only as a "<u>sensitivity test</u>" using inappropriate modal splits, <u>after</u> Highway construction, and in a policy vacuum.

- Its effects on land-use and urban form--especially suburbanization trends--were poorly considered.
- There was no assessment of area-wide and cumulative environmental impacts.
- The road's transport functions are vaguely specified, and in partial conflict with one another and with the proposed staging of construction.
- Travel demand modeling was based on an extrapolation of current transport policy--or, more accurately, its continued absence.

It is not exaggerated to say that **the Trans-Israel Highway was proposed, planned, advanced, and evaluated mostly as a <u>road project</u>, rather than a <u>transport solution</u>**, and emerged from bodies responsible for road-building, rather than from those with more comprehensive regional and national planning considerations.

INADEQUATE GUIDANCE BY NATIONAL-LEVEL PLANNING

The Trans-Israel Highway will affect land use, commuting and motorization patterns in the central region (where over half the country's population live,[37]) and beyond. A project of this scope should make reference to, if not be guided by national and regional transport policies and planning goals.

Israel, unfortunately, does not have the kind of national-level transport master plans or white papers that many European and other developed countries have. These plans, which could serve as models for Israel, typically attempt to meet national economic needs while reducing the dominance of automobiles and achieving quality of life and environmental goals. The goals are often in the form of specific targets for the redistribution of modal split, achievement of tolerable pollution, noise, and road injury levels, etc.[38] Nor does Israel have the kind of inter-agency transportation authority emerging in some countries.[39]

The fact that such a major project as the Trans-Israel Highway could be discussed and approved in the absence of (still unavailable) national-level transport criteria, objectives, and targets underscores the need for such a plan and authority. In its absence, critical transport assumptions will tend to be made by default or by the more powerful actors. Thus the project's traffic modeling and economic appraisal were based on critical assumptions that were never subject to the broad debate and systemic scrutiny they deserved. For example, these included assumptions that motorization rates will saturate at 500, and that future modal splits will reflect the absence of substantial public transport development and of policies to encourage modal shift.

In the absence of a transport master plan, guidance might have been sought in TAMA 31, the planning master plan drawn up in the early nineties, or other Israeli policy documents then available. However, it seems that the Highway was never systematically evaluated in the light of the kind of transport/land-use concerns contained in these documents (discussed below), nor the considerable body of international transportation planning wisdom they reflected.

POOR INTEGRATION WITH LAND-USE, INTERMODAL, AND DEMAND MANAGEMENT CONSIDERATIONS

The lack of inter-modal planning was a central shortcoming. It is by now well recognized that once a region's transport needs are defined (a process also inadequately handled--see below), the full range of transport modes and planning solutions that can meet these should be considered at the earliest stages of planning, their relative costs and benefits weighed, and their interactions considered, in order to put together an optimal package of measures. "Transportation should be managed as a multimodal, coordinated system. A full range of alternatives should be considered, including demand management and low-cost operational improvements."[40]

Current World Bank guidelines on transport, for example, state that[41]

> The process of preparing a project should include an evaluation of the full range of modal possibilities, including non motorized transportation and modal integration and interchange facilities within the sector strategies, as well as consideration of a variety of options at the project level.

Similarly, one of the most significant pieces of transport legislation in the U.S., the Intermodal Surface Transportation Efficiency Act of 1990 (ISTEA), was designed to overcome the problems that result from a lack of inter-modal planning. The Act states that[42]

> Corridor and sub-area studies shall evaluate the effectiveness and cost-effectiveness of alternative investments or strategies...The analysis shall consider the direct and indirect costs of relevant alternatives.

A second area in which the planning was lacking was its isolation from land-use considerations. One of the clear-cut lessons of recent decades has been the interaction of land-use and transportation phenomena,[43] and the tight coupling between suburbanization on the one hand, and increases in motorization levels and highway provision on the other.[44] A transportation project does not simply meet travel demand, but creates new and longer trips by easing travel in the short term, and attracting development in the longer term. For this reason, transport planning--and highway development in particular--should be inseparable from land-use planning.

In short, the provision of new highway capacity is only part of the supply side dimension of modern transport planning, which is in turn only one leg of an intelligent and coordinated approach to improving access and relieving congestion that also includes demand management and land-use measures.[45] Other supply-side interventions include the improvement or provision of new transit facilities (bus, rail, para-transit), the upgrading of existing road facilities, and improved traffic signalization, traffic engineering, incident detection, etc. Measures for managing transport demand include the provision of alternative transport modes and/or services for commuters, incentives for travel at non-peak hours, and the introduction of growth management or traffic impact policies into development decisions. In the long term, however, the most fundamental transport solutions for Israel will require careful attention to the zoning and land-use plans that shape trip-making patterns, volumes, and modal distributions.

The principles of integrated transport and land-use planning recommended in other countries, should apply even more forcefully in Israel. With rapid growth in population and rising incomes, a primary focus on increasing road supply is futile if not self-defeating, since even the most heroic improvements will contribute to and be swallowed up by a growth in kilometrage averaging over 11% a year in the early nineties.[46] Even significant investments in road-building have managed to add less than 2% in road length annually in the nineties.[47] And while increases in road supply will never match the growth in travel demand, they will foster car-dependent land-uses and lifestyles that undermine other transport alternatives.

The increased motorization that new roads are built to accommodate is not an inevitable consequence of increased income. Cities with almost equivalent high levels of real per capita wealth can vary widely in their motorization levels--depending on their urban densities, the degree of restraint on road and parking infrastructure provision, and the provision of public transport and possibilities for non-motorized movement that offer competitive travel times.[48]

While there may be need for some additional road capacity as part of an overall transportation and land-use package, it seems inappropriate for a massive transport investment decision to be made in isolation from planning that takes this overall background into account. Transport investments, especially substantial ones in the critical years of the nineties, should be part of more general attempts to coordinate the spatial distribution and intensity of land use with the strategic provision of an integrated network of transportation services.

COUNTER TO RECOMMENDATIONS OF MAJOR TRANSPORT PLANNING DOCUMENTS

These principles were indeed well recognized in key Israeli planning documents issued by government and professional bodies over the course of the late eighties and the early nineties. These firmly stated the necessity for integrated land-use and transport planning, for restraining motorization growth and suburbanization, and for the correct mix and timing of investments in public transport versus highways. Yet their recommendations did not seem to impinge on the Highway's evaluation and planning.

For example, on May 3, 1988, after hearing reports and reviewing the issue of commuter rail in the Tel Aviv area and "noting the seriousness of the transport situation," the **National Council For Planning and Construction** formally declared that "the planning of mass transit was of the highest priority," and ordered the Ministries of Transport and Interior, in consultation with the Ministry of Finance, to prepare a policy report on the subject within two months, and asked the Regional Councils to ensure that the rights-of-way for commuter rail were safeguarded.[49] On July 2 the resulting report which sketched the advantages and necessity for rail solutions was approved by the Council with minor changes. This report concluded that:

> there is a need to move the execution of rail forward immediately, especially in the Tel Aviv metropolitan area. Additional delays on this issue will accelerate the transfer from public transport to private cars, the degeneration of travel quality, amplify and continue [wasteful] sprawl and suburbanization...

The Council recommended to the government that rights of way and adjacent service areas be safeguarded, that planning agencies give priority to planning procedures related to rail, that resources be devoted to this essential task, and that as part of comprehensive transport planning the various involved agencies cooperate in the planning of rail solutions.[50] In its conclusions, under the section on the "Timing and Proportionality," the council noted that:

> Land use and transport are naturally related. For example, if the principle of preferred use of public transport is accepted, but in the initial years budgets are invested in highway projects, the process of rapid fringe development will continue, development that depends, among other things, on the growth of private car use. Such development will sooner or later create a situation in which <u>it will be impossible to invest in intensive public transport</u> for political and other reasons. Therefore, the preparation of <u>target plans for the year 2010 is not sufficient.</u> Staged development plans are needed, development plans designed to achieve urban goals; goals in the sphere of land use and the location of work and residences. The proposed Metropolitan Authority will prepare such staged master plans according to which it will be impossible to forward one stage <u>without the completion of the necessary elements</u> of the prior stage. The plan will include all modes of transport, roads, rail, and other forms of public transport. [underlining in original]

In the following years (1990-1), however, no major gains were made in public transport planning or investment while MA'ATZ made the Trans-Israel Highway a central project: it was included as a central project in their 5 year plan (1990), featured prominently in the 1990 report on road investments in the central area for the year 2010 commissioned from the Israeli Institute for Transportation Planning and Research (IITPR),[51] and was the focus of an extensive feasibility study (1991).

Thus the road-planning apparatus was in high gear on this project, largely in isolation from general transport or land-use planning considerations. The 1991 feasibility study, for example, considered the value of the project without mention of alternative transport measures or integration within an overall transport or land-use considerations. Such considerations appear only as parenthetic qualifications in the report on the road system in 2010, which focused entirely on various road solutions to the central region's transport needs--taken to be primarily the relief of congestion.

Thus the Five Year report mentions in a footnote that its modeling did not consider the likely impacts of roads, and of the Trans-Israel Highway in particular, on land-use, and thereby population distribution, and traffic flows.[52] Interestingly, the Five year Plan mentions that its modal split was calculated based on the assumption of "massive rail development," including suburban and light rail connections (to Herzliyya, Petah Tikva, Ben Gurion Airport and Lod, Bat Yam, and Rishon LeZiyyon, with a ring line through central Tel Aviv, and with "excess demand" taken up by light rail in the area bounded by Routes 1, 4, and 5).[53] This assumption of extensive rail development was elaborated in a subsequent (1992) report by the same body, the **Israel Institute for Transport Planning and Research**, prepared at its own expense in order to provide a "more realistic picture" of traffic flows than allowed by the parameters dictated to it in the MA'ATZ-commissioned study. This report, strongly supportive of the Highway, is prefaced by the following warning:[54]

> It is worth emphasizing and noting that the travel matrices found at the base of the test [of traffic flows and economic feasibility] assume that there will be a substantial investment in public transport, that is commuter/suburban rail, light rail, and special lanes dedicated to public transport. The implication of this substantial investment is in enabling us to assume that the modal split between private cars and public transport will be 65% travel in private cars and 35% in public transport. In the event that for various reasons the investments in public transport are not made there is a high likelihood that the demand for Route 6 will grow, that is the demand for the use of private cars, but in parallel there will be a collapse of the system of planned land use, in other words the

development of land in the metropolitan area will not be according to the existing and approved plans but according to pressures.

As mentioned below, later modeling and evaluations of the Highway by the Trans-Israel Highway Company dispensed with even such wishful flourishes and warnings about the need for a multi-modal solution.

TAMA 31, the **National Outline Plan** that appeared over the course of 1991-3 included the Trans-Israel Highway, though the project seems to be detached from or even contradictory to some of this document's central stated national and regional goals. TAMA 31's strategic development principles for the central area repeatedly warn against sprawl, especially close to the Tel-Aviv Metropolitan area, given the tremendous development pressures and the conversion of agricultural areas to other land uses spurred by the crisis in agriculture.[55] The document urged that suburbanization be stemmed through encouraging self-contained medium density settlements that would reduce commuting to Tel Aviv and which could be viably served by public transport.[56] In order to break out of the vicious circle it saw emerging--in which rising motorization leads to a deterioration of public transport, giving rise to further car use--TAMA 31 repeated the policy statements of the Ministry of Transport from 1975 on the restraint of private car use,[57] and reaffirmed the need for fiscal and other measures to accomplish this. The master plan explicitly argues that Israel's highest transportation priority is a massive and immediate investment in public transport even if this initially harms the level of service to private cars.[58] It is difficult to understand how these warnings and proposals can be reconciled with the Highway's anticipated impacts, or to find traces of attempts to do so.

> **While the Highway appears in TAMA 31 (the National Outline Plan) it seems to be detached from or even contradictory to some of its central stated national and regional goals. The master plan explicitly argues that Israel's highest transportation priority is a massive and immediate investment in public transport even if this initially harms the level of service to private cars.**

THE HIGHWAY MOVES FORWARD AS OTHER MODES ARE NEGLECTED

In addition to laying out a general orientation on the role of transport in achieving the country's planning goals, TAMA 31 made a number of specific suggestions, such as the creation of dedicated bus lanes, the expansion of rail service, and the formation of a supra-jurisdictional body to accelerate the improvement of the public transport system. While there has been negligible progress in these other areas, the Trans-Israel Highway has moved rapidly forward.

Thus, at the end of 1992 the Cabinet approved the establishment of the Trans-Israel Road Co. Ltd., whose goals were to do the planning, statutory, and financial groundwork necessary to advance the execution and operation of the Highway. The company was incorporated the following year, and began the necessary surveys and preparation of two special laws required to expedite land appropriation and seek international bids for the highway as a toll road. The head of MA'ATZ was appointed to direct this new company.

While the clear-cut and relatively familiar task of road-planning went ahead, the range of other transportation measures given priority in the late eighties were the responsibility of several uncoordinated and in some cases less powerful agencies: the Ministry of Transport, the Rail Authority, the Tel Aviv Municipality, and others. The proposed unified authority never emerged. Embraced in principle, these measures--the development of public transport and rail in particular--languished in practice;[59] a decade later almost none of the repeated recommendations have been implemented.

LACK OF PROJECT ALTERNATIVES

Under these circumstances, the Highway did not emerge as the superior solution among a range of other investment choices, but simply by default as the sole project that had powerful agencies to support it. The evaluations that were done were prepared by the organizations responsible for planning and building one mode of transport (roads)--the Public Works Department (MA'ATZ) and subsequently the Trans-Israel Highway Company. The cost-benefit analyses prepared by the former in 1991 and the latter in 1995 were more demonstrations of the worth of a project that had been chosen than tools for deciding among projects.

Thus the bodies that played a role in approving the project (such as the National Planning Council) could not be, and never were, presented with a range of options or a package of transport measures, only with a simple decision of whether to approve or reject a highly developed road scheme. The absence of alternatives in the process is reflected in the frustration voiced by the late Member of Knesset, Ariel Weinstein, in the Knesset Finance Committee discussion of the Highway on August 8, 1994, prior to the approval of the Trans-Israel Highway Law. After repeated unsuccessful attempts to discover the existence of any governmental alternatives to the proposed Highway, this Knesset member made clear the unsatisfactory circumstances in which he was forced to give his approval of the project.[60]

"I expected to come here and hear alternatives. Alternatives are a document opposite a document, that we can have some struggle of ideas, that one person will say he thinks we need a road, and another will say he thinks we need rail. To my sorrow this didn't happen. We didn't get any alternatives here."

-- Member of Knesset at the Finance Committee discussion of the approval of the Trans-Israel Highway Law.

> I think it's a good thing that the meeting opened with a general hearing of the issues. I expected to come here and hear alternatives. Alternatives are a document opposite a document, that we can have some struggle of ideas, that one person will say he thinks we need a road, and another will say he thinks we need rail. To my sorrow this didn't happen. We didn't get any alternatives here. We have the road and they say: this is what is before you. If there was an alternative here we could have had a discussion and turned to the government to develop this second alternative. It is not we that have to think of alternatives, we can raise questions if alternatives are available, but we have no tools to think of alternatives, only to be judges, and we can't be judges if there is no alternative. I have, as I said, an intuition, that this project is needed. On the other hand I fear that when this business is finished the road and entrances to it will be swamped with vehicles. .... So what is the alternative I have before me as a member of the Committee. I can demand that they abandon the road until we get some alternative, a different document. Another document will hold the story up for 5 years, and I can't come and say that. Therefore I think we have no choice. I think it's a scandal that there isn't an alternative and I say this to the generations of Governments, and to the generations of Transport Ministries, who didn't come to us with another document against these pretty documents here. I can't take it upon myself to postpone the discussion for 5 or 10 years, and I think therefore that we have no choice but to enter into this business, with all the protest and scandal of it.

INTENSIVE RAIL IMPROVEMENTS--ONCE PREREQUISITE, NOW UNLIKELY

The feasibility studies published in the later stages of project development by the Trans-Israel Highway Company have largely dispensed with any serious commitment to modal integration or the "massive rail improvements" assumed in the project's earlier feasibility studies. These improvements are now treated not as prerequisites (as described above) but as a sensitivity test whose likelihood of occurring is described frankly as "understandably very small."[61]

The sensitivity test demonstrates (to companies bidding to profit from toll income) that even in the unlikely case of accelerated rail development, traffic volumes on the Trans-Israel Highway would decrease by only 6%.[62] It should be noted that the inconsequentiality of rail is based on 12-14% of morning peak hour kilometrage being done on rail--an assumption that could be invalidated by modeling modal splits on comparable peak hour travel in European metropolitan areas of comparable densities, rather than country-wide averages, or by assuming an altered policy regime that encouraged modal shift. With rail development now the unlikely "sensitivity test," the base-line assumption of the Trans-Israel Highway Company's evaluation was that[63]

> public transportation in Israel is not expected to undergo significant changes before the year 2010 at least...Within the analysis period [of thirty years] no light or underground railway is scheduled for construction. Motorized public transportation... is expected to undergo minor changes: buses will be granted exclusive right-of-way on additional sections of Route 6 [the Trans-Israel Highway] and the standard of service will improve somewhat for this and other reasons. From the passenger vehicle owners viewpoint, however, public transportation will continue to be the inferior solution.

These projections are likely to be self-fulfilling. While the Trans-Israel Highway Company is currently funded at significant levels that are, as described below, likely to further increase, rail plans are frozen for lack of budget and bus ridership is shrinking. Of the 804 million shekel budget request by Israel Rail for 1997, for example, only 94 million was approved, leading to a virtual freeze on all development including the budgets for the remaining projects assumed in the early modeling of the Trans-Israel

> **"Public transportation in Israel is not expected to undergo significant changes before the year 2010 at least...Within the analysis period no light or underground railway is scheduled for construction."**
>
> **-- Trans-Israel Highway Company "Traffic Forecast and Economic Analysis" (1995).**

Highway.[64] It is doubtful whether the promised exclusive right-of-way for buses on the Highway will materialize.

VAGUELY SPECIFIED AND CONTRADICTORY TRANSPORT FUNCTIONS

At different stages of the highway's planning, and to different audiences, project proponents have declared a range of functions for the road: bypass for north-south travel, partial ring-road; congestion relief; connecting the northern and southern peripheries (Galilee and the Negev) to the center of Israel; suburban service road for development east of Tel Aviv. While "flexibility" is a virtue, in this case the vagueness of goals seems to stem from inadequate consideration of the country's actual transport needs, the best means to serve these, and the interactions of transport and land use. Because the travel demand modeling done prior to the project's approval to evaluate the highway's capacity and feasibility was insensitive to land-use changes, induced traffic effects, or the effect of tolling levels, the Highway's actual functions hinge on factors not properly considered in advance.

Of central concern is the likelihood that the central portion of the Highway now being planned will encourage and largely serve rapid and inadequately controlled development alongside the road, east of Israel's densely populated Tel Aviv region. With the current lack of convenient alternatives to the private car and with the growth of land-uses that emphasize commuting and car dependency, development already underway in this region will rely heavily on the Highway. In the longer term, the development of housing, industry, shopping, and recreational facilities alongside the road is explicitly presented as an advantage of the project in both MA'ATZ and the Trans-Israel Highway Company feasibility studies,[65] and anticipatory development is already occurring.

The experience with the Geha and Ayalon freeways should give us pause. Both roads were designed as easterly north/south bypass roads for Tel Aviv and now serve as suburban freeways approaching the upper limits of their capacity.[66] Even without considering the additional traffic and land-use changes the road would induce, the researchers who conducted the modeling of the road system for 2010 that recommended the Trans-Israel Highway were forced to consider a <u>further</u> longitudinal road, east of the Trans-Israel Highway, "which could become essential in the long term (i.e. after 2010)."[67]

> **The function of connecting the periphery to the center--critical for selling the road to the public and to decision-makers in the project's early stages--seems a distant prospect in practice and is likely to be undermined by its functions as a suburban service road.**

The large number of interchanges spaced every few kilometers in the road's central portion (12 in the section between Road 57 to Road 3), and the absence of strong zoning policies around these underscore the Highway's potential to create and serve local traffic. It is unclear how this will interact with the proposed ring-road and congestion-relief functions. The function of connecting the periphery to the center, ideologically critical for selling the road to the public and decision-makers in the project's early stages, seems a distant prospect in practice and is likely to be undermined by its functions as a suburban service road.[68]

Finally, claims about the congestion-relieving functions of the highway were not adequately tempered by current knowledge about the limitations of expanded road supply as a solution to congestion. Latent demand and the mispricing of congestion may largely undermine the relief due to new road capacity.[69] While it will be possible to limit congestion on the Highway itself through raising tolls, these raised tolls will reduce the Highway's congestion relief effects on other roads which will be additionally worsened by the induced traffic due to the Highway.

NO FORMAL ASSESSMENT OF CUMULATIVE AND AREA-WIDE IMPACTS

The project's effects were not adequately appraised at the area-wide or "strategic" level. Such an assessment would extend beyond the direct physical impacts of the project to consider its net cumulative effects: the differential physical, social, economic and other impacts over the project's lifetime of the "build," "no-action" and alternative transport solution scenarios. Such an assessment was demanded in an appeal to the High Court of Justice (BAGATZ) by the Israel Union for Environmental Defense for an Environmental Impact Assessment that was comprehensive and comparative, rather than the segmental non-comparative evaluation proposed. Project proponents fought fiercely and successfully against this kind of project-level comprehensive environmental impact statement that would have addressed the project's broader implications.

While the court's decision was justified within the rudimentary development of Israeli environmental assessment procedures and law, which were inadequate to force the necessary assessment, the resulting lack of comprehensive evaluation ran contrary to the standards and procedures of many developed countries, and the U.S. in particular.[70] The need for evaluation of highway impacts at the regional, corridor, or conurbation level--increasingly recognized in the transport planning profession over the last decade or more--is clearly stated in the conclusions of the 1994 UK SACTRA (Standing Advisory Committee on Trunk Road Assessment) report discussed later in this paper:[71]

> Proper account [must] be taken of the influences of road supply on road traffic demand at the aggregate national level...Routes should be assessed in their entirety for environmental reasons....The consequences of trunk road improvements for the pattern of land-use and development also need to be considered primarily at regional or corridor level; since traffic is stimulated in part by network quality, induced traffic effects [discussed below] must be considered at the wider network level.

Expert testimony brought by the Highway Company claiming that the consideration of basic alternatives should be done at the planning, rather than evaluation stage, runs counter both to the axioms of EISs and ignores the fact that such consideration did not occur at prior stages.

EVEN NOW, THE PROJECT REMAINS INADEQUATELY LINKED TO LAND USE AND MULTI-MODAL PLANNING

Because the Highway did not emerge from nor was it linked to principled national or regional policies, its transportation and land-use implications remain unclear even at this late stage. In their September 1996 report on urban transport,[72] the transportation team of the recently completed **2020 National Master Plan** warns that the development of the Trans-Israel Highway could prove a blessing or a curse, depending on the land uses around it, the provision of high quality public transport to the region (including rail solutions along and perpendicular to the road), the creation of employment centers that form strong independent foci, rather than sprawl, and the development of lateral connecting roads.

Without strong government policies in these areas, claims the 2020 report, there is a danger that the Highway will encourage California-style low-density bedroom communities along its path, devour open space, deepen car-dependency and worsen congestion. "For this reason," conclude the authors, "the decision of whether and how to construct the Highway must be based on general development policy considerations." It is worrying that this sound advice about "if and when" came after detailed planning and approval were completed and almost a year after the opening of international bidding on the project. There is still little clear policy in any of the key areas they point to even as options are steadily foreclosed.

The Highway should be part of a land-use and inter-modal package. Forceful policies will be urgently needed in order to compensate for the lack of integration of land-use and zoning considerations into the early stages of thinking about transport solutions for Israel's central region. On April 5, 1994 the National Council Planning and Construction created a steering committee in order to formulate principles for the planning of the strip along the Highway's right-of-way, a necessary if partial and belated measure. This committee published a draft statement in September of that year, recommending certain central principles (concentrated development, protection of open space and agricultural land, the exploration of development opportunities for communities along the right of way, long-range and comprehensive planning).[73] The report warned that existing plans and tools were inadequate to ensure these, and recommended the formulation of a plan that would encompass an area of several kilometers to each side of the road, that would establish at the national and local level the principles for development, land use, and other transport modes in this area, and would have the power to enforce these. As of this moment, however, no such plan exists, and the compensation arrangements for expropriated land--on which future land-use patterns hinge--have not been established.

CONCLUSION

Despite well-recognized principles of transport planning and the recommendations of Israeli planning institutions, a road project has reached advanced stages of design without being properly linked to comprehensive transport or land-use planning, nor subject to an evaluation of its cumulative and area-wide impacts. The political power and effectiveness of the bodies responsible for road design and construction and the lack of coordination and political power of the agencies responsible for overall and public transport planning, has resulted in a situation in which Highway planners are not simply executors of a portion of Israel's transport system, but have become *de facto* definers of critical aspects of the country's transport policy, and the land-use future of its central region. *Post-hoc* zoning measures and accommodations of the road to other transport modes are scant substitutes for genuine planning, and even these are scarcely in place.

CHAPTER 3

THE TRAFFIC FORECAST AND ECONOMIC ANALYSIS

THE COST-BENEFIT ANALYSIS: OVERVIEW AND CHRONOLOGY

A country with limited resources, especially in an era of budget cuts, must carefully weigh the value for investment of given projects. A cost-benefit analysis is one tool that allows decision-makers to make explicit and carefully consider all the consequences for the general economy--for better and worse--of a given course of action. Once the benefits and costs of a project have been quantified a "net" benefit calculation can be done, and compared with that of other projects designed to achieve similar goals.[74]

While other methods of evaluation have been suggested and used for transportation infrastructure projects, the widespread use of cost-benefit analysis makes this a good place to start discussion.[75]

The cost-benefit analysis discussed below was conducted by the government company created to advance the Highway plans, and prepare a call for international bids for the project. As mentioned, the analysis did not compare a range of solutions, but demonstrated that a single solution--the Highway--would yield a high return on investments. This was done by comparing travel on Israel's road system under a "do-nothing" scenario with travel after the construction of the Highway.[76] The costs considered were land acquisition, construction, and periodic and ongoing maintenance. The benefits considered were time savings and reduced operating costs. **Appendix A** contains a copy of the cost-benefit analysis of the Highway.

The evaluation conducted for the Trans-Israel Highway was considerably less comprehensive than those standard in many developed countries, and certainly less complete than the kind of cutting-edge procedures practiced in some.[77] In particular, the following costs were not adequately considered.

ITEMS ABSENT FROM TRANS-ISRAEL HIGHWAY COST-BENEFIT ANALYSIS

- **Air pollution: not calculated.**
  Claimed reductions due to shorter routes, higher speeds, and diversion eastwards are likely to be more than offset by induced traffic, development around the highway, and those more costly pollutants (SO_X and NO_X) whose production increases with speed.

- **Road injuries: not calculated.**
  Claimed reductions due to safer travel on a higher quality road are likely to be more than offset by increases in injuries due to raised speeds throughout the network if the claimed congestion relief occurs, and the entirely new travel induced by the Highway. If the legal limit of the Highway is higher than that on other highways, raised average speeds and the speed spillover effect onto other roads will lead to further added costs.

- **Severance: not considered**
- **Relocation of infrastructure: not considered**
- **Disruption during construction: not considered**
- **Visual obstruction and intrusion: not considered**
- **Traffic noise: not considered**
- **Recreation and amenity loss: not considered**
- **Cultural and heritage asset conservation: not considered**

Appendix B presents a timeline of British and American developments relevant to the economic appraisal of road schemes. This underscores the fact that the precedents and models for a far better appraisal than was performed have been around for a long time. While Israel lacks the resources of countries like Britain or Germany, it is unacceptable that a major transport project did not benefit from adequate evaluation in so many realms.

While cost-benefit analysis is a useful tool, widely accepted since World War Two for the evaluation of public expenditure projects, it must be correctly understood. It is not so much a measure of a project's value in real terms as a tool for comparison, clarification, and consensus-building. By forcing us to make explicit the range of costs and benefits considered, and the value given to each, the decision-making process can be made transparent. A cost-benefit analysis used to simply give the value of a project is far less useful than a comparison of several solutions.

A comparison of a series of traffic forecasts and economic analyses of the Trans-Israel Highway gives a window into their vulnerability to background assumptions. While each of these analyses used similar modeling software and was produced to demonstrate the project's necessity and high value, there is considerable variance in their central results with respect to the Highway's cost, value, and scale.

The MA'ATZ modeling performed in 1991, for example, found that the road system in 2010, a few years after completion of the Trans-Israel Highway, would be completely jammed, with average speeds approaching zero.[78] Even after the "correction" of especially congested sections of road and intersections, the models produced "unreasonable" results. The report dealt with the issue by stating that "we must assume that the problem will be solved by lengthening the rush hours, changing destinations, or giving greater emphasis to mass transit."[79]

The MA'ATZ modeling performed in 1991 found that the road system in 2010, a few years after completion of the Trans-Israel Highway, was completely jammed, with average speeds approaching zero.

In order to continue their calculations nonetheless, the modelers assumed that traffic volumes would be only 80% the figures produced by their models.[80] This left a highly congested but working system (an average speed of 20 kilometers an hour with the presence of the Highway). It was assumed that the tolling on the Highway would reduce traffic volumes considerably, and this reduced flow was used to calculate the necessary number of lanes in the highway's central portion (from Netanya to Gedera): 12 lanes in the central portion (south of Rosh Ha'ayin), 10 north of Rosh Ha'ayin, and 6-8 lanes elsewhere.[81] This 63 kilometer section of the Highway was estimated to cost 450 million dollars.[82] The savings in operating expenses alone gave a net present value of 4.4 billion dollars (internal rate of return of 62%), and with time savings added (estimated at 75,000 hours during each peak hour), the project's net present value rose to $7.4 billion (an IRR of 76%).[83]

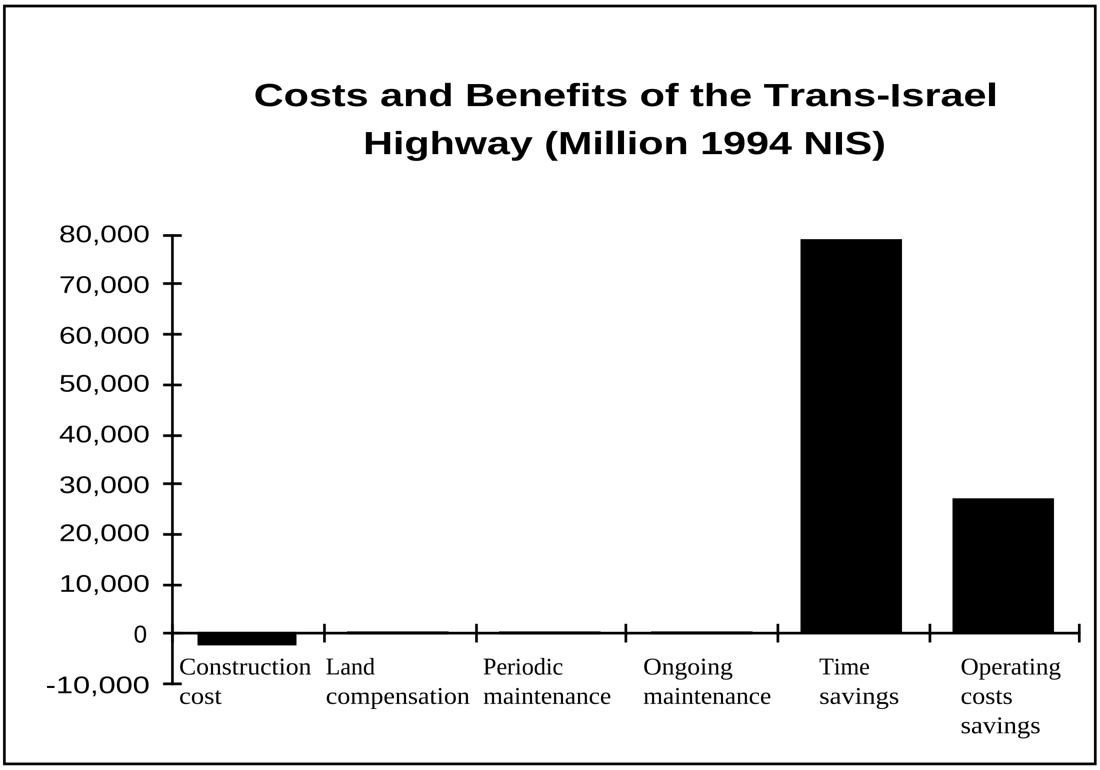
The following year, the Israel Institute for Transportation Planning and Research, dissatisfied with the parameters they had been asked to use by "an external agent" in preparing a cost-benefit analysis of the Trans-Israel Highway, ran the models again at their own expense with their own assumptions and a non-standard road network in order to obtain "a more realistic picture" of traffic flows.[84] The highway suggested by their models was 82 kilometers in length, 8 lanes in the center and 6 or 4 elsewhere.[85] It was estimated to cost $443 million and have an IRR of 29%

The modeling performed by MATAT (The Center for Transport and Traffic Planning) for the Trans-Israel Highway Company in 1995 also suggested a highway narrower than the MA'ATZ study, of 6-8 lanes, and 134 kilometers in length, which would cost $1.2 billion and whose vehicle operating cost and time savings yielded an IRR of 35%. Its net present value was calculated to be $34 billion (101.8 billion NIS), almost five times as large as that of the MA'ATZ study.

The MATAT study figures were used by the Trans-Israel Highway Company in lobbying for the Highway's approval before the National Council for Planning and Construction and the Government, and presented to the bidding consortium. They were, for example, the basis for the claim made to the Council that each year of delay in executing the project would cost the national economy one billion NIS,[86] and similar claims were made to argue against a comprehensive environmental impact assessment that might cause a similar costly delay.[87]

The breakdown of the costs and benefits of the Highway according to the MATAT analysis appear below in Fig. 6 and Table 5. Most of the project's benefits derive from time savings.

Figure 6. Breakdown of the costs and benefits of the Trans-Israel Highway



Source: Derived from the cost-benefit analysis presented in the Trans-Israel Highway Company "Traffic Forecast and Economic Analysis" (1995).

Table 5. Breakdown of the costs and benefits of the Trans-Israel Highway

ITEM	NPV (Millions of 1994 NIS)	% OF TOTAL COST OR BENEFIT
COSTS		
Construction cost	-2,571	69.8%
Compensation for economic value of land	-256	7.0%
Periodic maintenance	-417	11.3%
Ongoing maintenance	-437	11.9%
Total costs	-3,680	100%
BENEFITS		
Time Savings	78,669	74.6%
Savings in operating costs	26,819	25.4%
Total benefits	105,489	100.0%
TOTAL	**101,808**	

Source: Derived from figures in the Trans-Israel Highway Company "Traffic forecast and Economic Analysis" (1995).

THE EROSION OF TIME SAVINGS BY TRAVEL DEMAND ELASTICITY

As is evident from the cost-benefit table presented earlier in this section, seventy five percent of the calculated value of the Highway derives from estimated time savings.[88] These estimates, however, do not reflect a major methodological upheaval in traffic modeling over the last decade that has significant implications for the economic evaluation of project benefits, and time savings in particular.

The modeling of the Trans-Israel Highway does not reflect a major methodological upheaval over the last decade that has significant implications for the economic evaluation of project benefits, and time savings in particular.

Over this period, especially in the U.K. and U.S., there has been growing knowledge and concern over the elasticity of traffic demand with respect to travel costs, and in particular the phenomenon of "induced traffic"--new trips due entirely to the provision of additional road capacity. Because this phenomena can reduce the time-savings substantially below the level projected by conventional modeling procedures, these are in the process of being overhauled, and in England hundreds of roads approved under the old procedures were reevaluated. While this phenomena can be captured by a new generation of variable-matrix traffic modeling software, or partially compensated for by available procedures, it was not taken into consideration in the fixed-matrix models used by MATAT for the Trans-Israel Highway Company. Since the Highway is one in which induced traffic might be a major effect, this constitutes a significant gap in the project's evaluation.

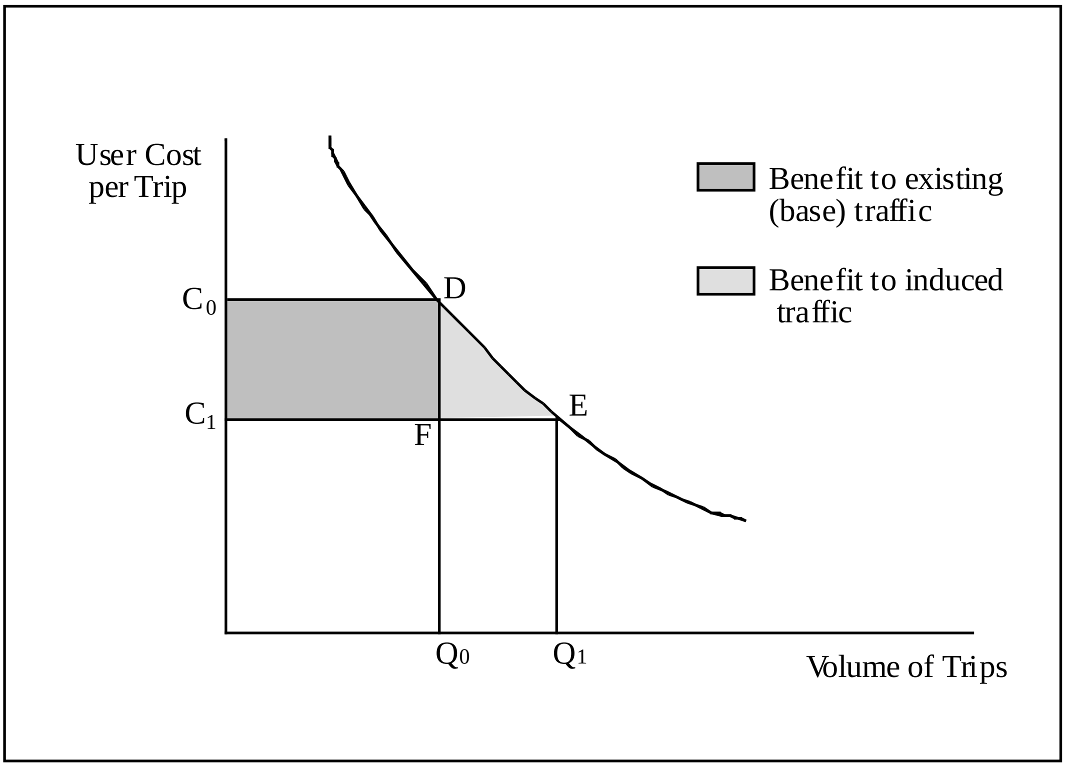
The following section gives a more extended introduction to the findings on demand elasticity and induced traffic, why they are inadequately captured by the conventional fixed matrix four stage models used to evaluate the Trans-Israel Highway, why the calculations of time savings may be substantially inflated as a result, and how the effect can be quantified and corrected for.

Very briefly, travel is like most other goods: the amount people consume depends on its cost. In other words, demand is elastic: if roads become congested people will travel less; if a new highway reduces the cost of travel, people will travel more. In order to calculate time savings (and thus project benefits) of the Trans-Israel Highway, traffic flows on the road network with and without the road were computed. However, because the software procedures used assumed an inelasticity of demand, traffic flows in both the "with-" and "without-highway" scenarios were unrealistic. Congestion in the "without" scenario was overestimated because suppression was ignored. And total traffic volumes were assumed to remain constant in the "with" scenario, disregarding new trips generated and the resultant degradation of travel times in a congested network. Because of both effects, the calculated relative time saving due to building the highway was considerably overestimated. The extent of this overestimate can be gauged and corrected for by considering a range of empirical findings on the elasticity of travel demand.

A brief overview of induced traffic

As with most goods, reducing the cost of travel by providing a faster route results in an increase in the overall volume of travel. Thus when cost falls from C_0 to C_1 (Fig. 7), the volume of trips rises from Q_0 to Q_1.

Figure 7. An elastic demand curve



Source: based on SACTRA Report, Fig. 8.1

Or, to put it differently for a congested road network, there is suppressed demand (trips foregone because their time costs were over a certain threshold) that are released once this threshold is lowered by a new road. More specifically, there is a range of behavioral responses to the provision of a new road, described in Table 6 below.

Table 6. Traffic effects of roadway improvements[89]

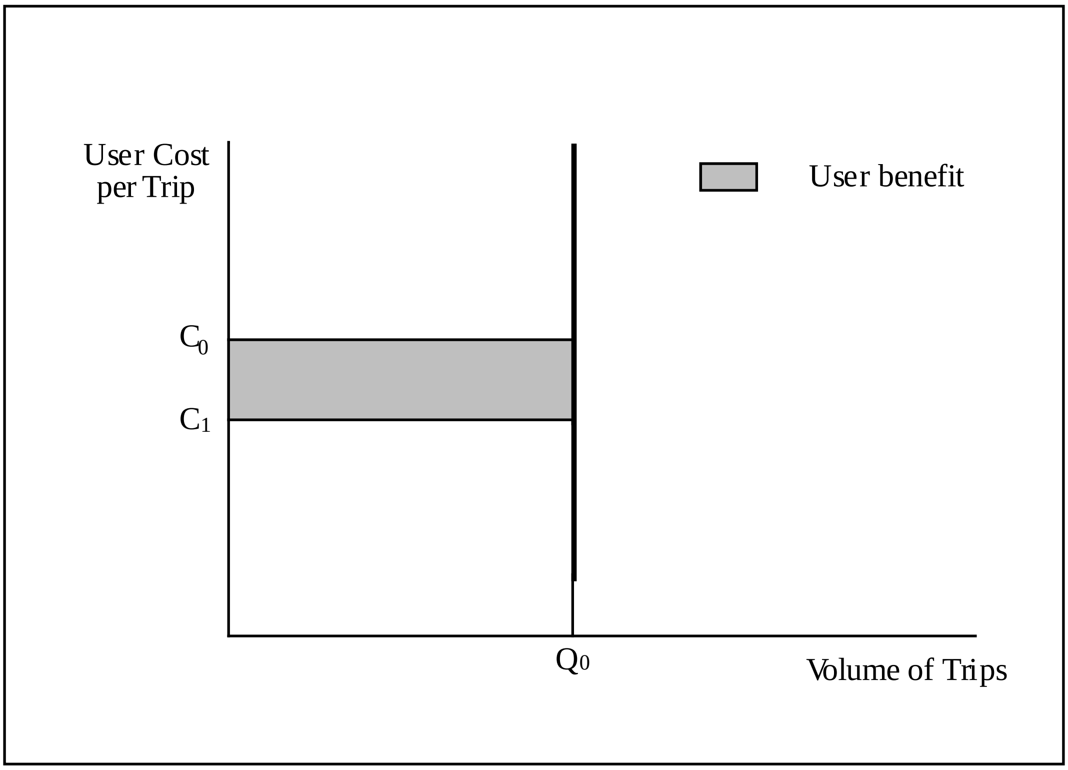
Effect	Description	Time frame	Travel Impact
Shorter route	Improved road allows drivers to use more direct route.	Short term	Reduction
Longer route and shorter travel time	Improved road attracts drivers from more direct routes.	Short term	Small increase
Time change	Reduced peak period congestion reduces the need to defer trips to off-peak periods.	Short term	None
Mode shift with no capital changes	Improved traffic flow makes driving relatively more attractive than other modes.	Short term	Increase
Mode shift with capital changes	Less demand leads to reduced rail and bus services, reduction in bike and pedestrian facilities, and more automobile ownership.	Long term	Large increase with equity costs
Destination change to current land uses	Reduced travel costs allow drivers to choose more distant existing destinations.	Short term	Increase
Destination change to new land uses	Improved access allows land use changes, especially urban fringe development.	Long term	Increased driving, auto dependency
New trip; no capital changes	Reduced travel time allows driving to substitute for non-travel activities.	Short term	Increase
New trip; with capital changes	Improved access increases activities that require driving and reduces alternatives to driving.	Long term	Increased driving, auto dependency

The generation of fixed matrix traffic forecast models of the kind used for the Trans-Israel Highway[90] were developed in the late sixties and early seventies. They were designed to help calculate the size and spatial arrangement of high-capacity freeways during an era in which highway construction was the overriding emphasis of the planning process.[91] These models were based on a sequential-independent four stage procedure, in which the output of each stage became the input for the following stage. In the trip generation stage of these models, socioeconomic data and existing motorization rates are used to estimate how many trips would originate in each geographic zone at different points in the future. The amount of trips generated is derived through extrapolating existing growth patterns in motorization rates and kilometrage as a function of population, income, etc. The next stage, of trip distribution modeling, takes as a given the trips originating in each zone and divides these among destinations. A separate mode choice procedure decides what portion of the trips between any given origin and destination pair would be made on each mode of transport. A final and separate traffic assignment procedure then places the trips made by car onto the available road network using the assumption that drivers will choose the optimal (quickest) route.

By placing future trips on an existing network, the extent and location of congestion is gauged. The effects of introducing a new road into this computerized network is then assessed by seeing how it affects congestion patterns. Travel time savings are derived from a comparison of network-wide travel times before and after the road's introduction into the network.

However, the trip generation stage of such models is not sensitive to road quality (i.e. travel times).[92] Because the four stages are independent, the same number and timing and mode distribution of trips is assumed to occur no matter what the road network looks like, and all the model does is calculate which routes the given traffic will travel on. To put it differently, the models assume the inelastic demand curve sketched in Figure 8, in which a reduction in the cost of travel (from C_0 to C_1) does not affect the amount of travel occurring.

Figure 8. An inelastic demand curve



Source: SACTRA report, Fig. 8.2.[93]

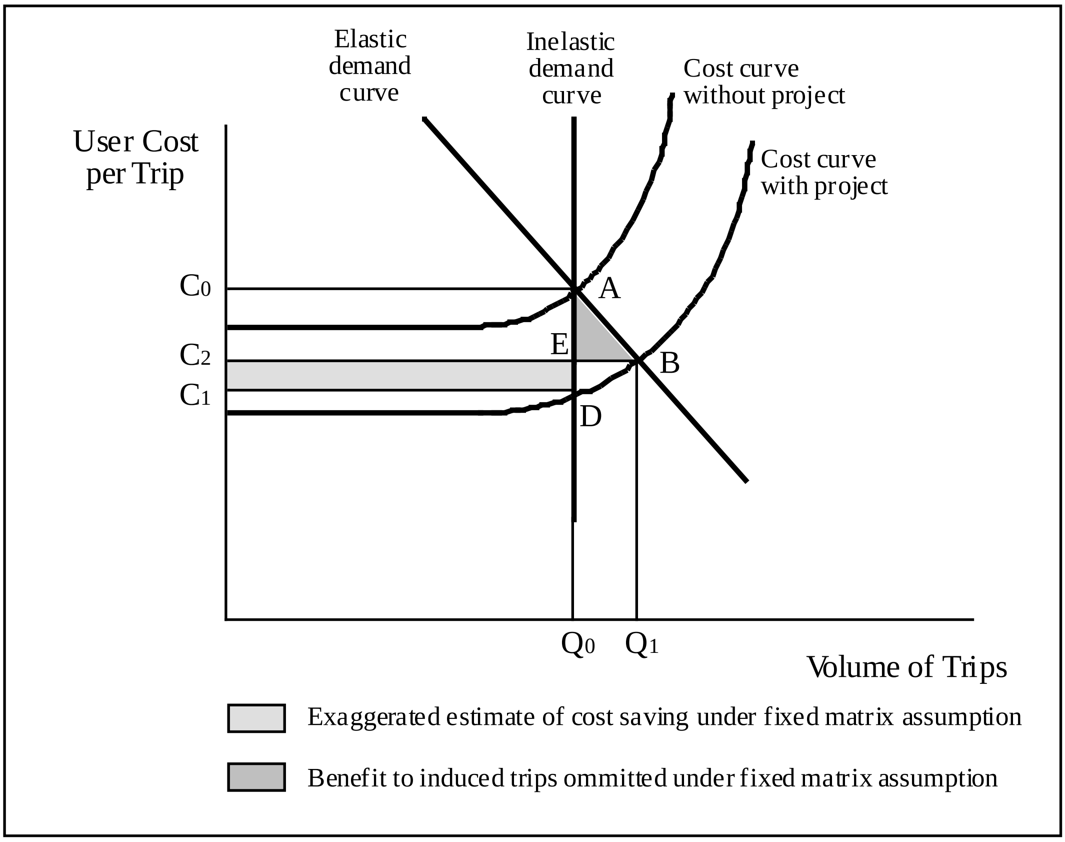
The modeling, therefore, does not reflect the range of changes in traveler decision-making that occur when a new highway lessens travel times and increases travel reliability. Only the first two of the many possible responses mentioned in table 6 are captured by the model: the re-routing of existing traffic onto the new road in order to achieve a reduction in trip time.

The range of responses that are ignored by these models are very significant, both geographically and in terms of reducing anticipated time savings. In the short term, by making travel easier the highway will promote new trips: if travel is cheaper (in time and cost), people will consume more of it. Paradoxically, the more "worthwhile" a scheme is--i.e. the more it reduces travel times--the more it will induce traffic. This affects time savings in two ways.

First, a good portion of the time "saved" by improved highway capacity goes into traveling more and further.[94] And these new trips will, by definition, tend to be of low value because they are travel that drivers decided to forgo until the marginal increase of convenience provided by the highway. On the basis of extensive empirical surveys, the SACTRA report described below estimates that up to 50% of the saved time goes on further travel in the short term, and up to 100% in the long term. Thus increased road capacity doesn't just reduce time spent on travel but allows the dispersal of activities, with much of the saved time being spent on more travel.

Second, in a congested network, new traffic raises the cost-per-trip for all traffic. Thus, in Fig. 9 below, a drop in cost-per-trip from C_0 to C_1 will raise the volume of trips from Q_0 to Q_1, and this new traffic will increase congestion (represented by the move from D to B) raising the cost-per-trip back to C_2. In other words, the area C_1DEC_2 must be removed from anticipated time savings.

Figure 9. Erosion of user benefits due to induced traffic



Source: SACTRA Report, Fig. 8.6[95]

The degree of this erosion of savings depends on several factors (especially the elasticity of demand and the degree of congestion), and some estimates are provided later in this chapter. While the tolled Trans-Israel Highway itself is likely to operate below the area in which additional traffic raises travel costs, this is not the case for the roads feeding to and from the Highway and the remainder of the congested network as a whole, so this erosion of benefits can be expected to occur.

In addition to--and perhaps more significant than--the short-term induced traffic, will be the traffic generated by highway-induced land-use changes, such as the growth of low-density car-dependent suburbs or ex-urban commercial areas. Over time, the greater car mobility enabled by the Highway creates structural changes (the distribution of dwellings and businesses, growth of car ownership, and the creation of diseconomies for other transport modes) and lifestyles that generate more and longer car trips. Empirical studies show, for example, how traffic volumes on a corridor with new highway capacity continues to grow over years, well beyond the steady slow growth in adjacent corridors in which capacity was not added.[96] These long-term impacts of the Highway were, as mentioned earlier, not systematically considered by any planning body prior to the highway's approval, nor were they reflected in the traffic modeling procedures of the Highway Company.

The growing recognition of induced traffic phenomena.

The objectives of transport planning have changed over the three decades since the kind of fixed-matrix sequential-independent four stage modeling were formulated. (The time-line in **Appendix B** lists some of these developments). During these decades, the unfeasibility of "predict and provide" approaches to transport planning that simply meet, rather than manage demand, became obvious, and over the last decade the empirical evidence for induced traffic phenomena and the inability of fixed-matrix models to capture these have become well recognized.

While one cannot hold a highway built in the past to the standards of contemporary transport planning, there are several reasons why the lessons of induced planning should have been and still can be applied to the Trans-Israel Highway.

First, the independent rerun in 1992 of the MA'ATZ projections for the Trans-Israel Highway by the Israeli Institute for Transportation Planning and Research, which acknowledged that induced traffic was not considered and included measures to bypass the creation of unrealistic congestion in the "do-nothing" scenario, indicates that the Israeli transport community was becoming aware of the limitations of fixed-matrix modeling prior to the MATAT/Trans-Israel Highway Company traffic forecasts prepared in 1994.[97] Overseas, the recognition of these problems was widespread in the transport modeling and planning community in the late eighties, In 1989 in the U.S., for example, five years before the MATAT final report was released, a well publicized court suit was filed against California transport planners by Citizens for a Better Environment and the Sierra Club largely because the fixed matrix models they used did not capture demand elasticity (suppression from congestion and induced traffic), and traffic-inducing land-use changes that were likely to significantly increase pollution levels after highway construction, rather than reduce them as claimed.[98]

> **"As soon as [the Great West Road] opened it carried 4.5 times more vehicles than the old route was carrying; no diminution, however, occurred in the flow of traffic on the old route, and from that day to this, the number of vehicles on both routes has steadily increased . . . These figures serve to exemplify the remarkable manner in which new roads create new traffic."**
>
> **--Bressey and Luytens (1938).**[99]

The California court ruled that the methods used were indeed inadequate, and ordered the delay of work on some existing projects and the postponement of decisions on significant new projects until adequate procedures were developed. The case, brought against a national leader in transportation planning, marks a fundamental transition in the field. From that point on planners were held to higher standards in predicting the regional impacts of freeway construction and upgrades, and especially their air pollution consequences. Improved analysis has become mandatory in all states and new litigation can be expected against agencies not complying.

The case injected energy into existing efforts toward a new generation of planning methods, leading to a 1991 DOT conference on "The Effects of Added Transportation Capacity" that focused on induced traffic,[100] culminating in the US DOT Travel Model Improvement Program (TMIP) initiative launched in 1992.[101] Under this initiative, the Department of Transportation in cooperation with the Environmental Protection Agency and the Department of Energy committed $25 million over the following 5 years to devise fundamentally new travel forecasting procedures and issued guidelines to improve existing models immediately until the new ones become available.

On an academic plane, Williams and Moore in a 1990 issue of the <u>Journal of Transport Economics and Policy</u>[102], developed a measure to relate project benefits under fixed versus variable matrix assumptions. This provided a measure of the error in approximations usually used in scheme appraisal, specifically the disbenefit resulting from induced traffic, which is not captured by the inelastic assumption of conventional 4 stage modeling. This was followed by a series of articles (Williams et al (1991); Williams and Lam (1991); Williams and Yamashita (1992)),[103] that presented a careful theoretical analysis tests of the errors introduced by fixed matrix assumptions and numerical modeling of their impact for a series of specific highway schemes under a range of conditions. Both approaches demonstrated that fixed matrix evaluation can considerably overestimate scheme benefits, especially under congested conditions.

The deficiencies of fixed-matrix modeling were also well recognized among transportation professionals in England, by the end of the eighties. The fact that the M25 highway had reached its projected 30 year capacity in a matter of months after being opened in 1986 spurred intense debate over generated traffic.[104] In 1989, the U.K. Secretary of State responded to years of critique by asking the Standing Advisory Committee for Trunk Road Assessment (SACTRA) "to review the circumstances, nature and magnitude of demand responses to road schemes"[105] (Its ground-breaking results published in 1994 are discussed below). A survey of 85 transport professionals in national and local government and academia in 1990 found that "there is a general belief that travel does respond to the provision of new road capacity in a variety of ways not modeled in fixed matrix methods, and that these responses may contribute significantly to traffic levels." [106] The trade journal publishing the survey warned that if these professionals' estimates of responses were correct, the current appraisal methods would overestimate the absolute value of schemes and distort their rank order in terms of cost-benefit ratios. It called for an urgent investigation into whether and in what circumstances the fixed-matrix assumption is tenable. A 1991 conference "What Are Roads Worth?" demonstrated that there was a growing perception that a major overhaul or even abandonment of current COBA techniques for road appraisal was needed.[107]

A survey of 85 British transport professionals in national and local government and academia in 1990 found that "there is a general belief that travel does respond to the provision of new road capacity in a variety of ways not modeled in fixed matrix methods, and that these responses may contribute significantly to traffic levels."

Despite these precedents from the years preceding the 1994 MATAT modeling, Israeli decision-makers were not notified of the debate around these models or of the implications of possible distortions in the forecasts. It is hardly the job of road-building companies to present professional developments that question the validity of its tried and tested tools. But mechanisms should be considered to allow the timely application of the most current procedures to future projects, especially those of national dimensions.

The intensive questioning of fixed matrix models that took place in the years prior to the MATAT modeling have since resulted in their institutional rejection in some countries, the re-evaluation of roads approved on their basis, the accelerated development of alternatives, and the adoption of interim corrective procedures. A major landmark here was the U.K. SACTRA report released in 1994.[108] This report by senior transport researchers and academics for the United Kingdom Department of Transportation (DOT) reviewed relevant theories and transportation models, empirical comparisons of the Department of Transport's own monitoring of predicted versus actual traffic on major trunk road improvements, and Europe-wide before-and-after studies of traffic flows on major improved roads. For example, traffic induction on several new highways led to major traffic increases within a short time after opening: 93% on the London Westway in 14 years, 131% on the M11 within 6 years, and 178% on the A316 within 9 years.[109]

Based on this evidence, the SACTRA report declared that the standard UK DOT evaluation method (the COBA procedure, which is significantly more sophisticated than that used for the Trans-Israel Highway) was responsible for major failures in transport decision-making. Central to their inadequacy was their divergence in practice from best-practice cost-benefit techniques, and lack of consideration of induced traffic effects.

> **"[Our recommendations] . . . will require the most radical changes in the traffic and economic appraisal of trunk roads since the development of COBA in the early 1970s. . . . We have not reached our judgment lightly, nor do we underestimate the magnitude of the changes we are proposing. But we do not think that continuing to appraise solely at the scheme level using the fixed demand approach is, either intellectually, or in practical terms, acceptable."**
>
> **-- SACTRA Report**[110]

After reviewing the empirical evidence, the SACTRA report concluded that travel time elasticities of -0.5 were reasonable estimates for short term induced traffic, rising to -1.0 in the longer term.[111] In other words, a reduction of travel time by a new highway will result in half of the time saved being spent on additional (induced) traffic in the short run, and nearly all of the time saved being spent on additional travel in the long run. Since time saved is a major component of value-for-money tests, the report concluded that

> These studies demonstrate convincingly that the economic value of a scheme can be overestimated by the omission of even a small amount of induced traffic. We consider that this matter is of profound importance to the value for money assessment of the road program.

The committee concluded its report with the recognition that its recommendations:[112]

> . . . will require the most radical changes in the traffic and economic appraisal of trunk roads since the development of COBA in the early 1970s.... We have not reached our judgment lightly, nor do we underestimate the magnitude of the changes we are proposing. But we do not think that continuing to appraise solely at the scheme level using the fixed demand approach is, either intellectually, or in practical terms, acceptable. It is this central conclusion which has led us to make the recommendations in this report.

Commentators have described the implications of the SACTRA report as being that:[113]

> Virtually no scheme which is within an urban area, feeds into an urban area, or bypasses an urban area, should use the old methodology. Induction must be included. The most likely effect will be a massive reduction in COBA [the British cost-benefit program] benefits.

As a result of the report, the central conclusions of which the British Government accepted in principle, interim guidance has been issued by the Ministry of Transportation on incorporating induced traffic effects into road appraisal schemes. The Ministry advised that:[114]

> Wherever any of the responses [trip retiming, modal transfers and induced land-use changes] are likely to have a significant impact on the appraisal of a scheme, they must be taken into consideration, and a methodology capable of modeling them adequately must be employed.

The British Government also initiated research to better quantify induced traffic elasticities, and commissioned the development of new modeling procedures in the long term.

The Israeli Ministry of Finance in early 1997, following the practice in Britain and elsewhere, announced new modeling procedures that correct some of the more serious distortions caused by the assumption of inelasticity in the models used for the Trans-Israel Highway.[115] It is an open question whether the current guidelines should be applied retroactively to projects approved but not executed, as was done in England.[116]

The implications and scale of induced traffic

As pointed out by the SACTRA report, induced traffic affects several kinds of appraisal of the highway.

- Operational appraisal. The chosen design might operate differently than planned with increased amounts of traffic;
- Environmental appraisal. Induced traffic will have environmental consequences beyond those anticipated;
- Economic appraisal. Induced traffic (and ignoring traffic suppression in the do-nothing scenario) undermine the estimations of time-savings that constitute the bulk of projected project benefits;

The magnitude of induced traffic effects is site-specific. A few studies have found this to be too small or difficult to distinguish from other reasons for traffic growth. However, the majority of studies have found very significant effects.[117] There is good reason to believe that induced traffic effects due to the Trans-Israel Highway will be large because of the project's size, Israel's rapid rise in motorization rates, and the fact that the Highway's central portion runs through the kind of area where, as the SACTRA report notes, induced traffic effects are greatest: in systems operating close to capacity, and where additional highway capacity causes large changes in travel costs.

In Table 7 I have summarized the findings from a sampling of these studies, to indicate that it is reasonable to expect the magnitude of the phenomena to be considerable. One cannot, of course, simply plug these numbers into this specific project, especially since it will be a toll road, but they underscore the need for serious investigation before the project goes ahead. In the words of one commentator:[118]

> "Ignoring the effects of generated traffic in economic analysis tends to overstate the benefits and understate costs of roadway improvements, leading to non-optimal transport investments. A common excuse for this omission is that no tools exist to predict how much traffic will be generated or to determine the resulting net costs. These excuses are no longer justified."

Table 7. Quantifying the effects of induced traffic

SOURCE	ESTIMATE
Hansen et al., Institute of Transportation Studies, University of California[119]	Total vehicle travel elasticities with respect to regional highway lane kilometers of 0.2 growing to 0.6 within two years at the county level, and 0.2 growing to 0.9 after 4 years at the metropolitan level. (A 0.9 elasticity means that a 10% rise in lane kilometers will lead to a 9% rise in kilometers traveled annually.) For a region like the San Francisco Bay Area, Los Angeles, or San Diego, these elasticities mean that each additional lane-kilometer would generate an additional 12,000 vehicle kilometers daily.
Litman[120]	Half of added capacity filled with induced traffic within a decade.
National Highway Institute[121]	Default elasticity of -0.5 for highway travel with respect to user costs (i.e. decreasing travel time by 20% will result in 10% more new traffic)
Keith Buchan[122]	Induced traffic results in a 70-75% reduction in total time savings.
Goodwin, <u>Transportation</u> 23(1)[123]	Summary of findings on rise in base traffic volumes in improved corridors versus controls concludes that they show an average 10% rise above control in short term, 20% in the long term, with wide variability
Williams et. al., (1992)[124]	Using the case study of the Cardiff road network, the authors show that by ignoring both the time losses caused by induced traffic and traffic growth cut-off in "do-nothing" scenarios, fixed matrix models typically overestimate scheme benefits by 20-30% under conditions of medium elasticity and congestion. Higher congestion, long-term land-use changes, and modal transfer are responsible for further overestimates.

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Coombe (1996)	A comparison of fixed versus variable matrix modeling of traffic in several English cities demonstrates that even when the amount of induced traffic trips is small (a few percent of the growth likely to happen anyway), the nature of fixed matrix models that ignore both suppressed and induced traffic is such that these modest additions to total demand lead to "very substantial reductions in economic benefits" (typically 20-50%).[125] Consideration of land-use changes would reduce benefits still farther.
SACTRA (1994)[126]; reappearing in revised form in Goodwin, Transportation 23(1)[127]	Converging lines of evidence for the elasticity of travel volume with respect to travel time give an elasticity of traffic with respect to travel time of -0.5 in short term and -1.0 in long term. I.e. halving the travel time to a destination will raise the volume of traffic by 50% initially, and 100% in the long term. Or in the Commission's phrasing, in the short term 50% of saved time will be used for further travel, with a higher proportion (perhaps all) being used for further travel in the long term.
A.M. Voorhees and Associates (1971)[128]; Zahavi (1972)[129]	VMT (Vehicle Miles Traveled) elasticities with respect to average highway speed are +0.58 and +1.76 respectively.
Cohen (1995) in TRB Special Report, Expanding Metropolitan Highways[130]	A conservative review of dozens of empirical studies of induced traffic. Studies of specific facilities show increases up to 30% more traffic in a corridor due to induced traffic. Areawide studies show effects ranging from negligible to large (elasticities greater than 0.5 with respect to average highway speed or lane miles). Studies of elasticity with respect to travel time include several where elasticities are greater than -0.5 in absolute magnitude, some considerably so.

In the absence of a remodeling, these findings could be used to give a rough estimate of the possible scale of induced traffic and its effects on the economic appraisal of the Trans-Israel Highway. It is comparatively easy to calculate the regional lane kilometers added, the travel time savings, or the rise in average regional speed as a result of the Highway's construction, and to apply to these the various elasticities of travel volume presented in Table 7 to yield the additional induced kilometrage

(VMT). An estimate of the overall costs of additional road injuries and pollution due to this induced traffic can then be easily derived from the readily available cost-per-kilometer figures.

It must be remembered that to the sheer costs of the induced traffic itself must be added the indirect structural costs of increased motorization, especially the costs of inefficiencies of providing infrastructure to the less dense land-use patterns and the undermining of other modes of transport, both encouraged by private car use.[131] Finally, there is the probably substantial erosion of time savings due to induced traffic, which is somewhat more difficult to estimate. The new Ministry of Finance Guidelines are a good start, and an outer bound can be taken from the above estimates of how much overall project value is inflated by when fixed matrix models are used.

The additional travel due to induced traffic is claimed by some to have benefits, captured by the traffic modeler's "rule of half," equivalent to the area DFE in Figure 7. Others, however, point out that this time should not be valued as highly as existing trips[132] More fundamentally, this gain must be weighed against all the costs of the dispersal of activities which is the flip side of this new travel, and perhaps the primary long-term effect of new road construction. For example, new travel will affect the quality of other transport modes by reducing ridership and creating land-uses that are more costly and not well served by transit.

CORRECTING BASIC PARAMETERS AND BENEFIT FIGURES

The Trans-Israel Highway Company's cost-benefit analysis is based on a series of overly generous assumptions. The following sections examine what this cost-benefit analysis and resulting rate of return would look like once more realistic values are introduced. A subsequent section shows that claimed reduction in pollution and accident rates are unfounded, and that the Highway will actually entail substantial additional environmental and road injury costs.

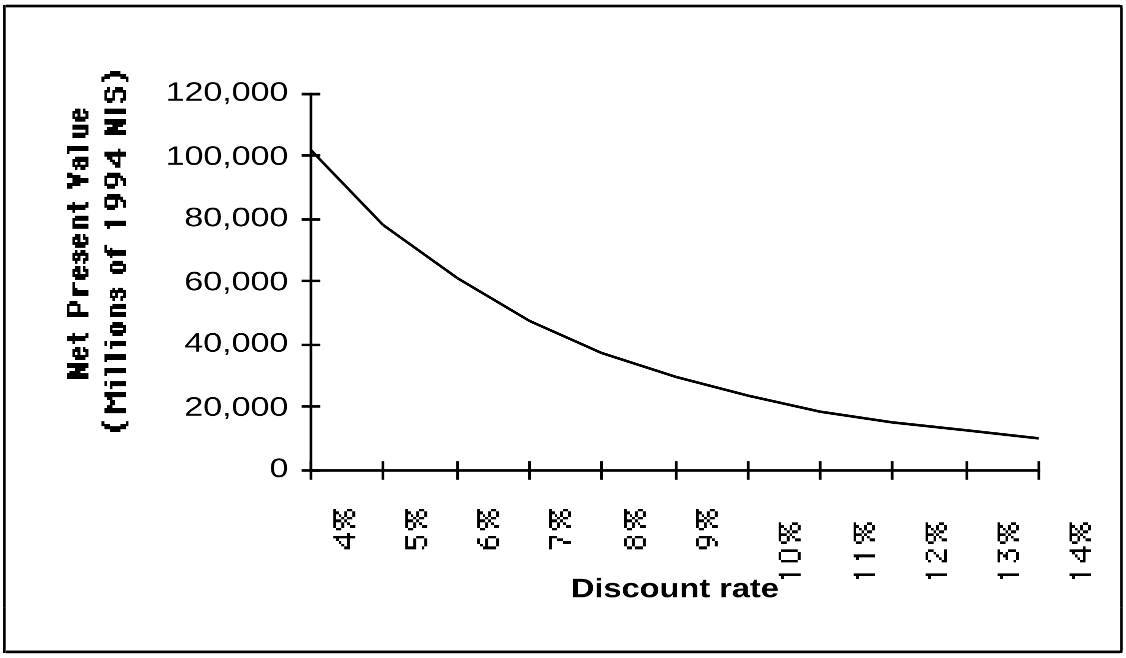
Choice of appropriate discount rate

The discount rate used to evaluate a project reflects the revenue-generating capacity of money for private sector projects, and thus the opportunity-cost of its use for the project. A lower discount rate indicates an economy in which capital would not yield fast returns, lessening our demands for high returns on public projects. There is considerable debate about the appropriate discount rate for large projects, which is usually set between 4% and 12%.[133] The MATAT cost-benefit analysis of the Trans-Israel Highway assumed a real interest rate of 4%, chosen to "represent the long-term capital-raising ability of the Israeli economy."[134] The figure was justified as the rate of interest given on 30 year U.S. Treasury bills (7.55%) minus inflation, a linkage explained through a vague reference to "the conditions of the loan guarantees which were granted to Israel by the U.S. government."

This 4% rate is the lowest that can be seriously considered for public projects.[135] More generally, rates are around 10%, which is the value that was recommended for Federal projects in the U.S. between 1970 and 1992.[136] (This despite the fact that Federal projects in the U.S. are likely to have a somewhat more reliable relationship to U.S. government loan guarantees.) When the project was first evaluated by the Israeli Public Works Department in 1990, a discount rate of 12% was used,[137] which is the rate suggested by the World Bank for the economic appraisal of transport projects.[138] A re-evaluation by the Israeli Institute for Transportation Research and Planning in 1992 used a value of 11% (and a sensitivity test of 15%).[139] The accepted Ministry of Finance rate for transport projects is 7%,[140] which is the rate recommended for evaluating all Federal projects by the United States Government since 1992.[141] It is unclear whether American loan guarantees will be used for the project's financing, and even if they are this will have an opportunity cost (they will not be able to be used elsewhere).

For these reasons the cost-benefit calculation should use as its baseline a more realistic rate of 7%. As shown in Fig. 10, the present value of a stream of income/expenditures is quite sensitive to the chosen discount rate, so that this is one of the more significant corrections that should be made to the cost-benefit analysis performed.[142]

Figure 10. Sensitivity of Highway worth to discount rate



Source: Recalculation of NPV using Trans-Israel Highway Company cost and benefit figures.

Table 8. Discount rates used in evaluating transport projects

Rate	International usage	Used for Trans-Israel Highway by	Used as sensitivity test for Highway by
4%		**Trans-Israel Highway Company (1994)**	
7%	Federal projects in U.S. (since 1992)	Israeli Ministry of Finance	**Trans-Israel Highway Company (1994)**
9%			Israeli Ministry of Finance
10%	Federal projects in U.S. (1970 to 1992); "Textbook"		
11%		Israeli Institute for Transportation Research and Planning (1992)	
12%	World Bank	Israeli Public Works Department/Ministry of Interior for Trans-Israel Highway (1990)	
15%			Israeli Institute for Transportation Research and Planning (1992)

Sources: see text on preceeding page.

Questioning the traffic forecasts

A basic input to all the traffic volume and thus cost-benefit analyses are the forecasts of future traffic levels over the three decades after the Highway's completion. As shown in Table 1, the modelers assume that compared to 1992, the number of cars on the road in 2020 will grow by 350%, the portion of the population owning cars by 228% (as it rises toward a final saturation of 500 cars per thousand people), and the total annual kilometrage by 267%.

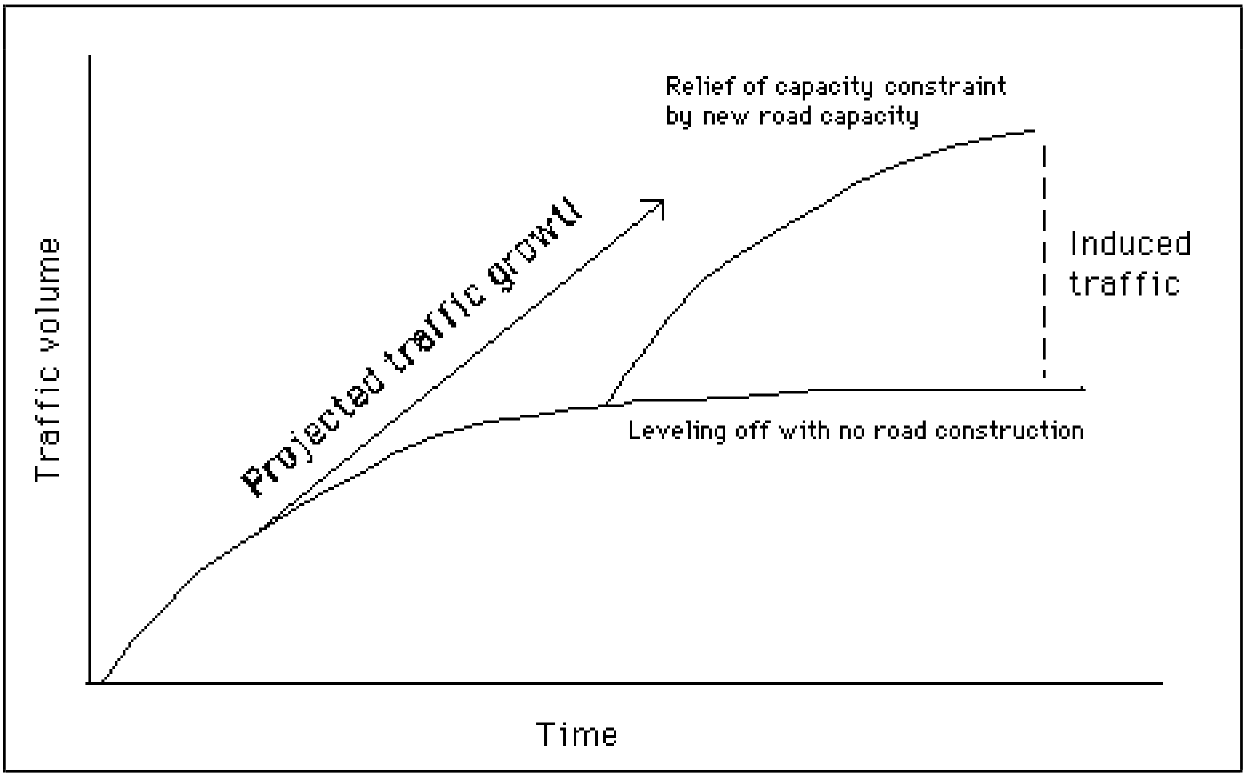
The numbers are produced by an extrapolation of existing trends under optimal conditions for motorization growth (level fuel prices, steady GDP per capita growth, no major transport alternatives to the private car, no substantial transport policy changes). Yet their use as the basis for calculating traffic flows and estimating the size and economic benefit of a highway to accommodate them, transforms them into <u>targets</u>, a concrete goal to be accommodated and built for. Thus, these forecasts become a self-fulfilling prophecy. With the environmental impacts of car use already becoming intolerable in major Israeli cities, it seems unacceptable that models should institutionalize without public debate what is, from an environmental point of view, a worst-case-scenario.

As discussed earlier, while Israel's current motorization rates are still lower than most industrialized countries, the measures of car density and thus impact are among the highest in the world and rising. Israel's size and population density makes even "low" European motorization levels of 500 worrying. Responsible Israeli planners have used saturation rates in the 350-450 range for even the "business as usual" scenarios for Israeli transportation,[143] and even lower long-term rates are conceivable as part of ambitious progressive transportation scenarios for Israel.

These levels are entirely compatible with the standards of living in advanced countries. We should remember, for example, that with motorization rates that will probably stabilize at slightly under 400,[144] Denmark has a transport policy committed to curbing the growth of traffic, stabilizing CO_2 emissions at 1988 levels by 2005 and reducing them by 25% of this level by 2030, and to eliminating bottlenecks and improving safety on existing highways rather than providing additional highway capacity.[145] Since Israel's is over five times more densely populated than Denmark, a saturation rate significantly below 400 seems a not unreasonable policy goal.

This proposal to adopt saturation levels lower than the 500 level assumed by Highway planners, and thus to plan for lower traffic volumes, must be correctly understood. It is not so much a refusal to provide highway capacity to serve rising traffic levels but a choice to not invest in the highway capacity that creates this rise.[146] The rise in traffic volumes and motorization rate predicted through extrapolation of existing growth by the Highway planners assumes the ongoing supply of enough road capacity to avoid the leveling off of traffic growth by capacity constraints. This mechanism is portrayed in Fig. 11.[147]

Figure 11. Traffic growth--supported or created?



Source: adapted from Litman (1996), Fig. 5-4.

The creation of more traffic through road building is not an inevitable natural process but a decision that must be taken with some care.[148] Modeling traffic flows at lower saturation rates is retrieving a critical decision about Israel's future from the realm of the natural, where it is amenable only to technocratic responses, and returning it to the realm of public policy and the conscious choice among alternative development scenarios.

For this reason, it seems reasonable to compare traffic flows and the need for the Highway at motorization rate saturation levels of 450, 400, 350, and 300. In addition, as discussed below, traffic levels under the "do-nothing" scenario which are critical to calculating time savings should be estimated using capacity-constrained forecast methods that realistically show traffic growth within the existing network such as those now recommended by the Israeli Ministry of Finance.

Will fuel prices be constant over three decades?

The models used to project future kilometrage assume that "government policy [on fuel taxation] will undergo no drastic changes... [and that] the international price of gasoline will not undergo any major fluctuations."[149] Specifically, of 4 scenarios considered, the modelers chose the assumption that yields the highest forecast, namely that "the real price of gasoline will remain constant through the target period [the six years from the date of the model plus another thirty years from completion of construction] and expenditures for private per capita consumption will increase at an annual rate of 2% [in correlation with the increase in per capita GDP]."[150] Motorization rate is linked to per capita consumption, but not to fuel prices.[151]

In an period characterized by a growing emphasis on using fuel prices as an efficient way to internalize the social costs of transport, the assumption of unchanged taxation policy--and stable fuel prices in particular--over the course of more than three decades is unrealistic. More appropriate would be a scenario in which Israeli fuel prices and vehicle taxes began to approximate current European price levels, or perhaps even the additional fuel price increases being advocated in these countries. As discussed below, given the high elasticity of travel with respect to fuel prices in the long term,[152] and especially if other modes of travel became more available than today, such increases could reduce travel demand significantly below the levels projected.

Currently, as shown below, Israeli gasoline and diesel prices are significantly lower than a European average.

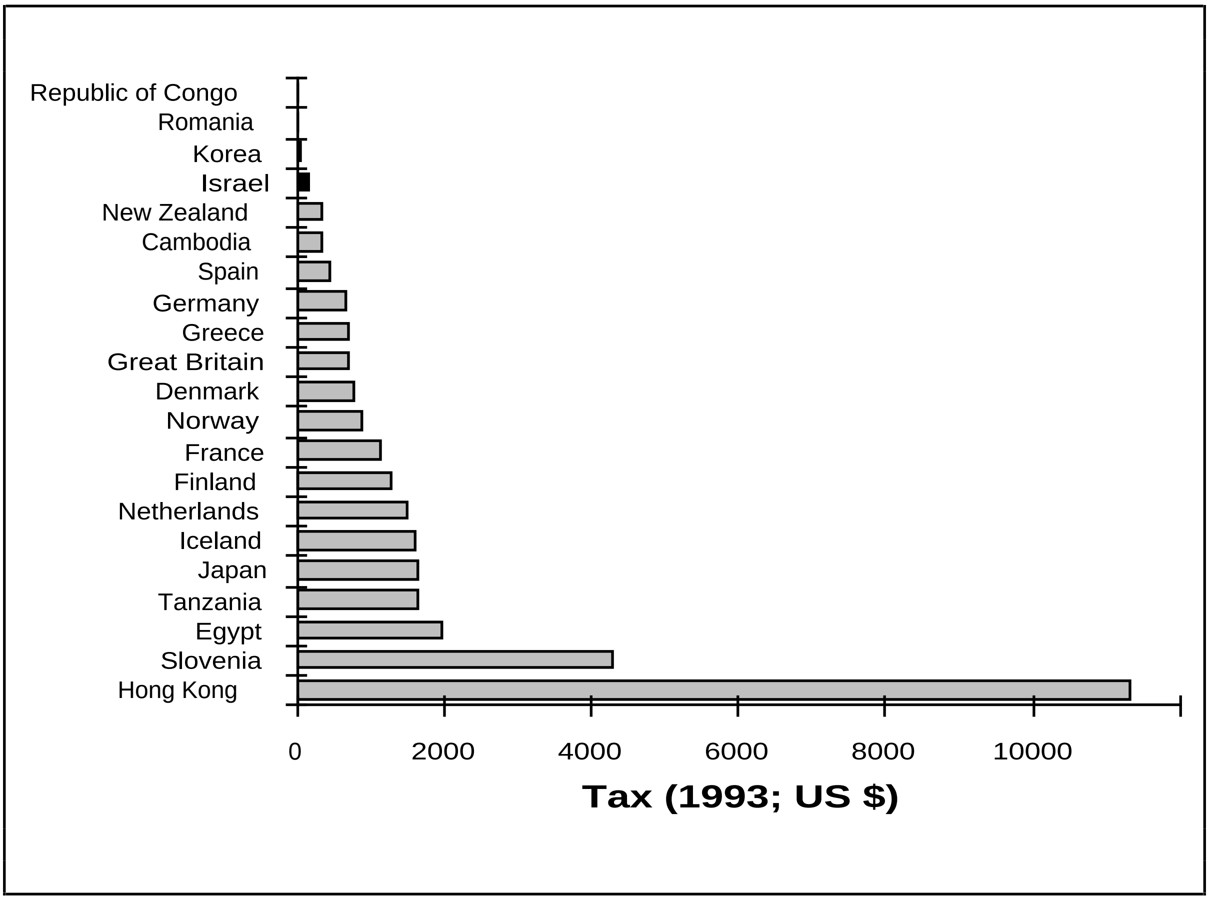
Table 9. Gasoline prices in Israel and six European countries (in $)[153]

Type	In Israel	Six country average	Israel/Europe ratio
SUPER	0.85/litre	1.17/litre	72 %
Regular unleaded	0.82/litre	1.09/litre	75 %
Diesel	0.35/litre	0.85/litre	41 %

Source: Ministry of Energy and Industry (1996)

Similarly, as shown in Fig. 12, a composite measure of annual taxation on car use is drastically low in international comparison.[154]

Figure 12. Average annual taxation on a private car of 1500 cc consuming 1500 litres of petrol



Source: International Road Federation Transportation Statistics (1994)

Even the much higher European petrol and diesel taxes still fall far short of internalizing the present social costs of road transport, and are expected to rise. The most comprehensive calculations show that European petrol taxes would have to be raised by an additional 40-60% and diesel taxes by 60-75% in order to achieve this internalization.[155] It is highly likely that gradual price raises that would achieve this internalization will be implemented in European countries in the coming years, and it would be wise to consider if Israel might adopt some of these measures, rather than diverging yet further from European fuel tax policies.

The outer bound of increases is suggested by the more authoritative policy recommendations of recent years. A central component of the 1994

> **As one of several measures to discourage private car use, the British government raised fuel taxes by 10% in 1993, and has continued to raise them by at least 5% over and above the level of inflation each year since. Even this rate was deemed insufficient by the highly respected Royal Commission on Environmental Pollution.**

31 country OECD European Ministers of Transport policy package for sustainable urban transport, for example, is a real rise in fuel prices (modeled at 7% per annum) in order to "promote more economical vehicles, shorter and fewer car trips, a shift in travel away from solo driving and greater use of environmentally friendly modes."[156] Given accepted long-term elasticity rates for fuel prices and a 2.5% per annum rise in income, by 2015 this 7% rate of increase would reduce annual kilometrage by 33% under what it would have been without the policy.[157]

From another direction, the British Government, in response to its commitments at the Rio Earth Summit in 1992 to the Framework Convention on Climatic Change, acknowledged the requirement for policies to discourage private car use[158] including, among other measures, an increase in fuel duty. Accordingly, fuel taxes were raised by 10% in 1993, and will be raised by at least 5% each year over and above the current rate of inflation during each subsequent year until 2000.[159] This rate of increase was deemed insufficient by the highly respected Royal Commission on Environmental Pollution, which in 1994 recommended a doubling of fuel price relative to the prices of other goods by 2005 through a 9% per annum increase for a decade.[160] And the European Federation for Transport and Environment (T&E) study funded by the governments of Sweden, the Netherlands and Norway, suggests a 200-400% rise in taxes (prices would rise less) over the course of a decade, leading to a 25% reduction in kilometrage over the "do-nothing" scenario.[161]

For this reason, the following baseline corrections to the calculation of total annual kilometrage are suggested: assume that the real price of fuel <u>will</u> rise significantly over the coming decades as Israeli transport policies begin to approximate European ones, and reflect this rise in reduced figures for motorization rates (how many people own cars), as well as kilometrage (how much they drive them). At a minimum, this rate of rise should close the large gap between Israeli and current OECD taxation rates, and at a maximum assume that Israel will follow some of the additional increases likely to be implemented in these countries in coming years.

Taking toll diversion into account

While the Highway Company and bidding companies have subsequently modeled the relationship between toll levels and traffic flows, the MATAT study on whose basis the Highway's dimensions and viability was modeled is "toll-free." In other words, the choice of travel route is not affected by the level of toll on the Trans-Israel Highway, assumed to be zero. This is an unrealistic assumption: traffic flows tend to be lower on a highway that is tolled. In the earlier MA'ATZ study, for example, the diversion effect of various tolling rates on traffic flow was tested. This was approximated relatively easily in the existing model, and could have been done similarly in the MATAT study. During the "traffic assignment" phase of these models, automobile trips between a given origin and destination are assigned the route that will take the shortest time, calculated on the basis of the time taken for each segment given the degree of congestion on it. By making a tolled section of a trip appear "longer" by a certain amount, reflecting the time value to the driver of a toll, the deterrent effect of tolls can be modeled.

A variable toll (of 5.6 cents per section plus 5 cents per kilometer) reduced traffic by up to 50% in some sections, and reduced overall vehicle-kilometers by 25%.[162] A fixed toll of $2.5 (a value representing 15 minutes of time) reduced traffic by 19% (twice as much as this during non-rush hours), and a fixed toll of 50 cents reduced traffic by only 6%. The MA'ATZ modelers assumed the $2.5 toll figure (19% reduction).

As tolling levels on the Trans-Israel Highway are unclear, the diversion of 10% of the volume of traffic would provide a conservative approximation of toll diversion. This is about half the amount anticipated by the MA'ATZ evaluation, and in line with the conservative 10% diversion figure for tolled roads suggested by the British Department of Transportation.[163]

Expropriation costs that reflect the social valuation of land

The cost of land expropriation was calculated at $5,000 a dunam in the cost-benefit analysis (any cost above this was considered a transfer cost and not represented in the calculation). What has kept the value of land artificially low in this region near a major metropolitan area is a societal commitment to the preservation of agricultural land and open space that has prevented its use for other purposes. With such restrictions lifted the land is typically worth an order of magnitude more. A similar situation in England prompted the British Royal Commission review of road evaluation procedures to conclude that:[164]

> It is an unsatisfactory feature of the present system of cost-benefit analysis (COBA) that use of low cost land of high conservation value gives a scheme a more favourable cost-benefit ratio. COBA does not in any case attempt to cover the value of land for the community, which is not reflected in its market price, and which may be considerable; this aspect is dealt with in a parallel environmental appraisal. Within the context of the cost-benefit analysis, however, it is a paradoxical feature that construction of a road effectively breaches the restrictions which were previously placed on development of such land and which have contributed to lowering its market value.

The Royal Commission therefore recommended that the appropriate policy objective be:[165]

> TO 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. [Capitalized in original]

The "best practicable environmental option" is a concept that the commission worked out for other environmental decisions. It demands a restructuring of transportation decision-making, and in particular, the inclusion of "an examination of options which do not involve new construction or involve constructing infrastructure of a different type (for example the upgrading of a railway line as an alternative to construction of a new road)".

Since this kind of policy was not applied to the Trans-Israel Highway, nor was the aesthetic/recreational value of the land monetized within environmental impact statements, the cost of land should reflect the high value society places on its current purposes, for which the forgone market value is a reasonable substitute. An increase of land values by a factor of 5 to 10 is recommended, which would increase the Net Present Value of compensation costs from 227 to up to 2,266 million NIS, i.e. to a cost roughly equivalent to construction costs. The actual cost of the land to the government (as opposed to the economic cost) is a different matter, treated in a later section on financial considerations.

ADDED SOCIAL COSTS

Environmental costs

While these were not included in the MATAT cost-benefit calculations themselves, claims were made in the "Traffic Forecast and Economic Evaluation" report that the Highway would reduce environmental and road-injury reduction costs. On closer examination, however, these claimed benefits are groundless, and in fact the Highway entails considerable net additional social and environmental costs described below.

There will be four categories of environmental and road injury impacts due to the Trans-Israel Highway.

(1) The Highway's direct local physical environmental impacts (as distinct from the effects of the traffic on the Highway). These were not quantified in the cost-benefit evaluation.

(2) The reduction in air pollution due to shorter trips, higher speeds, and dispersal of traffic, and the reduction in road-injuries due to safer travel. These were claimed but not quantified. They are probably more than negated by the induced traffic, higher speeds, and longer trips due to the Highway.

(3) The added environmental damage and road injuries due to the additional traffic induced by the ease of travel on the Highway in the short term. These were not considered.

(4) Environmental damage due to land-use changes and increased automobile dependency encouraged over the long term by the Highway. These were not considered.

Direct local environmental damages during construction and operation of the road include disruption of hydrological regimes (increased sediment loads, especially during construction; increases in peak runoff and storm discharges; altered sheet runoff and groundwater recharge; increased erosion),[166] ecological effects (roadkill, population fragmentation), and visual blight. While it is clear that the Trans-Israel Highway Company is committed to dedicating resources to the local environmental betterment of the project, it is unclear if and how environmental damage and/or remediation costs are reflected in the cost-benefit analysis. Unspecified "environmental damages" of $10 million were included in the construction costs when the project was initially evaluated by the Public Works Department,[167] but these do not appear as a separate category in the construction costs or elsewhere in the subsequent cost-benefit evaluation by the Highway Company. (Perhaps these have been absorbed into the costs for "landscaping" and "drainage structures" included in construction costs.) Needless to say, the project's calculated costs are too low without their inclusion. The clarification of the local environmental costs along the highway's right-of-way would offer an avenue for constructive dialog between the Highway's proponents and environmental groups that oppose it.

Air pollution

The Trans-Israel Highway Company claims that the Highway will lead to a reduction in air pollution,[168] though it does not include these savings in the cost-benefit analysis. It attributes this claimed reduction to three factors:

A. the reduction of total vehicle-kilometers throughout the network due to shorter routes enabled by the Highway;
B. the distribution of pollution due to the diversion of traffic eastwards, away from densely populated areas;
C. the reduction in emissions due to higher vehicle speeds.

As discussed below, these claimed benefits are uncertain or minimal. In addition to these claimed effects, the modeling and cost-benefit evaluation completely ignored:

D. the added pollution due to the substantial amounts of entirely new traffic induced by the Highway.

The following is a more detailed discussion of each of these effects in turn.

A. This claimed reduction of total vehicle-kilometers seems to directly contradict the results of the Company's own traffic modeling that the Highway produces almost no reduction in total kilometrage in the national road network, though it saves significant passenger hours.[169] Indeed, the traffic models show that during the average morning peak hour the Highway will save 11,000 vehicle hours but add 50,000 vehicle kilometers.[170] In other words, while trips diverted to the highway from other routes will be shorter in terms of time, the total length of these trips will barely be reduced and may even increase. This effect stems from the fact that while the number of trips whose distance will be reduced is small,[171] a significant number of trips will add distance to their routes in order to benefit from the faster travel speeds on the Highway. For example, a driver might travel several kilometers to the east, take the

Highway north or south, and then travel again to the west to reach their destination. The savings in travel distance in shortened trips will be balanced by the additional distance of travel made to take advantage of the higher travel speeds.

B. Pollution that occurs in less populated areas will indeed incur smaller health costs. However, for several reasons the air pollution implications of the Highway need further study before this can be claimed as an environmental contribution. First, a string of settlements (Rosh HaAyin, Kalkiliya, Tayibe, Tulkarem) lie immediately east of the proposed Highway. The relocation of a portion of Tel Aviv's traffic closer to them raises significant equity issues and certainly neutralizes some of this "dispersal" effect. Second, development planned around the Highway means that population densities will soon rise in those areas too, so this "diversion" effect is short-lived. Finally, the formation of O_3, a pollutant with significant health impacts, occurs 3-5 hours after emission from automobiles, after airmasses have drifted considerably. It is unclear whether the health impacts of this form of pollution will be increased or lessened by the relocation of traffic eastward. More specifically, until the behavior of the Tel Aviv area pollution plume is better understood we will not know whether or how the shift of traffic will affect the band of elevated O_3 levels that currently runs roughly from Nablus to Beer Sheva, and in particular the implications of this shift for the Jerusalem area population centers.[172]

C. The Highway will result in engines running faster in uncongested conditions, to cover the same distances. However evidence for pollution reduction due to raised travel speeds must be clarified further before an overall reduction in costs can be claimed. The EPA Mobile 5 model used by the Highway Company for calculations of reduced emissions with increasing speeds is calibrated for an American fleet which consists of newer cars and a far higher percentage of catalytic converters than the Israeli fleet. Mapping these results onto an Israeli fleet is a very uncertain exercise. And while the Mobile 5 model shows a reduction in emissions with increased average speed, empirical data from Germany shows, at least for that portion of the travel which is in built-up areas, that increased speed does the opposite, and increases the incidence of acceleration, deceleration and braking.[173] In addition, while the Highway Company models predict a reduction in CO, HC, and CO2 emissions, they also predict a 12% rise in SOx and a 5-12% rise in Nox.[174] The latter two increased pollutants have a cost per ton on the order of $4,011 (1996 dollars, SOx) and $8,212 (NOx), as opposed to the far lower cost per ton of the reduced pollutants ($842 for CO, $326 for HC, and $25 for CO2).[175]

Thus raised speeds may reduce some pollutants while increasing others, including some with costs an order of magnitude greater than the ones reduced.

D. It must also be remembered that the Highway planners assume, cater to, and thus reinforce, an overall rise in vehicle kilometers of 261% by 2020. In addition, the project is likely to induce traffic in the short term through reducing travel costs, and in the long term through a massive addition of highway capacity through a sparsely developed area close to a major metropolitan center. Any small reduction in travel distance due to the Highway's presence must be balanced against these major contributions to an overall rise in distance traveled.

Additional road deaths and injuries[176]

While they did not include this in the cost-benefit calculation, the Trans-Israel Highway planners claim that by rerouting traffic from lower quality roads onto a higher quality and thus safer highway, the project will reduce death and injury costs by 120 million NIS annually.[177] As detailed below, these claims are likely to be wrong in several ways, and the Highway could increase, rather than decrease collision costs.

The increased safety of the Highway that is claimed to contribute to the decrease in accident rates is derived from a comparison of lower accident costs per vehicle kilometer on highways versus other roads. However, this comparison will only be valid if the new Highway has the same speed limit as the roads it substitutes for. The Highway's design speed is 120 kph in the central area east of Tel Aviv (from route 431 in the south till route 531 in the north), and 130 kph outside these limits.[178] There will be a temptation to set the speed limit on the Highway at 100 or 110 km/hr, which would increase time savings and toll revenues but also collisions and injuries. It is important, therefore, to clarify what speed limit the traffic models were based on, and to ensure that increased accident costs are evaluated if higher speed limits are considered.

Several sources of increased road injury costs must be accounted for:

1) **the travel added due to induced traffic;**
2) **the network-wide rise in average speed due to congestion relief;**
3) **If speed limits on the Highway are above 90 km/hr, the increased speeds on the Highway itself; and**
4) **the spillover effect to other roads of this raised speed.**

If speed limits are set higher than 90 km/hr, and especially if traffic flow is uncongested, traffic that transfers onto the Highway will be less safe to a degree that rises sharply with additional speed. As Nilsson (1990) shows, physical first principles indicate that the chance of collision is directly proportional to speed, the chance of injury rises as the square of speed, and because the severity of injury is a function of the kinetic energy released upon collision, the chance of death rises as a fourth power of speed. These principles on the consequences in the rise of average travel speed have found extensive empirical backing: in accident-by-accident analyses of the relation of collision severity to speed of collision; in analyses of the 1974 lowering of speed limits from 70 to 55 mph (112 to 88 kph) in the U.S.; in new data on the effects of the subsequent raising of speed limits from 55 to 65 mph (104 kph) in the U.S.; and from similar rises in speed limit in many other countries.[179]

Evidence of this effect in Israel is available from the results of the raise in speed limits from 90 to 100 kph on three main interurban highways in November 1993 by former Minister of Transportation Keysar. The death toll jumped by 40-60 additional people annually, both on the highways themselves and throughout the system (see below on this "spillover" effect).[180]

Thus, if speed limits on the Highway are higher than that on other roads, this is likely to more than negate any safety advantages of better design.

In addition, any raise in the Highway's speed limit will also raise speeds elsewhere in the road system, due to the "spillover" or "halo" effect, whereby drivers carry over higher speeds from the Highway onto other roads. Thus, after the speed limit was raised from 90 to 100 kph on several highways, average speeds on other interurban and urban roads rose between 10% and 26%.[181]

A second and additional source of increased speed on other roads (one which will occur even if the speed limit on the Highway is set at 90 km/hr), will be the claimed congestion relief throughout the network due the Highway. The traffic forecasts by the Trans-Israel Highway Company, predict a rise of average speed by 6 kilometers an hour throughout the entire Israeli road network on a average weekday (07:00 to 19:00) in the year 2010.[182] Because of the exponential relationship described above, even this relatively small rise in average speed will result in large rises in the number and severity of collisions.

Finally, to the additional injuries due to raised speeds on the Highway and off, must be added the injuries due to the rise in overall traffic volumes due to traffic induction. This may be the most substantial effect.

Increased annual road injury costs (due to induced traffic, congestion relief, and to any raised of the road's speed limit), are likely to be the Trans-Israel Highway largest externalities.[183] According to a recent review in the Oxford Review of Economic Policy, because the costs of accidents are so high[184]

> safety is a vitally important feature of any proposed new transportation project. It follows that if scarce resources are to be allocated efficiently and equitably in transport investment and regulatory decision-making, then it is essential that safety effects should be explicitly weighed and evaluated, along with other costs and benefits, in the decision-making process. Only in this way can one reasonably hope to ensure that safety will be provided at adequate levels on the various different transport modes.

The explicit calculation of travel injury costs can help set the priority among various road projects, and also help decide between projects using different modes to achieve transportation goals. Different forms of travel (rail, bus, private car, etc.) vary greatly in their relative safety. In the U.S., for example, passenger rail was reported to be nearly 18 times as safe as private car travel, with 0.4 deaths per billion passenger-kilometers compared to seven deaths for the private automobile.[185] Calculations from 17 European countries place the risk per unit travel of getting killed in railway accidents at less than one quarter the risk in road transport, and the risk of injury at approximately one hundredth.[186] The health costs of further large investments in expanding high-speed road supply must be weighed carefully.

IMPROVED ASSUMPTIONS FOR TRAFFIC FORECASTS AND ECONOMIC EVALUATION

This chapter considered a series of questionable assumptions in the traffic modeling and cost-benefit analysis used to evaluate the need for and value of the Trans-Israel Highway, and discussed costs that were omitted from or improperly considered in the analysis. As a result, the estimate given of the Highway's value to the Israeli economy is probably far too high. At a more fundamental level, the modeling and evaluation used represent an outmoded "predict and supply" paradigm of transport planning. This paradigm, formulated in the late 60s, has been increasingly challenged over the last decade as planners have become aware of the impossibility of providing road capacity to meet demand and of the paradoxes of providing "time savings" that in fact primarily expand distance consumption. The unmodified fixed-matrix modeling and limited cost-benefit analysis used for the Trans-Israel Highway would not have been acceptable for a similar project in the U.S. or many Western European countries. In fact, the traffic modeling would not be acceptable under current Israel Ministry of Finance guidelines.

The following table summarizes some of the questionable assumptions used in evaluating the Highway, and the alternative assumptions that should replace them if the project is to be properly evaluated.

Table 10. Some assumptions built into the traffic modeling and cost-benefit analysis performed for the Trans-Israel Highway and alternatives to these

Assumption used	Improved assumption
Growth in motorization rate and kilometrage demands more roads. I.e. motorization is an independent variable to which road planning responds.	Continued road construction leads to growth in motorization rate and kilometrage. New roads lower or maintain the cost of car travel thus inducing new travel and preventing congestion that would reduce travel demand.
Israeli car use will expand so that compared to 1992, the number of cars on the road in 2020 will grow by 350%, the portion of the population owning cars by 228%, and the total annual kilometrage by 267%.	In a small densely-populated country, these growth rates are likely to be environmentally and socially insupportable. A variety of policy levers are available to restrain motorization while providing travel and access alternatives.
Demand for travel is different than the demand for most products: it does not increase when prices drop. I.e. traffic volume is inelastic with respect to changes in travel costs (time, fuel) when road conditions are improved or degraded.	Demand for travel is affected by its cost. Traffic volume is elastic with respect to road network quality, so that lowered cost (such as through the construction of a highway) will increase travel consumption, and raised costs (due to congestion) will reduce it.
The rate of overall traffic growth would remain constant under the "do nothing" alternative. This would cause massive and costly congestion. The time-savings benefit of the Highway is taken to be the difference between these congested conditions and the network with a highway added to it.	In practice, under the do-nothing scenario, traffic growth will slow as the network becomes more congested. A variety of behavioral responses, such as trip suppression, commute time spreading, and modal switch mean that congestion will never reach the levels produced by the artificial assumptions of a continued steady growth in traffic volume. The time savings benefit should be based on these realistic capacity-constrained figures, rather than impossibly severe congestion.
The traffic on the new road consists entirely of existing trips utilizing the new route (reassignment).	In addition to reassigned trips, a significant portion of the traffic on the new road consists of people traveling to new further destinations (re-distribution) or making trips they would not otherwise have made (generation).
A new highway will bring substantial congestion relief benefits: a car traveling on a new road means a car removed from another road.	Anticipated congestion relief will be substantially reduced by the new traffic that will be induced by the ease of travel on the Highway in the short term and by land-use changes in the longer term.
The impact of a new road on time savings is to reduce travel time on existing trips.	By encouraging travel to new destinations, over longer distances, and in formerly congested time periods, a new road will not save as much as expected, and can increase travel times in other congested parts of the road network.

Faster travel benefits the economy by freeing up time that will be put to economically productive uses.	Faster travel will allow travel over longer distances within the same amount of time, allowing the activities of daily life to spread further apart. The impact of the new road is not simply to generate time savings that are productively spent, but to encourage a greater consumption of distances. For example, it will allow people to commute further and thus purchase apartments at a lower price than equivalent apartments closer to the urban center. Thus, the economic impact of a new road is through the consequences of less dense land use (suburbanization), and a wave of increasing land values away from the urban center. These benefit some sectors of society but are associated with large overall social costs. In other words, the result is socially selective benefits that encourage more a waste of space than a saving of time.
Time savings for motorists is the key index of project benefits.	The value of motorized travel time savings is not uniformly distributed through society. While some people benefit from faster trips, others suffer from the side effects of increased motorization without benefiting substantially. Project evaluation should not, therefore, rest so heavily on time savings alone.
Small time savings aggregate and are economically significant.	Small time savings (e.g. under three minutes) have little or zero economic significance.[187]
Traffic volume on the Highway will not be affected by the level of the toll (assumed in MATAT Final Report on whose basis project was approved and evaluated).[188]	Tolls will lessen the amount of traffic on the Highway.
International gasoline prices and the tax on gasoline in Israel will both remain constant for the first three decades after the Highway's completion, and will therefore not effect motorization rates.[189]	International gasoline prices will continue to vary, and Israeli gasoline taxes are likely to rise to meet European taxation levels, which are in themselves rising to come closer to internalizing the true cost of transport. Travel demand, which is significantly elastic with respect to fuel prices in the long term, will therefore be less than predicted under the assumption of constant fuel prices.
The upgrade of roads connecting to the Highway to handle the traffic is assumed, but its costs are not included.	The upgrade of connecting roads should be included in project cost, since the use of the road and toll income are critically dependent on them.
Increased environmental and accident costs are not included in the cost of the Highway.	These costs should be included and where possible monetized using readily available methodologies.
The cost-benefit analysis produces a measure of real benefits, allowing us to say, for example, how much money the country will lose each year if the project is delayed.	Cost-benefit analysis is more aptly used as a tool for comparing the merits of competing alternative solutions than as a measure of absolute value.

The table below presents a preliminary correction of some of the problems described in this chapter.

Table 11. Declining value of the Trans-Israel Highway to the Israeli economy once more realistic assumptions are used

(In billion NIS, 1994)

Original estimate of Highway's value		**101.8**		**101.88**
KIND OF CORRECTION:	**MINIMAL NECESSARY**		**SEVERE ASSUMPTIONS**	
With reasonable discount rate	7% (Ministry of Finance recommendation)	**47.6**	12% (As per Israeli Public Works Department or World Bank)	**15.2**
and accounting for the losses in time and operating cost savings due to induced traffic[190]	15% loss in the short term; 30% after 20 years	**33.6**	30% loss in the short term; 60% after 20 years	**6.4**
and using realistic land prices	$25,000/dunam	**32.7**	$50,000/dunam	**4.7**
and including costs of increased road injuries		**?**		**?**
and costs of increased air pollution		**?**		**?**
and noise pollution costs		**?**		**?**

In short, the Highway's value is certainly far less than the 101 billion shekel claimed when the project was presented to decision-makers and when the Company informed the National Council for Planning and Construction that each year of delay in the project would cost the economy a billion shekel.

> **"The central findings of the MATAT cost-benefit analysis demonstrate a very large worthwhileness of the road. . . . The benefit is over 100 billion NIS . . . No reasonable sensitivity test challenges these significant findings."**
>
> **-- MATAT, "Traffic Analysis and Economic Evaluation: Summary for Presentation to the National Council for Planning and Construction, Sept. 1994.**

With rather minimal corrections the project's value is less than half that claimed. With a 12% discount rate (reflecting, say, the high cost of capital to the private sector and compensation for risk that the government would pay for indirectly through subsidies and guarantees), the project's value would be 15 billion shekel. The inclusion of environmental and road injury costs, and high (though not inconceivable) levels of traffic induction could easily half this. These figures are prior to challenge by the standard sensitivity tests for a construction cost overrun. Thus the economic benefits that featured centrally in the project's approval process may not be as large or robust as claimed.

CHAPTER 4

IMPLICATIONS OF THE LEVEL OF GOVERNMENT SUBSIDIES

INTRODUCTION

The cost-benefit analysis discussed above is an attempt to assess the value of the Highway to the Israeli economy as a whole. However, economic worth to the economy, financial impact on the Israeli government, and financial viability for the concessionaire (the winning consortia that will finance, design, construct, operate, and maintain the Highway) are three separate things, the distinction between which can be highlighted by the ways in which they can sometimes run at cross-purposes.

For example, the benefit of the Highway (reduced fuel costs) leads to a reduction of government income from fuel taxes,[191] which constitute almost half the variable costs of car operation,[192] and a significant portion of total government income. In other word the success of the Highway in economic terms might entail a non-trivial reduction of government income. Or to take another example, several sustainable transport measures (increased gasoline taxes, improved public transport in the center of Israel, etc.) would have important economic advantages for the country by decreasing energy use, pollution, and road injuries. Yet to the degree these cut into traffic volumes (and thus toll incomes) on the Trans-Israel Highway they would worsen the financial situation of the concessionaire (and of the government if it has guaranteed minimal traffic levels).

Thus a highway project could make or lose money independent of its economic value, and given the right guarantees a concessionaire could still make money off a project that was not financially viable in the sense that users did not cover its costs. A sound financial analysis is necessary in order to sort out these issues.

THE PROPOSED SUBSIDIES

When the Highway was broached to the government, one of its claimed advantages was that it would be entirely budget-neutral.[193] Over time, however, it appears that the income from tolls may be far from sufficient to cover the project's cost. The list of government costs and commitments to the concessionaires that have been proposed up to the date of writing indicates that those who benefit directly from the Highway (drivers and landowners) are, in fact, only going to cover a small portion of the construction and operating costs. It is possible that without some substantial level of government support no company would bid for the project in its current form. While the arrangements must still be negotiated with the winning company, at this point the following are some of the forms of support or protection that have been proposed.[194]

- Up to 80% of shortfall in toll income will be met by the government (and 50% of excess tolls will revert to the government).
- The government will provide assistance in raising the capital, possibly through use of government loan guarantees, and promises to provide capital for the second 15 years of the concession in the event that the concessionaire has difficulty raising this in the private sector.
- The government will commit to arrange for the repurchase of the highway from the concessionaire at the end of the concession period at the cost of $0.5 billion.
- The government has undertaken the construction of two major interchanges in the central portion of the Highway (Kesem and Ben Shemen).
- The government is responsible for upgrading the existing connecting road network to bear the increased traffic volumes in time for opening of the interchanges.
- The government is responsible for all land expropriation costs and the cost of relocating existing infrastructure. While any cost above $5,000 per dunam was considered a transfer cost and not represented in the <u>economic</u> analysis of the Highway, a <u>financial</u> analysis should represent the full expropriation cost.

This level of support raises a series of questions:

- What are the implications of the government continuing to subsidize transport infrastructure and services well beyond their beneficiary's willingness to pay for them? Is the demand for the capture of value evenly applied across transport modes?

- Is a government subsidy for highway users the highest priority for substantial government transportation spending, and for public expenditure more generally? Would other forms of transportation subsidy, or, indeed, other uses of these public funds yield better returns for investment or be more justified from a public policy perspective?

- Does the extent of proposed government guarantees and subsidies undermine the rationale for financing the project through a private sector BOT scheme?

- Can any guarantees be structured in a way that reinforces, rather than undermines, incentives for sound environmental behavior?

- In order to avoid paying landowners direct compensation at a level approaching the market value of their land, the government is considering a variety of land-use conversion arrangements. What are the implications of these?

SHOULD SUBSIDIES FOR CAR USE BE CONTINUED AND EXTENDED?

There are two ways in which the value of a highway can be captured: through charging its users (i.e. tolls) and through contributions from those land-owners whose property is likely to appreciate in value because of the increased access.[195] Under ideal market conditions, this and other infrastructure should only be provided if its costs can be covered by what beneficiaries are willing to pay for the value they receive. We are, of course, far from such conditions, for a number of reasons. On the one hand, for example, society has agreed that some goods are socially desirable and should be subsidized. On the other hand, activities have externalities: costs and benefits for people other than those who decide on them that thereby distort the decision to engage in them.

Economists have shown that various modes of transport, and private car use in particular, have massive externalities associated with them, and that the positive externalities of transport are negligible.[196] This travel, in other words, is significantly underpriced, especially once its externalities are taken into account.[197] In the case of car travel, for example, the government spends more on roads, traffic police, road injuries, health costs induced by air pollution, etc. than it gets back in the form of fuel and car taxes.[198] An OECD analysis concluded that in most developed countries the social costs of land transport amounted to 2.5% of GDP, of which 90% was due to road vehicles. A World Resources Institute study puts the figure at $300 billion for the U.S., or 5.3% of GDP, amounting to about $2,000 a year.[199] While government expenditures on the construction and operation of bus and rail services also exceeds government income from these (primarily through fares), the social cost per passenger-kilometer is far less than car travel. The level of social costs and comparison of the relative levels of subsidy per passenger-kilometer for different modes in Israel have not been carefully worked out, but are likely to present a similar picture.

This underpricing encourages more travel and kinds of travel that are economically inefficient. Against this background, it is becoming an increasingly accepted principle that users of various transport modes should begin to pay as much as possible of their true costs. The European Conference of Ministers of Transport (ECMT), for example, issued a declaration to this effect in 1989.[200] A variety of price changes have been suggested to encourage more efficient transport use. In the case of cars, taxation on fuel and vehicles, road-pricing, and parking fees have been suggested as central ways to recover more of the full costs of driving. It has been suggested that as an interim investment in eliminating distortions it is justified for the less damaging modes to be exempt from full cost liability in order to encourage modal shift to more efficient modes in the transitional period until all modes of transport bear their full costs.[201]

Given that user benefits won't even cover the infrastructure costs, never mind the external costs of travel, the Trans-Israel Highway clearly deepens the already large subsidy for private car use, and moves Israel further away from the goal of transport paying its true costs. How are we to relate to this subsidy? Does this short-term retreat from rational pricing policies contribute to rationalization in the longer term by beginning the process of charging for road use? Or does the level of subsidy and the induction of new underpriced car use negate any such benefit? Is car use the most pressing priority for travel subsidies, and for the public use of funds more generally, or should these be directed toward less damaging forms of transport? How is this retreat from full value capture for road use reconciled with the increasing demand that other modes pay their own way?[202] Finally, in the event that toll revenues do not meet project costs, what are the social equity implications of general public spending to cover the difference when the main beneficiaries of the Highway are a specific segment of society, namely car owners and those whose land value will increase?

In considering these questions it should be remembered that the arguments that road construction in general, and that of the Trans-Israel Highway in particular, will lead to economic growth both at a national and regional level[203] are on very shaky ground. The large amount of research on the subject since the 1970s has provided little evidence for these claims.[204] While the link between road provision and economic growth may be robust for countries and regions in very early stages of development (the U.S a century ago; Third World Countries today) where roads opened access to new resources and where transport costs were a major element of production costs, in countries at Israel's level of development the link is tenuous. Redistribution of economic activity is a more prominent effect, so that without careful study it is impossible to know whether a new road to the Galilee or Negev, for example, will create regional growth in these regions or simply drain economic activity out of them and thereby reinforce core-periphery differentials.[205]

DOES THE LEVEL OF SUBSIDY UNDERMINE THE RATIONALE FOR A PRIVATE SECTOR PROJECT?

The choice of private sector funding[206]

In early 1990, an overseas firm (GA / Partners-Arthur Anderson & Co.) was contracted by the Israeli Ministry of Construction and Housing / Public Works Department to study the various financing options for the Trans-Israel Highway. They considered three options: (1) financing entirely by the government of Israel; (2) financing by private sources in the State of Israel, and (3) a shared public-private financing approach accessing private international capital.[207]

The third option (primarily overseas private financing) was recommended based on claimed governmental financial constraints and the advantages of the private sector financing and construction. Government resources were considered inadequate and too oversubscribed to allow the appropriations necessary for the Highway, estimated to average $23-30 million annually to cover operating costs and debt service on loans taken at rates of interest available to the government. While the government would enjoy lower interest rates on debt than the private sector, a private sector project would "eliminate the need for government capital investment, access private market capital resources and expertise, reduce the completion time-frame, and provide for ultimate government ownership."[208] In exchange for assuming the burden of financing and some of the risks of the project, the contracting consortium would receive the highway tolls over the course of the concession, typically thirty years.

Though not universally preferred, the private-sector option was ultimately adopted by the government, and the Trans-Israel Highway Company took on implementation of this BOT (built, operate, transfer) funding strategy. It prepared an international tender for the project, and the four private sector consortia that passed the pre-qualifying stage submitted their bids on the highway in May of 1997.

Preserving the virtues of public/private partnership: criteria for allocating risks and costs

There are good arguments for drawing on private sector capital to enable a large infrastructure project of national importance. However, international experience suggests that as a project moves toward actual bids and ultimately a signed contract it is important to ensure that the principles guiding the choice of private sector construction and operation are not eroded by pressures for inappropriate levels of government subsidy. Preserving the merits of privatization is especially important in the case of the Trans-Israel Highway.

First, as a project that is often presented as the flagship of the trend towards privatization in the Israeli economy, the Highway will set the tone for future deals and similar public/private partnerships. It is important to not set precedents for over-extensive guarantees and subsidies. Second, such guarantees and subsidies would obscure the financial viability of the project--a good index of the project's value that should guide the decision on whether to go ahead. If the value expressed by toll income (with the possible addition of contributions from those land owners and developers who will benefit from the appreciation of property made more accessible[209]) are not sufficient to enable private sector land purchase, construction and operation, this should be taken as a strong signal that the project may not be worthwhile. Undue government subsidies and guarantees that go much beyond minimal assurances of stable operating conditions for the collection of toll revenues mask this signal, and distort the decision on whether to proceed with the project.

More concretely, the list of incentives--and in particular the significant levels of toll shortfall guarantee being discussed--seem to run against the MA'ATZ study's recommendations on risk allocation. This study emphasized that if the private financing option was chosen it would be important to "avoid direct guarantees to the maximum degree possible."[210] According to the traffic and financial analysis performed then,

> forecast revenues from tolls appear to meet appropriate levels of debt coverage. Were that not the case, or if the potential private sector sponsors seek greater assurances, government contingent guarantees might be necessitated. These might be limited to 10 to 20 percent and fixed at a predetermined magnitude. . . . Should potential shortfalls still be at issue, private insurance coverage could be a source of protection. In that event, the selected road sponsor may elect to reduce their risk by means of such insurance.

International evidence alerts us to the danger that government guarantees and subsidies--and an over-generous commitment to subsidize traffic shortfalls in particular--may undermine the incentives of bidding companies and their banks to perform their own careful traffic and toll income projections. In a 1996 publication, Walter Hook examined five toll road projects in (Mexico, China, Hungary, Japan, and Spain) where financing was done without government guarantees, and which therefore illustrate "sound banking principles" for road sector lending.[211] Among his conclusions are that when government guarantees of toll road projects are <u>not</u> offered, the bidding companies tend to rely on their own technical experts to determine that traffic volumes times toll rates are high enough to guarantee repayment of loans. Conversely, "the more secure the government guarantee, the less concern the bank showed about the financial viability of the project."[212] He points out that, sometimes, bidding companies will enter into projects knowing that toll collection income levels make them unprofitable because they enjoy other forms of support that make the overall deal profitable.[213]

While some government assurances may be desirable to keep capital committed to a public/private partnership, these should be of the right kind and extent. They should allocate risk in a way that encourages rather than undermines sound independent financial and traffic analysis (as discussed above), and that adheres to the principle that agents should cover the kind of risk they are in the position to do something about.[214] Thus government guarantees might cover exchange rate terms, or assure that the government would not construct a competing road and would maintain connecting roads to adequate levels. Government guarantees of toll income, on the other hand, especially at the percentage level currently discussed, are more worrying.

In sum, it is important to clarify whether the range and extent of government subsidies and guarantees offered do not undermine the advantages of private sector financing that were the basis for deciding to adopt this mode of financing. If the government commits to raise or underwrite a good portion of the necessary capital, to take most of the risk upon itself, to assure investors a minimal rate of return through toll guarantees, to purchase and prepare the land, and so on, couldn't it more profitably construct the highway by itself, raising capital at more favorable terms through a bond issue or other means and subcontracting out portions of the work as necessary?

THE ENVIRONMENTAL AND LAND-USE IMPLICATIONS OF FINANCIAL ARRANGEMENTS

If the Highway is to proceed in anything like it's present form, regional and environmental planners--who had scant opportunity for orderly input into the project's planning and evaluation--should at a minimum be involved in limiting the damage of this *fait accompli.* In particular, they should have some say in shaping financial arrangements that might have undesirable environmental and land-use implications. For example, a government commitment to make up shortfalls in toll income could undermine government incentive to reduce traffic flows by significant public transport measures.

The long-term regional implications of expropriation settlements must also be carefully examined.[215] Land owners are currently demanding dunam-for-dunam exchanges of agriculturally zoned land (their first choice), zoning changes for their other agricultural holdings, the substitution of their taken lands with smaller areas zoned for commercial or residential use, or--as a last resort--cash compensation. Between 16,000 and 22,000 dunam will be expropriated for the first phase of the Highway.[216] This will have either massive land-use implications (if zoning changes are a substantial aspect of the expropriation agreements), financial impacts on the government (if anything close to market value is offered for expropriated land), or engender significant political resistance and possible expensive work stoppages (if the communities along the right-of-way remain unsatisfied with expropriation settlements).

The government is now under tremendous pressure to provide off-budget solutions to the demand of land-owners. While the cost of land expropriation was calculated at $5,000 a dunam in the cost-benefit analysis (any cost above this was considered a transfer cost and not represented in the calculation of costs), market land prices can reach $60-70,000 a dunam for private land near interchanges in the central portion of the Highway, and half that for agricultural land for which an expectation of zoning change exists. Except for the lands to be returned to the Israel Lands Authority by kibbutzim as part of the "kibbutzim debt settlement" agreements, there is little substitute land available in the center of the country.

Thus at the same time as the Highway's land-use implications are inadequately thought through, there is mounting pressure on the government to offer zoning changes and road-side concession rights as a quick off-budget means of compensation to land-owners on the one hand, and as greater incentive for bidding companies to invest on the other. It seems important, therefore, to simultaneously analyze three critically linked elements: the appropriation settlements; road-side concessions and other incentives to the bidders; and the Highway's overall economic, financial and land-use implications.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

INADEQUATE INFORMATION IN CRITICAL AREAS

If major gaps in the planning and evaluation of the Highway are not addressed immediately, the country will proceed with a project whose value, costs, and impacts are all uncertain.

The transport planning and evaluation process of the Trans-Israel Highway propelled the project to the threshold of execution without adequate evaluation in a range of critical areas. As a result, we have large gaps in our knowledge about its long-term environmental, land-use, economic and financial impacts, and even its effect on the overall transportation system. To proceed with "the largest transportation project undertaken since the establishment of the state of Israel"[217] on this basis seems unwise.

In not systematically considering the Highway's land-use implications or its relation to an array of potential transport/access solutions, the Highway planning process ignored not only the mandates of progressive transport planning but the recommendations of a series of Israeli policy documents. Decision-makers never had the opportunity to systematically compare the Highway's costs and benefits with those of other transport investments. Because the Highway's cost-benefit analysis was based on a series of overly generous assumptions, did not consider induced traffic effects, nor incorporate a range of social and environmental costs, its value was overestimated. The value given by a more realistic assessment could be far lower than that used by decision-makers who approved the Highway, and thus reduce the public policy rationale for the project. Given this, the possible financial impact of the project on state coffers should be carefully considered. A preliminary analysis shows that the structure of risk allocation and government guarantees to the concessionaire currently being discussed could seriously degrade the advantages of private sector involvement, including the goal of off-budget financing, while unresolved land compensation issues threaten to have large land-use and/or financial repercussions.

The significance of the Trans-Israel Highway extends beyond this project. The Highway is a benchmark for whether Israel will seize the rapidly closing window of opportunity to retain the viability of public transportation and a range of alternatives to car-dependent lifestyles. The coming 5 years are critical. While moderate increases in road capacity may be worthwhile after investments in mass transportation have been made, massive road construction in their absence would undermine the future possibility of other transport solutions. Car-intensive land-uses, spatial structures, and travel behaviors would be further encouraged, while funds and passengers would be drained from public transport. It would be extremely worrying if such a large project goes ahead at this juncture without being evaluated with respect to these staging considerations and to sustainability criteria for Israel's overall and long-term transport system.

Depending on choices made in the next few years, by 2010 Israel could have double the numbers of cars on the road today, a national highway that serves car-dependent development east of the Dan region and country-wide commuting to the Tel Aviv metropolitan area, and little transport budget left over for anything else. Or it could be well on its way to a competitive rail system, expanded bus service with extensive separate lanes, the creation of new communities and the renewal of old ones to support high quality lifestyles that don't require extensive car use, more efficient use of existing road systems, and a slowing in the pace of car purchases.

It may be that a road along part of the Highway's route could have a place in the latter system--but the planning and evaluation done up to this point provide an insufficient basis for deciding if, when, and how. A vigorous discussion of the issues raised in this report and others would help decision-makers proceed with a broader base of public support and increased confidence that a critical decision was made with the care it deserves.

FILLING IN THE GAPS IN OUR KNOWLEDGE

The following are some overarching suggestions as well as concrete corrections that would fill in the gaps in our knowledge about the Highway.

Setting acceptable motorization levels

Until achievement targets are set (by an acceptable transport master plan or "white paper" for Israel), immediate interim guidance on key transport parameters is necessary to inform decision-making on the Highway and alternatives to it. In particular, projections of traffic flows, pollution levels in major cities, available parking spaces, etc. should be used to determine the maximum motorization rate and annual kilometrage Israel can tolerate given its already extreme vehicle-density figures. Another important consideration in setting this level is the impact of rising motorization levels and car use on Israel's trade balance. With all vehicles and gasoline imported, and a trade deficit approaching $1 billion a month, Israel must weigh this additional drain on its economy carefully. The desirable motorization rates and kilometrages should drive the policy decisions and modeling described below.

Re-opening the problem definition lens

The premature closure of options that took place during the planning process of the Highway must be reversed. The narrower the definition of Israel's transport problems, the more self-evident and reasonable will certain solutions seem to be. Thus if Israel's transport problem is defined as congestion, and we seek single-project road-supply solutions, the Trans-Israel Highway seems inevitable. But if we take one step back and consider multiple projects and means to meet congestion (such as a package of spot widening of roads, improvements at problem interchanges, a range of demand and traffic management measures, etc.), it could be that far more relief could be achieved for less cost. And if we widen our lens yet further, to include not just congestion as Israel's most pressing problem but the mobility and access needs of all of its citizens (including the majority of the population that is carless), for instance, or the health-endangering pollution levels from vehicle emissions, we may be pointed to an even broader range of alternatives as the most desirable and urgent.

Given that the Highway did not emerge from a national transport master plan, this widening of problem scope is now a pre-requisite for an objective evaluation of the project's merits and priority. Since substantial background work is contained in existing policy and planning documents, this process need not be very prolonged or costly; the problem is not so much the lack of knowledge as its translation into the correct prioritization and execution of projects.

Putting together an optimal basket of transport investments

Since the Trans-Israel Highway was never systematically compared with alternatives, and was wrongly assumed for a long time to be budget-neutral, and therefore not be at the expense of other projects, the relation of the project to other transport investments was inadequately considered. Now, with substantial government funds being projected for use on the Highway, and demonstrated private-sector interest in revenue-earning infrastructure projects, it would make sense to consider the optimal basket of transport measures toward which these resources could be applied given Israel's overall transport priorities. A project as consequential as the Highway should only be considered as part of an overall package of transportation measures, and the extent and timing of its funding within such a package should be a function of its merits relative to other projects.

Improving the traffic modeling

The need for and dimensions of the proposed Highway should be reconsidered in light of the more realistic and up-to-date traffic modeling and economic evaluation procedures. Ideally, scenario or risk analysis procedures should be used so that the variation possible in each of the various parameters is be considered simultaneously to provide a composite worst and best-case estimate of project value.[218]

As described in the body of this paper, improved traffic modeling would do the following

- Rerun the traffic models with saturation motorization rates of 400 and 350. Sensitivity tests of 450 and 300 should be applied.
- Model traffic using current Ministry of Finance modeling guidelines, and especially those that correct the inflation of time savings by unrealistic congestion in the "do-nothing" scenario.
- Calculate projected annual kilometrage using a more realistic assumptions for fuel price increases.
- Include a factor for the diversion of traffic by tolls, using the procedure developed by MA'ATZ in the early analyses of the Highway.
- Run the "do-nothing" scenario with a realistic alternative transport development scenario. This would assume that projected expenses of the Trans-Israel Highway and possibly additional funds were redirected to other transport investments. Some possible components of this scenario might be:

1. The intensive improvement of bus service, and especially through the provision of dedicated bus lanes in areas of congestion.
2. Spot improvements at critically congested sections of existing highways.
3. The use of the "toolbox" of congestion-relief measures, such as those whose cost and effectiveness have been worked out by the U.S. Institute for Transportation Engineers.[219]
4. Consideration of the impact of a rail development scenario on road traffic using appropriate urban rather than national modal split figures and with special attention to peak-hour commuting as described in the body of this paper.

In the longer term, Israel's circumstances make the best possible modeling especially important. The recent upgrading of models represented by the new Ministry of Finance instructions and the current research being done by the Israeli Institute for Transport Research and Planning are important steps. International experience (especially by the Dutch and Swiss) should be drawn on to create models that do consider how roads affect the decision of <u>if</u> to travel (trip generation) and <u>where</u> (trip distribution), and even factors such as residential location. In the U.S., increasingly, the more progressive planning agencies are developing quantitative methods of forecasting land use changes, and linking their land-use and transportation models (which are now actually seven or eight linked steps).[220]

Improving the economic evaluation

As described in the body of this paper, the following variables in the existing cost-benefit analysis need improvement.

- Use the Ministry of Finance approved discount rate (of 7%) or higher if necessary to reflect the higher cost of capital to the private sector and the indirect costs associated with government guarantees.
- Use current Ministry of Finance guidelines for calculating time savings. These correct some of the distortions due to the fixed-matrix assumption of inelasticity in the "do-nothing" scenario.
- Estimate the possible scale of induced traffic effects and their impacts, namely increased pollution, road injuries, and erosion of time savings (i.e. correct the assumption of inelasticity in the "build highway" scenario"). Rough minimum and maximum figures can be derived from the studies and elasticity figures presented in Table 7, and added injury and pollution costs due to these can be roughly estimated as described. Alternatively, adopt at least the

conservative UK DOT protocol for assessing the erosion of time savings due to induced traffic.
- Include the cost of upgrading subsidiary roads in the project cost.
- Calculate the costs of additional road deaths and injuries due to congestion-relief and induced traffic, and weigh any raise of speed limit above 90 km against the cost of the resultant further rise in accident rates.

Improving the environmental evaluation

- Highway Company claims about the reduction in air pollution should be corrected as described in the body of this report.
- The current UK COBA guidelines should be used to consider the range of environmental costs currently absent from the cost-benefit analysis (and these should be monetized where appropriate).
- The cumulative, long-term, and area-wide impacts consequences of the Highway's should be "scoped," and the consequences of not conducting a comprehensive / strategic EIS that would capture these should be considered.

Assessing the Highway's likely effects on land-use in light of current development policies

Considerable resources should be invested in clarifying the likely and possible land use impacts of the Highway as well as of alternatives to it, and evaluating these in light of the goals laid out in Israeli planning documents. These assessments are critical for understanding the long-term traffic induction due to the highway, the impact of the highway on agricultural land and open space, and on suburbanization and sprawl.

Some have claimed that while sprawl is indeed undesirable, the Highway follows rather than induces it, since the road is designed to serve developments already under construction or planned. There are several problems with this argument. First, some of these projects may have been developed in the anticipation of the road, without which they would have to have been scaled back. Second, if higher densities and mixed use were encouraged in these developments, and they were supported by public transport measures, existing roads might suffice to serve them. Finally, if the Highway proceeds, it will encourage development well beyond that already planned or in place. The pressure for development around highway junctions is so large that in the long term it tends to occur whether or not it conforms to the original approved development plan.[221]

We urgently need a systematic appraisal of the project's land-use impacts and their relationship to national planning policy. As discussed in the body of the report, these are interlocked with the nature of the proposed land appropriation settlement and incentives to concessionaires, and should be considered with them jointly.

SYSTEMATIC PROJECT EVALUATION AS A MEANS TO GREATER CONSENSUS

The circumstances that propelled the highway to the threshold of execution without adequate opportunities for debate, evaluation, and informed public involvement are complex, and not the direct subject of this paper.[222] Whatever its causes, the lack of integrated planning, systematic comparison of alternatives and adequate evaluation may be one of the reasons the level of debate about the Highway has remained rather shallow until recently, and continues unabated into advanced stages of planning.

Though both sides of the debate have matured through their battle, there have been caricatures along the way: the project's proponents have tended to regard it as a panacea for Israel's transport problems, the last chance to save a transport system about to collapse because of a backlog of missing road infrastructure. It's opponents have tended to see it as an unmitigated disaster, and point to an unrealistically extensive rail system as a counter-panacea.[223] A clear definition of Israel's transport needs, the kinds of measures that could meet these, and their relative costs and benefits might have helped break this unproductive standoff. While public awareness of the highway's cumulative environmental and land use implications is growing, consideration of these impacts is largely absent from the technical documents that evaluate the project. And in general, the kind of planning and evaluation tools that could bring concerns on these counts into systematic contact with claims about the Highway's function and benefits have not been employed thus far. Constructive conversation between proponents and opponents is largely non-existent, and the broader public remains confused about how to reconcile the two.

By examining what evaluation was done, and what was not, and pointing to the kind of evaluation that would be necessary in order to know what the Highway means for Israel's society, economy, and environment, this report tries to lay the groundwork for better future conversations among the stakeholders in this project.

APPENDICES

APPENDIX A: COST-BENEFIT ANALYSIS OF THE HIGHWAY

Note: All figures in millions of NIS, April 1994 prices, for the most worthwhile alternative (Option # 12). Discount rate: 4%. As the given Net Present Value figures for land compensation and total savings differ from the correct (calculated) values, I have given both sets of figures. Shaded cells are those in which the figures appearing in the English version of the study submitted to competing companies differ from the original Hebrew version. In these cases I have used the latter.

Year	Construction cost	Compen-sation for economic value of land	Periodic main-tenance	Ongoing main-tenance	Time Savings	Savings in operating costs	Total Savings
1994	0	-48.3	0	0	0	0	-48.3
1995	-327.14	-48.3	0	0	0	0	-375.44
1996	-490.71	-48.3	0	-3.27	0	0	-542.29
1997	-490.71	-48.3	0	-8.18	0	0	-547.19
1998	-490.71	-48.3	0	-13.09	0	0	-552.1
1999	-490.71	0	0	-17.99	0	0	-508.71
2000	0	0	0	-22.9	893.75	203.21	1074.06
2001	0	0	0	-22.9	1001.84	238.2	1217.14
2002	0	0	0	-22.9	1123	279.21	1379.32
2003	0	0	0	-22.9	1258.8	327.29	1563.21
2004	0	-13.68	0	-22.9	1411.07	383.64	1758.12
2005	-163.6	-13.68	-43.88	-22.9	1581.72	449.69	1787.36
2006	-163.6	-13.68	-43.88	-24.54	1773.02	527.12	2054.44
2007	-163.6	-13.68	-43.88	-26.17	1987.45	617.87	2358
2008	-163.6	-13.68	-43.88	-27.81	2227.82	724.26	2703.11
2009	-163.6	0	-43.88	-29.44	2497.26	848.96	3109.29
2010	0	0	0	-31.08	3446.1	1172.7	4587.73
2011	0	0	0	-31.08	3813.24	1312.82	5094.99
2012	0	0	0	-31.08	4219.5	1469.68	5658.1
2013	0	0	0	-31.08	4669.04	1645.28	6283.24
2014	0	0	0	-31.08	5166.46	1841.87	6977.25
2015	0	0	-96.72	-31.08	5716.89	2061.94	7651.02
2016	0	0	-96.72	-31.08	6325.95	2308.3	8506.45
2017	0	0	-96.72	-31.08	6999.91	2584.1	9456.21
2018	-201.5	0	-96.72	-31.08	7745.66	2892.86	10309.22
2019	-201.5	0	-96.72	-33.1	8570.87	3238.51	11478.05
2020	0	0	0	-35.11	8992.2	3333.18	12290.27
2021	0	0	0	-35.11	9854.1	3598.69	13417.68
2022	0	0	0	-35.11	10798.6	3885.34	14648.84
2023	0	0	0	-35.11	11833.7	4194.83	15993.38
2024	0	0	0	-35.11	12967.9	4528.97	17461.77
2025	0	0	-76.27	-35.11	14210.9	4889.72	18989.23
2026	0	0	-76.27	-35.11	15573	5279.21	20740.83
2027	0	0	-76.27	-35.11	17065.7	5699.73	22654.02
2028	0	0	-76.27	-35.11	18701.4	6153.74	24743.78
2029	0	0	-76.27	-35.11	20494	6643.92	27026.48
2030	0	0	0	-35.11	22458.3	7173.14	29596.32
Discounted total (given)	2,571	237	417	437	78,669	26,819	101,828
Discounted total (calculated)	**-2,571**	**-256**	**-417**	**-437**	**78,669**	**26,819**	**101,808**

NET PRESENT VALUE (NPV) Calculated:	**101,808**	**INTERNAL RATE OF RETURN (IRR) Calculated:**	**34.5%**

Source: The Trans-Israel Highway Company, Traffic Forecast and Economic Evaluation, Vol. 2, p. 204.

APPENDIX B: DEVELOPMENTS RELEVANT TO THE APPRAISAL OF ROAD PROJECTS

Developments relevant to the economic appraisal of road schemes: a survey of British and American experience[224]

DATE	EVENT	FINDINGS/SIGNIFICANCE
1960	Application of cost-benefit analysis to the London–Birmingham motorway.[225]	First use of formal cost-benefit techniques for a road project.
1963	Cost-benefit analysis of Victoria line[226]	Demonstrates substantial return on rail extension, with half of the benefit due to congestion relief or generated traffic on parallel lines.
mid sixties	Cost-benefit analysis a standard requirement for project approval	
1968–1972	Debate over location of London's third airport; Roskill Commission Inquiry	Tremendous debate over the role of monetary valuations in project assessment, and the need for additional planning factors and consideration of equity issues. Even though it was found worthwhile through the most comprehensive cost-benefit assessment of a transportation investment decision ever done up to that point, the project was rejected.
1972	COBA (COst Benefit Analysis) method of road project evaluation	Becomes standard framework. Costs and benefits considered (savings in travel time and operating costs, traffic accidents, capital and maintenance costs) are discounted over 30 years to derive a net present value.
1973	Pearce and Nash (1973)[227]	A standard cost-benefit evaluation of a highway done for the city of Southampton was revised to include the following: induced traffic, the necessary complementary interchange investments, market value of appropriated property, more realistic construction costs, noise nuisance, and disruption during construction. These corrections showed that most of the projects costs fell on lower income groups while its beneficiaries were higher income car drivers, and that the project's present value to the economy (originally estimated at 6 million in 1971 prices) was actually marginal when realistically assessed.
mid–seventies	Wave of concern over the road planning process	Fundamental questions raised about traffic forecasts used, valuation of time, and accident savings. A search for alternatives to further road building to accommodate growth in car traffic. Public no longer content to leave decision-making to professionals. Series of major road inquiries disrupted or suspended. High profile anti-road demonstrations. The average time of road project from inception to completion rises from 6-7 years to 10-12 years.

1977	Findings of UK Government's Leitch Committee	A comprehensive review that largely vindicates the claims of pressure groups as to the many inadequacies of existing trunk road appraisal procedures. In particular, it critiques the following: their lack of access to non-experts, the overriding priority given to road user benefits, the unexamined basis for and self-fulfilling nature of traffic projections, the inadequate consideration of environmental factors, unwarranted assumptions about the economic value of claimed time savings and underestimations of the cost of capital.
seventies	Development of matrix approaches to project evaluation.	Techniques acknowledge wide range, political nature, and differential effects of the impacts in pubic sector decisions and the inherent in-comparability of different kinds of impacts. Examples: Leitch Comprehensive Framework (1979); Lichtfield Planning Balance Sheet Appraisal (1970, 1976); Hill's Goal Achievement Matrix (1973).[228]
Late seventies	Development and application of land-use/transport interaction models in cities around the world.[229]	
1978–1984	Harrison and Rubinfeld (1978); Nelson (1982); McLeod (1984)	Development of techniques for evaluation of environmental impacts associated with road projects such as air pollution, noise, and landscape values.
1983	DOT Manual of Environmental Appraisal	Adds to list of environmental factors requiring consideration in road assessment, including assessment of heritage and conservation areas.
1985	EC issues Directive on assessment of the effects of projects on environment, including roads. Member states required to comply within three years. Britain does so by issuing regulations in July 1988 supported by guidelines and advisory booklet.[230]	"Member states shall adopt all measures necessary to ensure that, before consent is given, projects likely to have significant effects on the environment by virtue inter alia, of their nature, size or location are made subject to an assessment with regard to their effects."[231] Requires assessment of direct and <u>indirect</u> effects of a project on a wide range of factors (humans, fauna, flora, soil, water, air, climate, landscape, material assets and cultural heritage), and on their interactions. requires developers to present findings in an EIS before project can proceed, including a non-technical summary of the information.
1986	Completion of M25 around London	The road reaches its projected 30 year capacity almost immediately after opening, spurring debate over generated traffic. The extent of unexplained (i.e. induced) traffic is 30-45% of total volume by 1992.[232]
1986	First SACTRA report released and partially accepted by UK government[233]	Recommendations: integrate road appraisal with wider land-use and environmental impacts; consult with public and authorities at early stages of planning; clearly state project goals and consider range of feasible options through which they could be achieved; appraisal should include social and environmental impacts: i.e. a further move toward multi-criteria analysis.

1989	UK Department of Transportation's National Traffic Forecasts	Forecasts that economic growth and existing trends would result in a 83-142% increase in traffic levels by 2025 leads to a "new realism": it is no longer possible or desirable to build roads to keep up with demand, so demand must be reduced by policy levers to match available supply.[234]
1989	Court suits filed against California transport planners by Citizens for a Better Environment and Sierra Club.[235] Court rules that fixed matrix methods used are inadequate, and orders delay of work on some existing projects delayed, and postponement of decisions on significant new projects until adequate procedures are developed.	Existing fixed matrix forecasting methods in general use around the world and used by the Metropolitan Transportation Commission--a national leader in transportation planning methods--were judged inadequate as the basis for estimating the air pollution impacts of new highway projects. Specifically, they don't capture feedback from congested conditions, land-use changes induced by new highway capacity, nor their air-pollution impacts. Marks a fundamental transition in transportation planning. Holds planners to higher standards in predicting the regional impacts of freeway construction and upgrades, and especially their air pollution consequences. Improved analysis has become mandatory in all states and new litigation can be expected against agencies not complying. The case injected energy into existing efforts toward a new generation of planning methods, culminating in the Travel Model Improvement Program TMIP initiative launched in 1993 (see below).
1989	Massam (1989) in Progress in Planning.[236]	Availability of formal multi-criteria assessment methods
1990	Surveyor conducts a survey of 85 transport professionals in national and local government and academia on their estimate of the composition and scale of travel responses to new road schemes.[237]	"There is a general belief that travel does respond to the provision of new road capacity in a variety of ways not modeled in fixed matrix methods, and that these responses may contribute significantly to traffic levels." If these professionals' estimates of responses are correct, the current appraisal methods would overestimate the absolute value of schemes and distort their rank order in terms of cost-benefit ratios. An urgent investigation is necessary into whether and in what circumstances the fixed-matrix assumption is tenable.
1990	Williams and Moore in Journal of Transport Economics and Policy[238]	Development of a measure to relate project benefits under fixed versus variable matrix assumptions. This provides a measure of the error in approximations usually used in scheme appraisal, specifically the disbenefit resulting from induced traffic, which is not captured by the inelastic assumption of conventional 4 stage modeling.
1991-2	Willliams et al (1991), Willliams and Lam (1991), Williams and Yamashita (1992)[239]	Careful theoretical analysis tests of the errors introduced by fixed matrix assumptions and numerical modeling of their impact for a series of specific highway schemes under a range of conditions. Both demonstrate that fixed matrix evaluation can considerably overestimate scheme benefits, especially under congested conditions.
1991	Hanley (1991)[240]	Development of willingness-to-pay methods allowing the estimate of monetary values of open space to be taken by highway development.
1991	"What Are Roads Worth?" conference[241]	A call for major overhaul or even abandonment of current COBA techniques for road appraisal.

1989–1992	Pearce and Markandya (1989), Turner et al (1992), Barge and Pearce (1991)	Growing application of techniques for monetary evaluation of environmental impacts and consensus as to their validity.
1992	US DOT Travel Model Improvement Program (TMIP)[242]	In response to a growing realization of the inadequacy of existing traffic models designed in the 60s, the Department of Transportation in cooperation with the Environmental Protection Agency and the Department of Energy commit $25 million over the coming 5 years to devise fundamentally new travel forecasting procedures and immediately improve current models until new ones are available.
1994	Second SACTRA report[243]	Standard COBA is declared responsible for major failures in transport decision making. Central reasons: lack of consideration of induced traffic effects and application that diverges from best-practice cost-benefit techniques. Empirical evidence shows that induced traffic is a major effect not captured by standard fixed matrix modeling. Because these models can greatly overestimate the benefits of a road scheme, they should be corrected in the short term and replaced by variable matrix methods in the long term. The report, whose conclusions are largely accepted by the Government, marks the end of an era in traffic modeling. The reevaluation of hundreds of schemes already approved is ordered. As a result of new procedures, the benefits of demand management measures and other transport solutions are likey to rank more highly than before compared to the provision of new highway capacity.
1994	Oppenheim's Urban Travel Demand Modeling	Major textbook replaces faulty 4-stage modeling of the 50s and 60s with a synthesis of the advances of subsequent decades in a "behavioral combined equilibrium model" of urban transport demand that addresses some of its major flaws.
1996	Special issue of Transportation devoted to "Induced Traffic"	Summary of empirical and theoretical findings on induced traffic and its implications for project evaluation and for the land-use impacts of highway projects.
1997	Updated COBA manual in UK	Release of detailed guidelines for calculation of induced traffic effects and variable matrix modeling methods.

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NOTES

1 Preface to the "Technical Description" volume of the November 1995 Ministry of Finance/Ministry of Construction and Housing/Trans-Israel Company documentation submitted to companies during the pre-qualifying stage. These pre-qualifying documents consist of the following and will be referred to as such in this paper: Vol. 1, "Pre-qualifying Information and Questionnaire"; Vol. 2, "Traffic Forecast and Economic Analysis"; Vol. 3, "Traffic Forecast and Economic Analysis--Appendices"; and "Appendix--Technical Description."

2 Ulrich Beck, Ecological Enlightenment: Essays on the Politics of the Risk Society. Trans. Mark A. Ritter. Atlantic Highlands, N.J.: Humanities Press, 1991, p. 17.

3 Elaine Fletcher's important work on Israeli transport first called my attention to the two central distinctions I elaborate in this section: car density versus motorization rates and urban versus national modal splits. See her essay "Israeli Transportation and the Environment: Learning from the European Experience," in Robin Twite and Jad Issac eds, Our Shared Environment, Jerusalem: Israel/Palestine Center for Research and Information, December 1994, and the forthcoming report by the Adva Center for the Study of Israeli Society, Tel Aviv.

4 While my emphasis here is on the need for scale-sensitivity in thinking about road infrastructure, the same applies to other modes. The prospect for high-speed rail, for example, will remain very limited into the foreseeable future since this is most appropriate for travel between large population centers several hundred kilometers apart.

5 "The Cross-Israel Highway: Road Number 6," official colour prospectus, available from the Cross-Israel Highway Company, Tel Aviv. The brochure contains 3 pages of text and a colour map of the Highway's anticipated route.

6 "Traffic Forecast and Economic Analysis," op. cit., pp. 71 and 74.

7 Ibid., Table 3.22.

8 Ibid., Table 4.14, p. 108.

9 This number was derived by dividing the given number for the fleet in 1992 (1027 thousand) by Israel's population in that year (5195.9 thousand). Central Bureau of Statistics (CBS), Vol. 46, Statistical Abstract of Israel, 1995, p. 3.

10 On the method of deriving these see "Traffic Forecast and Economic Analysis," section 4.1 on p. 86.

11 Motorization rate is not the best indicator of the intensity of motorization for another reason. The ownership of cars is not a perfect predictor of their use. Annual kilometrage per unit area is a better indicator.

12 Numbers derived from Trans-Israel Highway Company projections and International Road Federation Statistics as explained below. International Road Federation, World Road Statistics 1989-1993, Geneva, November 1994.

13 Central Bureau of Statistics (CBS), Vol. 46, Statistical Abstract of Israel, p. 3.

14 Averaging over 2% annually even after the removal of the large immigration pulse of the early 90s.

15 The population projections for different regions in Israel appear in Table 3.7 on page 45 of the "Traffic Forecast and Economic Analysis." The fleet projections for these areas appears in Table 3.22 on page 77. I use areas 1 through 29 as "North of Beer-Sheva," deriving the area for this and the country as a whole from

the Israeli Central Bureau of Statistics Annual Bulletin for 1995. Table 1.1 on page 21.

16 The figures are:

Country	Motorization rate (1992)	Fleet growth–annual average (1989-1993)	Population growth–annual average
Belgium	413	2.5%	0.3%
Denmark	334	0.5%	0.2%
Israel	198	5.4%	2.2%
Netherlands	380	2.0%	0.8%

The figures for fleet growth (for the entire fleet) and population growth are derived directly from International Road Federation statistics. In order to render European motorization rates comparable to Trans-Israel Highway Company projections for 2010, which are for cars plus light commercial vehicles (calculated as two thirds of the trucks under four tons), a similar formula is used to derive a "car plus light commercial" fleet for European countries from European car and truck figures, and this fleet size is reduced by the 7% necessary to compensate for the fact that the European truck category also contains trucks over 4 tons.

17 Figures derived from International Road Federation Statistics for 1993 as explained above.

18 See, for example, John Pucher and Christian Lefévre. The Urban Transport Crisis in Europe and North America. New York: MacMillan, 1996. Organization of Economic Co-operation and Development--European Conference of Ministers of Transport. Urban Travel and Sustainable Development. Paris: OECD/ECMT, 1995.

19 Area = 20,770 km2.

20 Area = 7,935 km2.

21 Data from the National Survey of Travel Habits, June-Nov. 1993, by MATAT (The Center for Transport and Traffic Planning) for the Cross-Israel Highway Company Limited, as it appears in the pre-qualifying material, appendix 2, table 2.3.

22 See OECD, Urban Travel and Sustainable Development, op. cit., p. 169.

23 "Traffic Forecast and Economic Analysis," p. 177.

24 The figures for the category of "low automobile dependency cities" are from Kenworthy, Jeffrey R. and Peter W.G. Newman. Cities and Automobile Dependence: A Sourcebook. Aldershot, England: Gower Publishing Company Limited, 1989, as cited in Gur, Yehuda, Shuki Cohen, and Motti Zaaga. Transport in Israeli Cities at the Start of the Twenty-First Century: Trends and Degrees of Freedom. Israel 2020: Master Plan for Israel in the Twenty First Century, 1996. Stage Three, Report # 18. Public transport is still more prominent in the "very low automobile dependency cities" such as Munich, Singapore, Paris, Hong Kong, and Tokyo.

25 Quotations from the widely distributed informational brochure, "The Cross-Israel Highway: Road No. 6," available from the Cross-Israel Highway Company, Tel Aviv. Similar claims were made before the members of Knesset Finance Committee (Va'adat Hakesafim). See the discussion of Nitzan Yotzer and Benni Temkin in protocol # 356 of the August 8, 1994 meeting of the Committee.

26 Quotation from the official Company brochure.

27 "Traffic Forecast and Economic Analysis," pp. 75-77.

28 A figure of 2.7% was given by Ilan Salomon, Chair of the Steering Committee that oversaw the preparation of the economic and traffic forecast for the Highway, in his July 3, 1996 talk "Becoming Realistic About Transportation-Environment Policy Options," at the Sixth Annual Conference of the Israel Society for Ecology and Environmental Quality Sciences (in conjunction with the Eighth Regional

Conference of the International Union of Air Pollution Prevention and Environmental Protection Associations), Jerusalem.

29 According to the "Traffic Forecast and Economic Analysis," the Highway will carry about 13% of Israel's traffic ten years after opening.

30 See P. Goodwin, S. Hallett, F. Kenny, and G. Stokes. Transport: The New Realism. Oxford: Report to the Rees Jeffeys Road Fund, 1991.

31 The Highway Company does not give the source for its figures, but they are the same as those that appear in the International Road Federation statistics for the entire road network.

32 International Road Federation, World Road Statistics 1989-1993, 1994 edition. Table 1 "Road Networks as of December 31."

33 See Table 1 "Road Networks as of December 31, in International Road Federation, "World Road Statistics," which gives a breakdown of road lengths of different kinds of road in each country. A similar picture emerges from the United Nations Annual Bulletin of Transport Statistics for Europe and North America, Table 2B.

34 Figures from Table 3 in "Shuki Cohen, Travel Habits and the Development of Passenger Traffic--Israel Compared with the European Experience," Travel and Transport, January 1997, p. 37. In Hebrew.

35 Prof. Elisha Efrat, the editor of the TAMA 3 National Master Plan, claims that the road was marked in order to preserve the right-of-way for some time after the year 2000. Personal communication, 1996.

36 For a critique of the road planning process in Israel, albeit one from a very different viewpoint and reaching very different conclusions, see Benjamin Ilan, "Problems in Planning and Building Interurban Roads in Israel," Institute for Advanced Strategic and Political Studies (Jerusalem), 1995. Research Papers in Land Economics #3. The paper argues for the removal of barriers to rapid development of roads, the reduction of government involvement in the free operation of the market, and a technocratic bypassing of citizen participation in planning. In addition to his expert opinion on the High Court of Justice appeal (see below), Ernest Alexander has studies of the Trans-Israel Highway planning process I have not yet seen that are to appear in Environment and Planning B (1997-forthcoming) and in the proceedings of the International Workshop of Evaluation in Spatial Planning (Dordrecht: Kluwer, 1997-forthcoming) See also his "The Politics of Evaluation: The Relation between Method and Results in Evaluating Multi-purpose Projects," Environmental Planning (Tichnun Svivati) 48/49 (1993): 41-52. In Hebrew. For a thought-provoking first pass see Tamar Bergman-Gitmol's essay, "A National Project from the Garbage Can: An Analysis of the Decision-Making Process of The Trans-Israel Highway," unpublished manuscript, Tel Aviv University, Program in Public Policy.

37 Over 44% of the population live in the Central region, an area of 1,400 square kilometers. Gur et al., Transport in Israeli Cities, op. cit.

38 See Figure 1 in W. R. Sheate, “Strategic Environmental Assessment in the Transport Sector.” Project Appraisal 7, no. 3 (1992): 170-174. The British Royal Commission Report and the Dutch master plan are exemplary documents. (Royal Commission on Environmental Pollution. Eighteenth Report: Transport and the Environment. Cm 2674 London: HMSO, 1994.)

39 See John Pucher and Christian Lefévre, The Urban Transport Crisis, op. cit.

40 Elizabeth Deakin and W.L. Garrison, “Land Use.” In Public Transportation, ed. G. Gray and L. Hoel, New York: Prentice Hall, 1992, p. 536.

41 World Bank, "Sustainable Transport: Priorities for Policy Reform," 1996 , p. 94. This work is the most detailed statement of World Bank transport policy available, and has been endorsed by the full Board of Directors.

42 Quoted in Walter Hook, Counting on Cars, Counting Out People: A Critique of the World Bank's Economic Assessment Procedures for the Transport Sector and

their Environmental Implications. Institute for Transportation and Development Policy, 1994. I-0194, p. 11.

43 For a historical overview and bibliography see Elizabeth Deakin and W.L. Garrison. "Land Use." In Public Transportation, ed. G. Gray and L. Hoel, New York: Prentice Hall, 1992.

44 Homberger, Kell and Perkins, Fundamentals of Traffic Engineering, 13'th edition, Institute of Transportation Studies, U.C. Berkeley, 1982, pp. 2-8.

45 For overviews see Downs, Anthony. Stuck in Traffic; Coping with Peak Hour Traffic Congestion. Washington, D.C.: The Brookings Institution, 1992 and Institute of Transportation Engineers. A Toolbox for Alleviating Traffic Congestion. Washington D. C.: Institute of Transportation Engineers, 1989.

46 Kilometrage grew from 18,668 million km in 1990 to 27,551 in 1994, an average of almost 12% a year. CBS, 1995 Abstract, Table 18.21. The Trans-Israel Highway Company predict an annual average growth in kilometrage of well under half this rate, of 5.3% between 1992 and 2000, 3.5% between 2000 and 2010, and 1.8% between 2010 and 2020. "Traffic Forecast and Economic Analysis," Sect. 4.5.5, p. 108.

47 Road length grew from 13,199 km in 1990 to 14,169 in 1994. CBS, Table 18.16.

48 Michael Replogle, "Sustainability: A Vital Concept for Transportation Planning and Development." Journal of Advanced Transportation 25, no. 1 (1991): 3-18. Jeffrey R. Kenworthy, Peter W. G. Newman, Paul Barter, and Chamlong Poboon. "Is Increasing Automobile Dependence Inevitable in Booming Economies?: Asian Cities in an International Context." IATSS Research, 19, no. 2 (1995): 58-67.

49 The National Council for Planning and Construction, "Metropolitan Areas in Israel: Integration of Arrangements for Mass Transit within General Planning for the Dan Region--Policy Principles Report," edited and authored by Gideon Hashimshoni, June 1988, pp. 1-2. In Hebrew.

50 The National Council for Planning and Construction, "Metropolitan Areas in Israel," p. 2-A.

51 The Israel Institute of Transportation Research and Planning. Investment Plan for the Central Area: Recommended Roads for the Year 2010. The Israel Institute of Transportation Research and Planning, 1990, for the Public Works Department (MA'ATZ). In Hebrew.

52 The Israel Institute of Transportation Research and Planning. Investment Plan for the Central Area, footnote 1 on p. 42.

53 The Israel Institute of Transportation Research and Planning. Investment Plan for the Central Area, Section 1.4.5 on p. 12.

54 Gadi Kfir, Vladmir Lipshitz, Vered Ben Shlomo, Haim Aviram (Israeli Institute for Transportation Research and Planning), "Route 6-Economic Feasibility Study," December 1992, p. 2. In Hebrew.

55 TAMA 31, Vol. 4 (Explanatory Overview), March 1992, p. 54. In Hebrew.

56 TAMA 31, pp. 54, 27, 43, 223, and chapter 14.

57 TAMA 31, p. 173.

58 TAMA 31, p. 172, p. 54.

59 See Raviv Druker's overview of the problems of Israeli rail, "Paper Trains," Ma'ariv, Weekend Business Section, March 8, 1996, p. 4. In Hebrew.

60 Late member of Knesset A. Weinstein at the conclusion of the Knesset Finance Committee Meeting on the approval of the Trans-Israel Highway Law (August 8, 1994). Protocol number 356. In Hebrew.

61 "Traffic Forecast and Economic Analysis," section 7-5, p. 175.

62 Op. cit., section 7-7, p. 177.

63 Op. cit., section 1.5, p. 10.

64 See Sagi Chemetz, "Rail Development Plans Frozen for Lack of Budget," Ha'aretz March 23, 1997, Real Estate supplement. In Hebrew. Figures are from

the budget proposals of the Ministry of Infrastructure and Ministry of Environment for 1997, as collated by the Society for Protection of Nature in Israel.

65 See, for example, the opening paragraphs of the summary (p. II) of the Public Works Department, Ministry of Construction and Housing, State of Israel. Highway Number 6: Engineering, Economic, and Financial Feasibility Study. 1991, and the list of thirty-plus "Development Focuses" in "Main Possibilities for Development Focuses Along the Cross Israel Highway Strip," Appendix 4 of Vol. 3 of the pre-qualifying material.

66 On this episode and for a general discussion of the Highway's conflicting purposes, see Gideon Hashimshoni's comments at the January 25, 1994 meeting of the Institute for the Study of Land Use (report 18949 28; volume 47A), p. 13. In Hebrew.

67 The Israel Institute of Transportation Research and Planning for the Public Works Department (MA'ATZ). Investment Plan for the Central Area: Recommended Roads for the Year 2010. Footnote 1, p. 50.

68 A transportation adviser to the Highway has recently affirmed that there is no immediate need for the northern and southern portions of the road, and that the central portion from Hadera to Gadera "will fulfill most of the road's goals." Interview with Ilan Salomon in Tsafrir Rinat, “A Hierarchy of Roads.” Ha'aretz, 20/9/97 1996. In Hebrew.

69 Richard Arnott and Kenneth Small, “The Economics of Traffic Congestion.” American Scientist 82 (1994): 446-455; Anthony Downs, Stuck in Traffic; Coping with Peak Hour Traffic Congestion Washington, D.C.: The Brookings Institution, 1992; Institute of Transportation Engineers. A Toolbox for Alleviating Traffic Congestion. Washington D. C.: Institute of Transportation Engineers, 1989.

70 For an excellent review of the arguments for a comprehensive Environmental Impact Statement of the Trans-Israel Highway see the expert testimony of Prof. Ernest Alexander in the "Matter of Adam Teva V'Din versus The National Council for Planning and Others," High Court of Justice (BAGATZ), case 2920/94.

71 Standing Advisory Committee on Trunk Road Assessment (SACTRA), Trunk Roads and the Generation of Traffic. London: Department of Transport, 1994, p. iv.

72 Yehuda Gur, Shuki Cohen, and Motti Zaaga. Transport in Israeli Cities at the Start of the Twenty-First Century: Trends and Degrees of Freedom. Israel 2020: Master Plan for Israel in the Twenty First Century, 1996. Stage Three, Report # 18, pp. 48-9.

73 Ministry of Environment, Sept. 18, 1994, "DRAFT: Guiding Plan for the Development and Preservation Around Route Number 6." In Hebrew.

74 More formally, a cost-benefit analysis takes the stream of costs and benefits and discounts them (translates benefits or costs that occur in the future to a present value). Discounting is necessary because money has a time value and people have time preferences. A payment or income made today is valued more than one due several years into the future. The money spent on an investment today might have been used in other productive ways (i.e. it has an opportunity cost). Theoretically, this opportunity cost determines the discount rate used in calculating present value (see below). Often the discount rate chosen approximates the interest rate, so that if a project's net present value (NPV) is positive this indicates that it uses funds to better advantage than the private sector would. An additional metric of project worthwhileness often used is the "internal rate of return" (IRR). This is the discount rate at which the present value of a project becomes zero. If a project's IRR is greater than the rate at which money can be borrowed then it is worthwhile.

75 Cost benefit analyses have certain shortcomings, and other methods such as a planning balance sheet (PBS) or goals achievement matrix have been suggested as alternatives. See Donald M. McAllister, Evaluation in Environmental Planning: Assessing Environmental, Social, Economic, and Political Trade-offs. Cambridge: MIT Press, 1980.
76 Because unrealistic congestion is created in the "do-nothing" scenario by the assumption of inelasticity of demand, most road projects will show a high value.
77 For a comparison of substandard, standard, and cutting-edge procedures along 19 dimensions see Yaakov Garb, "A Comparison of International Road Evaluation Procedures," unpublished manuscript, 1997.
78 Public Works Department (MA'ATZ), Ministry of Construction and Housing, State of Israel. Highway Number 6: Engineering, Economic, and Financial Feasibility Study. 1991, page III--7, section 8.1.
79 ibid., p. III-7, section 8.1.
80 ibid., p. III- 7.
81 ibid., Table 305, p. III-16.
82 ibid., p. IV-1.
83 ibid., Table 308, p. IV-5.
84 Israeli Institute for Transportation Planning and Research, "The Trans-Israel Highway: Economic Feasibility Study," 1992.
85 ibid., Table 4.1.
86 MATAT, "Traffic Analysis and Economic Evaluation: Summary for Presentation to the National Council for Planning and Construction," Sept. 1994. This is a brief summary and presentation of the centra findings of the "Traffic Forecast and Economic Analysis."
87 See the expert opinions brought by the Company in the appeal to the High Court of Justice (BAGATZ).
88 This is typical of cost-benefit analyses of highway projects. On the sensitivity of the Highway's benefits to reductions in time savings see the "Traffic Forecast and Economic Analysis," p. 206.
89 Modified from Todd Litman, Transport Cost Analysis: Techniques, Estimates, and Implications. Victoria Transport Policy Institute, 1996, Table 5-5.
90 The 4 stage procedure is sketched in the "Traffic Forecast and Economic Evaluation."
91 See pp. 5-9 in Mark Garrett and Martin Wachs. Transportation Planning on Trial: The Clean Air Act and Travel Forecasting. Thousand Oaks, CA: SAGE, 1996 and the citations therein.
92 The modelers' use of volume/speed curves in the traffic assignment process (section 6.3 of the "Traffic Forecast and Economic Analysis," p. 145) is not relevant here.
93 Standing Advisory Committee on Trunk Road Assessment (SACTRA), Trunk Roads and the Generation of Traffic.
94 For references on travel time budgets underlying a claim that some of the time saved by a new road will be redirected to further travel see section 2.3 in Phil Goodwin, "Empirical Evidence on Induced Traffic: A Review and Synthesis." Transportation 23.1 (1996): 35-54.
95 Standing Advisory Committee on Trunk Road Assessment (SACTRA), Trunk Roads and the Generation of Traffic.
96 See the SACTRA report and Phil B. Goodwin, "Empirical Evidence on Induced Traffic: A Review and Synthesis." Transportation 23.1 (1996): 35-54.
97 Gad Kfir et al., "The Trans-Israel Highway: Economic Feasibility Study," Israeli Institute for Transportation Planning and Research, 1992. In Hebrew.
98 See Mark Garrett and Martin Wachs. Transportation Planning on Trial: The Clean Air Act and Travel Forecasting. Thousand Oaks, CA: SAGE, 1996.
99 Quoted on p. 35 of Phil B. Goodwin, "Empirical Evidence on Induced Traffic: A Review and Synthesis." Transportation 23.1 (1996): 35-54.

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101 The publications from the project are available from the Planning Support Branch, Federal Highway Administration, U.S. Department of Transportation, Washington D.C.
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103 All cited in Denvil Coombe, "Induced Traffic: What Do Transportation Models Tell Us?" Transportation 23, no. 1 (1996): 83-101.
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109 ALARM UK, Traffic Modeling, Cost-Benefit Analysis, and Traffic Generation. (London), 1995, p. 2.
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113 Metropolitan Transport Research Unit, "Trunk Roads and the Generation of Traffic: The SACTRA Report and Associated Government Guidance--What Does it Mean and Does it Matter?" Transport 2000: London, 1995, p. 6.
114 Ministry of Transport, "Guidance on Induced Traffic, Highways Economics and Traffic Appraisal," Note, December. Quoted in Peter J. Mackie, "Induced Traffic and Economic Appraisal." Transportation 23.1 (1996), p. 117.
115 These new guidelines appear in the "Ministry of Finance, Budget Division, Instructions for Economic Feasibility Studies of Land Transportation Projects" ("Nohal Prat"), dated September 1996. In Hebrew.
116 On this reconsideration and a discussion of its likely impact see Transport 2000, "Trunk Roads and the Generation of Traffic: The SACTRA Report and Associated Government Guidance--What Does it Mean and Does it Matter?" London and ALARM UK (London), "Traffic Modeling, Cost-Benefit Analysis, and Traffic Generation." See also William Walton, "Policy Changes in the Government's Road Building programme: A U-Turn or Just an Application of the Brakes?" Town Planning Review 67(4), 1996: 437-455. p. 447.
117 For reviews of empirical studies of induced traffic see Harry Cohen, "Review of Empirical Studies of Induced Traffic." In Expanding Metropolitan Highways: Implications for Air Quality and Energy Use, Transportation Research Board, Special Report 245. Washington, D.C.: National Academy Press, 1995 and the SACTRA report, op. cit.
118 Todd Litman, Transport Cost Analysis: Techniques, Estimates, and Implications. Victoria Transport Policy Institute, 1996, p. 5-2.
119 M. Hansen, D. Gillen, A. Dobbins, U. Huang, and M. Puvathingal. The Air Quality Impacts of Urban Highway Capacity Expansion: Traffic Generation and Land Use Change. Institute of Transportation Studies, University of California, Berkeley, 1993. UCB-ITS-RR-93-5. See also Mark Hansen, "Do New Highways Generate Traffic?" Access (UCB Transportation Research Center) 7, Fall 1995: 16-22.

120 Fig. 5-5 in Todd Litman, Transport Cost Analysis: Techniques, Estimates, and Implications. Victoria Transport Policy Institute, 1996.
121 Estimating the Impacts of Urban Transportation Alternatives, Participants Notebook, National Highway Institute, NHI Course 15257, Federal Highway Administration (Washington D.C.), Dec. 1995. Cited in Litman, p. 5-12.
122 In several of his testimonies, including his expert opinion on the A259 scheme, "Traffic Assessment, Generated Traffic, and Suppressed Demand," p. 6.
123 Summary of findings from Goodwin (1996), op. cit. p. 51.
124 H. C. W. L.Williams and Y. Yamashita. "Travel Demand Forecasts and the Evaluation of Highway Schemes Under Congested Conditions." Journal of Transport Economics and Policy 26, no. 3 (1992): 261-282; H. C. W. L.Williams and Y. Yamashita. "Equilibrium Forecasts of Travel Demand and Investment Benefit Measures for Congested Transport Networks." In Proceedings of PTRC Summer Annual Meeting. Both discussed in Denvil Coombe, "Induced Traffic: What Do Transportation Models tell Us?" Transportation 23, no. 1 (1996): 83-101.
125 The figures are from Peter J. Mackie, "Induced Traffic and Economic Appraisal," op. cit., p. 113.
126 See SACTRA, op. cit., Par. 4.72.
127 Summary of findings from Phil Goodwin, "Empirical Evidence on Induced Traffic: A Review and Synthesis." Transportation 23.1 (1996): 35-54.
128 Alan M. Voorhees & Associates. A System Sensitive Approach for Forecasting Urbanized Area Travel Demands. U.S. Department of Transportation, Federal Highway Administration, 1971. FH-11-7546.
129 Y. Zahavi, "Traffic Performance Evaluation of Road Networks by the Alpha-Relationship." Traffic Engineering and Control 14, no. 5-6 (1972).
130 Harry Cohen, "Review of Empirical Studies of Induced Traffic." In Expanding Metropolitan Highways: Implications for Air Quality and Energy Use, Transportation Research Board, Special Report 245. Washington, D.C.: National Academy Press, 1995.
131 For a review of these costs see the relevant chapters in Todd Litman, Transport Cost Analysis: Techniques, Estimates, and Implications. Victoria Transport Policy Institute, 1996.
132 See p. 15 in Peter Hills, "What Is Induced Traffic." Transportation 23 (1996): 5-16. Also see Stephen Plowden's claim that the distortions introduced by the procedure of using generalized costs models for the average value of time makes the value derived by the "Rule of Half" an overestimation. Talk given to the Institute for Civil Engineers meeting on the SACTRA report, 23 May, 1995, London, unpublished manuscript.
133 The literature on discount rates in project evaluation is vast. Additional complexities in its choice are introduced in considering projects with long time horizons, environmental impacts, or financing enabled through earmarked foreign loans--all three of which may apply to the Trans-Israel Highway. The discussion that follows, therefore, simply compares the discount rate adopted with those adopted for other highway projects or by other bodies for the same project. For more fundamental discussion and further references see the following: Robert Sugden and Alan Williams. "The Discount rate in Cost-Benefit Analysis." In The Principles of Practical Cost-Benefit Analysis, 211-228. Oxford: Oxford University Press, 1978; Ian Livingstone and Michael Tribe. "Projects With Long Time Horizons: Their Economic Appraisal And The Discount Rate." Project Appraisal 10, no. 2 (1995): 66-76; Colin Price, "Long Time Horizons, Low Discount Rates and Moderate Investment Criteria." Project Appraisal 11, no. 3 (1996): 157-168; Shlomo Eckstein and Tikva Lecker. "The Diminishing Marginal Effectiveness of the Discount Rate as a Screening Device." Project Appraisal 10, no. 1 (1995): 49-55.
134 MATAT, "Traffic Forecast and Economic Analysis," Vol. 2, op. cit., p. xxxiv.

135 Donald M. McAllister, Evaluation in Environmental Planning: Assessing Environmental, Social, Economic, and Political Trade-offs. Cambridge: MIT Press, 1980, p. 111.
136 U.S. Office of Management and Budget, Circular A-94.
137 MA'ATZ (Public Works Department), "Highway Number 6: Engineering, Economic, and Financial Analysis." Appendices: Table 345.
138 See Hans A. Adler, Economic Appraisal of Transport Projects: A Manual With Case Studies. Revised and Expanded ed., Washington, D.C.: World Bank, 1987.
139 Gad Kfir et al., "Route 6-Economic Feasibility Study."
140 "Traffic Forecast and Economic Analysis," op. cit., Section 8.11, p. 198.
141 See U.S. Government Office of Management and Budget, Circular A94-revised (October 29, 1992).
142 If project financing is tied to overseas loans the relation of NPV to discount rate may not be monotonic declining. See Shlomo Eckstein and Tikva Lecker. “The Diminishing Marginal Effectiveness of the Discount Rate as a Screening Device.” Project Appraisal 10, no. 1 (1995): 49-55.
143 Motorization rates of 350-450 vehicles per thousand population are used, for example, in both the wise planning and "business as usual" scenarios for Israeli transport presented by Gideon Hashimshoni, Director of the Israeli Institute for Transport Research and Planning, Society for Protection of Nature in Israel annual meeting, Dec. 1996.
144 374 per 1000 in 1993 when Israel's motorization rate was 227 per 1000. International Road Federation, op. cit.World Road Statistics, Table IV, "Vehicles in Use on 31st December (1993)."
145 English summary of the Danish Government's White Paper on Transport and the Traffic Plan "Traffic 2005" submitted in December 1993.
146 See Peter J. Hills, “What is Induced Traffic?” Transportation 23(1), (1996): 5-16.
147 Derived from Todd Litman, Transport Cost Analysis, op. cit., fig. 5-4.
148 On treating scheme-induced traffic as if it was externally caused, thus causing an overestimate of project benefits, see p. 111 in Peter J. Mackie, “Induced Traffic and Economic Appraisal.” Transportation 23(1), 1996, p. 117.
149 "Traffic Forecast and Economic Analysis," Section 4, p. 25.
150 "Traffic Forecast and Economic Analysis," Section 4.4. pp. 101-102. The difference in annual kilometrage between the most stringent assumptions (3.2% PA real rise in fuel prices, per capita private consumption grows by only 1%) is 2.2% under a hyperbolic model, and 11.4% under a logarithmic model. A combined model was used (p. 102). These differences are per year, and their cumulative effect on the cost-benefit analysis is unknown.
151 "Traffic Forecast and Economic Analysis," op. cit., Section 3.6, p. 69.
152 After reviewing the evidence, the Royal Commission on Environmental Pollution uses an elasticity figure for fuel use of 0.3 in the short term, and 0.7 in the long term. (Royal Commission on Environmental Pollution. Eighteenth Report: Transport and the Environment. Cm 2674 London: HMSO, 1994, section 7.50 to 7.59). Other studies described in Litman op. cit., Section 5-2 support this range. Since fuel costs are only part of user costs, the long-term elasticity of car use with respect to fuel prices is lower. Litman cites a figure of -0.2, and Goodwin's discussion of several reviews of the elasticities of travel with respect to fuel prices points to ranges of -0.16 (short term) to -0.3 (long term), -0.1 to -0.26, 0.09 to -0.52, and -0.16 to -0.31. Phil B. Goodwin, “Empirical Evidence on Induced Traffic: A Review and Synthesis.” Transportation 23, no. 1 (1996), pp. 37-8.
153 Israeli Ministry of Energy and Industry, January 15, 1996. "Report On Prices Of Products To The Consumer In Israel And In A Select Number

Of European Countries -- (including Italy, Belgium, Holland, France, England, Germany)."

154 International Road Federation, World Road Statistics 1989-1993, Geneva, November 1994.

155 See Table 10.4 on p. 170 of Per Kageson, Getting the Prices Right: A European Scheme for Making Transport Pay its True Costs. Stockholm: The European Federation for Transport and Environment, 1993.

156 Organization of Economic Co-operation and Development--European Conference of Ministers of Transport. Urban Travel and Sustainable Development. Paris: OECD/ECMT, 1995, p. 13.

157 op. cit., pp. 155-6.

158 Her Majesty's Government, Climate Change: The UK Programme (Cm. 2427), London, HMSO, 1994.

159 See section 3.74 in Royal Commission on Environmental Pollution. Eighteenth Report: Transport and the Environment (Cm 2674), London: HMSO, 1994. For broader background see William Walton, “Policy Changes in the Government's Road Building programme: A U-Turn or Just an Application of the Brakes?” Town Planning Review 67(4), 1996: 437-455. p. 447.

160 Section 7.58 of the Royal Commission on Environmental Pollution. Eighteenth Report: Transport and the Environment. Cm 2674 London: HMSO, 1994.

161 Per Kageson, Getting the Prices Right: A European Scheme for Making Transport Pay its True Costs. Stockholm: The European Federation for Transport and Environment, 1993. pp. 175-6.

162 MA'ATZ, pp. V-5 to V-22

163 Department of Transport (1989), New Roads by New Means: Bringing in Private Finance (Cm. 698), London HMSO. Mentioned in Walton 1996, p. 448.

164 Royal Commission, op. cit., p. 56.

165 Royal Commission, op. cit., p. 59.

166 For detailed treatment of these effects, literature reviews, bibliographies, and recommended mitigation procedures see the U.S. DOT publications Young et al. (1995), Evaluation and Management of Highway Runoff Water Quality, Federal Highway Administration, Environmental Analysis Division, Environmental Quality Branch; and Brian Roberts, Best Management Practices for Erosion and Sediment Control (U.S. DOT report # FHWA-FLP-94-005), June 1995.

167 Public Works Department, Ministry of Construction and Housing, State of Israel. Highway Number 6: Engineering, Economic, and Financial Feasibility Study. 1991. Table 306, p. D-2.

168 "Traffic Forecast and Economic Analysis," op. cit., Section 8.10.

169 See table 6.3 in the "Traffic Forecast and Economic Analysis," p. 152.

170 Gadi Kfir of the Israeli Institute for Transportation Research and Planning at a seminar at Neve Ilan on 6/6/93, quoted in the Trans-Israel Highway Publication, "The Trans-Israel Highway: The Question of Tolls and Financing Methods," July 1994, p. 25.

171 The number of trips whose distance will be reduced is small. Over 60% of the total predicted volume of traffic on the highway is along sections immediately adjacent to an existing road (primarily highway no. 444)--i.e. they will introduce time but not distance savings. (See Table 6.5 in the "Traffic Forecast and Economic Analysis,") The sections that closely parallel existing roads are those from the intersection with route 65 to the intersection with route 1.

172 See M. Luria et al., “The Formation of O3 Over Israel, A Growing Concern and A Potential International Issue.” Preservation of Our World in the Wake of Change: Proceedings of the 6'th International Conference of the Israeli Society for Ecology and Environmental Quality Sciences

Jerusalem, June 30-July 4, 1996. Ed. Y. Steinberger. Jerusalem: ISEEQS Publications, 1996, pp. 13-16.

173 Michael A. Replogle, “Appendix E: Minority Statement of Michael A. Replogle.” In Expanding Metropolitan Highways: Implications for Air Quality and Energy Use, Transportation Research Board, Special Report 245. Washington, D.C.: National Academy Press, 1995, p. 369. One would need to clarify how much of the faster speeds are on the Highway itself as opposed to raised speeds in the rest of the network due to congestion relief.

174 "Traffic Forecast and Economic Analysis," op. cit., Section 8-10.

175 Figures are the average from a review of 37 regulatory and research sources by Kevin Bell, Valuing Emissions from Hermiston Generating Project, Seattle: Convergence Research, 1994. On the politics of constructing scientific certainty and uncertainty with respect to the air-pollution implications of increased highway capacity see Michael A. Replogle, op. cit., in Expanding Metropolitan Highways.

176 The following section draws from discussions with Dr. Elihu Richter and Dr. Gary Ginsberg and draws from a forthcoming report with them.

177 Section 8.9 in Vol. 2.

178 "Engineering Guidelines," Section 5.2.2," from the "Technical Description" section of the pre-qualifying tender.

179 Paul Barach, “100 Kilometer Per Hour: What Have We Gained? Impact of Raising the Speed Limit on Interurban Highways on Accidents, Deaths, and Injuries in Israel.” MPH thesis. Hebrew University, School of Public Health and Community Medicine, 1996, p. 23-30, and references therein, especially the summary of research findings in Table 7. Nilsson's findings are presented in: G. Nilsson, Reduction in the Speed Limit from 110 km/h to 90 km/h During Summer 1989. VTI Report, Sweden, 1990; and G. Nilsson, The Effect of Speed Limits on Traffic Accidents in Sweden. National Road and Traffic Institute, 1992. VTI Report S-58101, No. 68.

180 See the central findings of Barach's thesis, op. cit..

181 Barach, op. cit.

182 "Traffic Forecast and Economic Evaluation," p. 163.

183 On traffic injuries as a first-order externality see D. M. G. Newberry, “Road user Charges in Britain.” The Economic Journal 98 (1988): 161-76.

184 M. W. Jones-Lee, “The Value of Transport Safety.” Oxford Review of Economic Policy 6.2 (1990): 39-60.

185 Worldwatch Institute, State of the World (New York: W.W. Norton, 1993), p. 124.

186 The figures are per million tonne and passenger km. Per Kageson, Getting the Prices Right: A European Scheme for Making Transport Pay its True Costs, European Federation for Transport and Environment (May 1993), p. 108-9.

187 See J. Schofield,. Cost-Benefit Analysis in Urban and Regional Planning. London: Allen & Unwin, 1987, pp. 115-16.

188 Subsequent to approval, there have been evaluations of the link between toll rates and traffic volumes.

189 "Traffic Forecast and Economic Analysis," op. cit., Section 4.4. pp. 101-102. and section 4, p. 25.

190 The loss of savings is derived very crudely by deducting an increasing percentage of the time and operating cost savings in the given annual figures in the cost-benefit analysis, beginning with the lower percentage figure and rising evenly to reach the higher figure by 2020. The resultant overall reduction of Net Present Value of 29% in the minimal case is

within or below the ranges given by Williams et al., Buchan, and Coombe mentioned in Table 7 , and the 58% reduction in NPV under the severe assumption is still below the range given by Buchan.
191 Walter Hook, Wheels Out of Balance: Suggested Guidelines for Intermodal Transport Sector Lending at the World Bank: A Case Study of Hungary. Institute for Transportation and Development Policy, 1996, p. 39. On the calculation of decreased operating costs see section 8.8.
192 See "Operating Costs," in MA'ATZ, "Engineering, Economic, and Financial Evaluation of Route 6," 1991. Table 307 on p. D-3. Figures for 64 km/hour.
193 Member of Knesset Yossi Sarid, former Minister of Environment. Personal communication, April 1997.
194 This list is drawn from a talk by the Chair of the Board of Directors of the Trans-Israel Highway Company, Moshe Levi, at a recent forum on the private sector contribution to road infrastructure, Hebrew University.
195 On this mode of revenue generation see Jose A. Gomez-Ibanez and John R. Meyer. Going Private: The International Experience with Transport Privatization. Washington D.C.: The Brookings Institute, 1993, p. 266. In the U.S. a sizable portion of some highway project costs have been raised in this way through charging developers substantial charges for each unit that will be served by the new road. Of course such capture of external benefit should take place within land-use zoning regulations.
196 On the lack of significant positive externalities see Werner Rothengatter, “Do External Benefits Compensate for External Costs of Transport?” Transport Review. 28A, no. 4 (1994): 321-328.
197 See Kageson, Getting the Prices Right, op. cit. For a comprehensive review see chapter 6, "Transportation Cost Implications," in Littman, op. cit. See also the 1994 special issue of Transportation Research A (Vol. 28, no. 4.) on transportation externalities.
198 Kageson, op. cit.
199 Living With the Car," The Economist, June 22, 1996. p. 7.
200 European Council of Ministers of Transport, Ministerial Declaration, Paris, November 1989.
201 European Federation for Transport and Environment. Getting the Prices Right: A European Scheme for Making Transport Pay its True Costs. Brussels: European Federation for Transport and Environment, 1993.
202 See Walter Hook, Counting on Cars, Counting Out People: A Critique of the World Bank's Economic Assessment Procedures for the Transport Sector and Their Environmental Implications. Institute for Transportation and Development Policy, 1994. I-0194; Walter Hook, Wheels Out of Balance: Suggested Guidelines for Intermodal Transport Sector Lending at the World Bank: A Case Study of Hungary. Institute for Transportation and Development Policy, 1996.
203 The public literature of the Highway Company, for instance, contains many declarations of this sort.
204 For reviews of the literature see Transport and Environment. Roads and Economy State-of-the-Art Report. European Federation for Transport and Environment / Centre for Energy Conservation and Environmental Technology, 1996. Also see Marlon G. Boarnet, “New Highways & Economic Growth: Rethinking the Link,” Access (University of California, Berkeley, Institute of Transportation Studies) 7, Fall 1995: 11-22.
205 Boarnet, op. cit.
206 Reuven Gronau has written forcefully on some of these and other problems associated with private sector funding of the Highway. "To Go for a Toll--Probems," Ha'aretz n.d. In Hebrew, and unpublished mss.

207 GA/Partners-Arthur Anderson & Co, "Organizational and Financial Alternatives to Highway No. 6 Corridor," Appendix 5 to the MA'ATZ Financial, Economic, and Engineering Feasibility Study, op. cit., p. V-10.
208 MA'ATZ, op. cit., p. V-42.
209 Gomez-Ibanez and Meyer, Going Private, op. cit.
210 GA/Partners-Arthur Anderson & Co, p. V 34.
211 Walter Hook, Wheels Out of Balance: Suggested Guidelines for Intermodal Transport Sector Lending at the World Bank: A Case Study of Hungary. Institute for Transportation and Development Policy, 1996. Section IV.B, pp. 27-32.
212 Hook, Wheels, op. cit., p. 28.
213 Walter Hook, personal communication, December 1996.
214 Prof. Eytan Sheshinski, at a recent forum on private sector contribution to road infrastructure, Hebrew University.
215 The Trans-Israel Highway is made feasible by the unique historic and political configuration of land-ownership in Israel. Toll projects tend to be congestion-relief roads adjacent to heavily built up areas, and development roads that are built through more open country in anticipation of future traffic. The former kind of road is assured high traffic volumes, but faces high construction costs because land values and disamenity costs in built up areas are high. The latter kind of road has less problem with acquiring land, but faces a slow and uncertain buildup of traffic. (See Gomez-Ibanez, op. cit., p. 179). A toll-road along the Trans-Israel Highway's route east of Tel Aviv seems at first glance to enjoy the best of all worlds. Traffic volumes will be high from the start because of the proximity to Tel Aviv, rapid population growth (in the absence of a strong demand management policy) assures continued growth of traffic, and yet land is remarkably cheap to the government given the location. Much of the private land along the right-of-way is under Arab ownership, a community less politically able to resist expropriation, while the remainder of the land is largely government land held by Kibbutzim under long-term leasing arrangements. With Israeli agriculture in deep crisis, and with the kibbutzim under financial duress because of a backlog of debt, the latter lands are also more readily available than they would be in equivalent settings in most countries.
216 The lower figure is the calculation by the Trans-Israel Highway Company. The upper figure is the calculation by Moshe Barnea, Secretary of the Organization of Trans-Israel Highway Settlements (December 1996).
217 Preface to the "Technical Description" volume of the Ministry of Finance/Ministry of Construction and Housing/Trans-Israel Company document submitted to companies during the pre-qualifying stage.
218 See Savvakis Savvides, “Risk Analysis in Project Appraisal.” Project Appraisal 9, no. 1 (1994): 3-18.
219 Institute of Transportation Engineers, A Toolbox for Alleviating Traffic Congestion. Washington D. C.: Institute of Transportation Engineers, 1989.
220 Elizabeth Deakin, University of California, personal communication, May 13, 1997.
221 Peter Headicar, “The Local Development Effects of Major New Roads: M40 case Study.” Transportation 23, no. 1 (1996): 55-69.
222 Benjamin Ilan has argued that road approval procedures in Israel must be accelerated. This is a worrying proposal given the experience described in this paper. Benjamin Ilan, "Problems in Planning and Building Interurban

Roads in Israel," Institute for Advanced Strategic and Political Studies (Jerusalem), 1995.

223 For an extended discussion of the limited role for rail in Israel see Yossi Berechman, et al., The Place of Rail in Israel's Transport System. Jerusalem: Jerusalem Institute for Israel Studies, 1993. While this essay helps clarify thinking about some of the problems rail may face in Israel's unique transport system, many of the critiques raised are incomplete.

224 This table includes items drawn from David Banister, Transport Planning in the UK, USA and Europe. London: E and FN Spon, 1994; and Ian Bateman, R. Kerry Turner, and Seeseana Bateman, “Extending Cost-Benefit Analysis of UK Highway Proposals: Environmental Evaluation and Equity.” Project Appraisal 8, no. 4 (1993): 213-224.

225 T. M. Coburn, M. E. Beesley, and D. J. Reyolds. The London-Birmingham Motorway: Traffic and Economics. Road Research Laboratory, Department of Scientific and Industrial Research, 1960. Technical paper 46.

226 C. D. Foster and M. E. Beesley. “Estimating the Social Benefit of Constructing an Underground Railway in London.” Journal of the Royal Statistical Society A 126, no. 1 (1963): 46-92.

227 See J. Schofield, Cost-Benefit Analysis in Urban and Regional Planning. London: Allen & Unwin, 1987, pp. 127-8 section 10.5.

228 See Banister, Transport Planning, op. cit., p. 59.

229 Coombe in Transport 23(1), op. cit., p. 844.

230 Department of Environment (1988), Environmental Assessment Circular 15/88. And Department of Energy (1989) Environmental Assessment: a Guide to the Procedures, Appendix 7.

231 Article 2, paragraph 1 in Commission of the European Community, Official Journal L175/40, 5/7/85).

232 Phil Goodwin in Transport 23(1), op. cit.

233 Standing Advisory Committee on Trunk Road Assessment, Report on Urban Road Appraisal, 1986.

234 See Goodwin et al., (1991), op. cit.

235 See Garrett, Mark and Martin Wachs. Transportation Planning on Trial: The Clean Air Act and Travel Forecasting. Thousand Oaks, CA: SAGE, 1996.

236 B. H. Massam, "Multi-criteria Decision-making Techniques in Planning," Progress in Planning, 30, 1989, pp. 1-84.

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238 Williams, H. C. W. L. and L. A. R. Moore. “The Appraisal of Highway Investments Under Fixed and Variable Demand.” Journal of Transport Economics and Policy 24 (1990): 61-81.

239 See Williams, H. C. W. L. and H. S. Lai. “Transport Policy Appraisal With Equilibrium Models II: Model Dependence of Highway Investment Benefits.” Transportation Research 25B, no. 5 (1991): 281-292; Williams, H. C. W. L. and W. M. Lam. “Transport Policy Appraisal With Equilibrium Models I: Generated Traffic and Highway Investment Benefits.” Transportation Research 25B, no. 5 (1991): 253-279; Williams, H. C. W. L., W. M. Lam, J. Austin, and K.S. Kim. “Transport Policy Appraisal With Equilibrium Models III: Investment Benefits in Multi-modal Systems.” Transportation Research 25B, no. 5 (1991): 293-316; Williams, H. C. W. L. and Y. Yamashita. “Travel Demand Forecasts and the Evaluation of Highway Schemes Under Congested Conditions.” Journal of Transport Economics and Policy 26, no. 3 (1992): 261-282.

240 For an Israeli implementation of this in evaluating the Carmel Park see M. Shechter et al., in Preservation of Our World in the Wake of Change:

Proceedings of the 6'th International Conference of the Israeli Society for Ecology and Environmental Quality Sciences Jerusalem, June 30-July 4, 1996. Ed. Y. Steinberger. Jerusalem: ISEEQS Publications, 1996, p. 343. The authors estimate a willingness to pay that amounts to 11,500 NIS per dunam, or a billion shekel for the entire park.

241 Transport 2000, "What Are Roads Worth? Fair Assessment for Transport Expenditure," proceedings of a conference held on April 8, 1991 in London, organized by Transport 2000 and the New Economics Foundation. London, Transport 2000

242 See the various publications available from the Planning Support Branch, Federal Highway Administration, U.S. Department of Transportation, Washington D.C.

243 SACTRA, Trunk Roads and the Generation of Traffic. London: Department of Transport, 1994.