CEER-X-132

CEER-X-132

TRANSPORTATION ENERGY CONSERVATION IN PUERTO RICO:

POTENTIAL, APPROACH METHODOLOGY AND PROSPECT To 1985

BY

JARO MAYDA

octoger 1981

* ,

g % CENTER FOR ENERGY AND ENVIRONMENT RESEARCH

5 BN cnensir or suenTo nico ~ US CEPARTHENT OF ENERGY

% &

?Gon. oot

---Page Break---

TABLE OF contents

ABBREVIATIONS AND ACROWYMES

SAPATIVE summary

INTRoDveTTON

LT Qdiective o. , 2

2:2 Scove and tele? |)] ! i

dip Rodley method. 22D D5 tt 2

24 Adequacy of the data baie? a

Lift Munber of active venicies . 1... | 5

A:43 Jetgl direct transportation energy | | 3

1:43 Indirect? (secondary) transportation ;

Lilb Otheeaiesine aata 2D DIS tt &

145 Conclusions ss SDD TI It 9

2 FEE POPENSIAL FOR TRANSPORTATION ENERGY GONSERVA-

STOW IN PUERTO RECO

3:3 Policy baselines. B

3:8 Beerey import anduzea 2222222 D 05:

5g Gonsumption trons iii:

2-4 Comparative interpretation | pilil ag

3:2 JSQE IRC categories and targets |) 12225 3S

2.6 A summary evaluation ss 2et8 7 + + 2b

SCENARIO ANALYSIS AND consmRUCTION:

AVATIABLE CONCEPTS ?AND TROENTGUES

32 see 6

3:2 bs

3 pill Bs

38 pili #

35 for

Boa fchte oad dency? abe ates 92

3:6 Codification and Agency? mask Snoeke

3:8) Bumposeof codteication «2... ap

HSE Eropasea° sofas SSA

389 Agenoy Task Sheets 2 ITB

?4. THE NEED FOR SYSTEM APPROACH

i} Sfcens developments in transportation planning 36

?2 Syston anaiysla in poltey and scenario! develop-

eeed qxanple of fuel conservation theese

speed control. prea

we peeryerion * 8

4.3 Interpretation of? Figures 6? ana??

4.3L The apsed actor » 40

#32 Tahsebgtd, factor - piiiiii: B

4:3) FeAl eehdent ia weit

3B Briver below 25 youre of ago) Me

495 Driving while Eodowteatsanee ooo Me

---Page Break---

Eage

4.4 The corresponding scenario models... ... 3

fll Policy analysis 6 oye

?42 Conceptual mode 2) 1 TTT T I ae

443 Scenario matrix <2 1) 1 Pe

?ub Comments. ee TTT ll a

THE PRosrect

5:2 ecisional and implementation environment

5-11 The worsening altuation

(2) Ue ets of te Tapia transit

option ss Senet es 50

(4) Traftic?tawiessness 110212 @

(G44) Decreasing skill, caution and dis

eipiine of the average driver

(iv) the relative decrease of motor

f10n 609 Teg ttt BB

5.12 Record of official TEC actions | | 52

5.13 Institutional and other major obstacles? 54

to effective Tea. . 7

5-2 Implications for realletic axpectations

5.21 The ?crisis scenario". s+ . 6

5:22 The expectation with regard to public?

actions eee es ne 9

5:2), Conmorvation, infoigh iutotaite factor?

and technical fixes. Ses 82

5:3 More advanced affirmative Tic ?actione? 111) 35

APPENDIX,

Note on the calculation of scrappage rate as the

pase for eGtlnating the cureent aciive fleet ?in

Puorte Rises ss =

SOURCES OF REFEREN:

?te reference nunbors are underecored in the text: page

nunders or other current symbols are added where indicated.

The general cut-off date for information and reference is

October 1981. Oceasicnal nore recent infornation could be

Added during the preparation of the final typescrigt.

a?

---Page Break---

PIGURES AND TABLES

Page

Pig

1. Rherg imports and uses in Puerto Rico... 22

2 Energy disposition tree (FY 1981)... 0.0... 15

9. Gasoline price and consumption»... ss... 0. 1?

4, Major groups of fuel-econony and TEC-proncting

menwese se ee ee tee Se. 29

5 Trangertation aysten planning for San Jum |... 37

$. Comactson of speed, fuel consuaption, fatalitive,

age of drivers and size of passenger vehicles in

aeoidinto es ee ee reeeeee vomsctee IB ag

7. Concortualized smoveis of Pigureé . 0.1...) aL

8. Vehicle registration in Puerto Rico, 1976-80... . 62

able

1. Comparative dimensions of transportation eneray

Sonsusption \snenevoTe Of *ransportation energy we

2. Summary of the catezorice and estimated potential

for transportation energy conservation in Puerto Rico 21-23

3. JBC measures ranked according to assumed difficulty

inemetment and implenentation 7

- Tables corresponding to sections 4.u2, 4.42, 4.43» bal?

us

---Page Break---

PvIs

078

NS AND ACRONYMS

barrel

bildion

calendar year

(por) aay

fuel economy

fiscal year

gation [3.73 11tres]

Litre [.265 gal?

kiloneter [.62 mi.]

million

million barrele per day

mite [1.6 kn]

miles per gallon

miles per hour

per capita income

private vehicle transportation syst

total direct transportation enersy

?transportation energy conservation

?transportation system management

vehicle miles travelled

year

Occasionally used other abtreviations are

explained in the text:

ty

---Page Break---

NARRATIVE SUDURY

The potential for energy aavinge in transportation in Puerto Rico,

?already shown in a previous study (Energy conservation in transportation

in Puerto Rico: A policy study, CEER X-32, 1978) has further increased.

?The transportation share in the total energy budget grew from less than

20% in 1979 to 32.5% in 1981. While the total energy consumption was dzopping by some 10%, transportation energy wae decreasing by less than 4A. Official figures tended to distort the real average consumption per vehicle: the sotal number of active vehicles was overstated by perhaps as much as 15% the fuel consumption was understated by more than 7% vecaus the statistics showed only gasoline consumption, not also diesel fuel used in transportation (pages 4-7, 61-64).

Together with secondary energy expenditures incident to transporta-?tion (such as losses in refining and distribution, construction and maii tenance of roads, public services,and rehabilitation of accident danages to persons and property), the transportation sector ised in the fiscal Year 1961 over 27 million barrels of fuel, xore than: 528 of all the enerey used in Puerto Rico, 90% of the directly used fuel was tumed by p: ger vehicles, 898 of then private, 66% in urban traffic. Driving other han to Job, school or essential shopping represented about 40% of all ?rips, that is almost one-half of all private auto travel. Consumption of energy in tranportation in Puerto Rico wae on several accounts relatively

much higher than in the United States as a whole (pages 13-23).

Wide margine for fuel economies exist in such areas as the maintenance of vehicles and roads; more controlled use of power equipment (such as aircooling): traffic engineering and enforcement; driving style and bona viory driver denand (vehicle occupancy, length and consolidation of trips Feduction of nonessential driving) and, of course, inproved public transportation. Several recent estimates have confirmed a tentative figure Proposed in the 1978 study: that up to 50% of fuel could be saved in Puerto Rico without substantially affecting private mobility. In 1981, this

would have reduced the cost of the imported petroleum by some $290 million: ?his anount represents almost 40% of the cost of crude which PREPA tisce

?© generate all the electricity for Puerto Rico ina year, if the daily bill 4s $2 million (pages 12, 21-25).

overage

A public policy of eystenatic transportation anergy conservation (TEC)
Could be implemented on the basis of alternative scenarios, that i9 various

---Page Break---

conbimtios ard sequences of measures calculated to achieve predetermined sargets (poreentages of past consumption or quantities of petroleum) in specitic future years. This study provides an inventory of possible nea-sures, scenario structures and levels, and a shorthand code for easier Bandling of the many variables. It also identifies the more than a dozen governnent agencies that would have to coordinate their efforts in imple Renting the chosen scenario. Their activities would be guided ty agency ?ask sheets, that is subscenarios arranged in the perspective of organi. rational implementation rather than the total TEC targets (pages 26-35).

To illustrate the methodology, data are analyzed and arranged in a Rodel scenario for one major category of TEC measures--fuel conservation Shrough speed control. he analysis shows the inseparable relations bet-

ween speed (too fast, too slow, erratic), energy consumption, accident vases and driving wnile intoxicated. Other najor categories are transportation system nanagenent (which includes conatruction/maintenance, traffic engineering and control, collective transportation), TEC related to vehicle Gautpnent and maintenance, and cost-conditioned driver denand and behavior. ?TH essential information and nethodology is ready for concrete, detailed elaboration whenever there is public interest and will (pages 38.43).

At the present, the decisional and implementation environment is unfavorable and worsening. The rapid transit option, alive until 1980, has been lost for at least a decade. Vested interests are etrong. Private vehicle transportation ig heavily publicly subsidised because of low nigh way user costs. The average motorist is, in fact, Ising substantially nore than he gains, Decause of poor road maintenance, inadequate traffic engineering and token enforcenent: but he does not know it. Improverents Gost money. An adjustment of the gasoline tax to compensate for inflaton since 2974 would raise it by 10¢ a gallon, generatirig an Income of > $65 million (based on 1961 gasoline consumption). Systematic driver informe-Sen and prudent vehavior would pernit an average fuel economy of 208 per venicle. The tax could thus be raised by additional 29¢ a gallon (wien 70 20% of the present pump price) without increasing the total yearly gasoe Aine Bill of careful, law-abiding drivers. Even with the decreasine con Susption, the governnent would collect on the order, of $250 aillicn @ year. Take would go @ long way also toward improvements in public transpersavion and the beginning of a mass rail transit for the 19908.
cost situation, which should facilitate sone such course

The easing fuel

of action spread

?

---Page Break---

over a couple of years, paradoxically further reduc

any meaningful systematic measures (pages 50-56).

?the prescure to take

The expertation to 1985, the tine span of this study. is for the ?worst case? scenario. Some gradual decrease of fuel consumption will cone only through automatic factors and technical fixes, such as the conti-puing switch to new, more efficient, cars, mileage-inereasing gasoline and motor oil additives, the spreading information about individual TEC oppor tunities and, perhaps substatially, the decrease of federal transfer pay-nents channeled inte private transportation expenses. Alternate fuele may make a fractional difference; but a more extensive use of sone of them, for example Liquid petroleum gases (propane, ete.), would substantially imerease traffic risks unless all truckers could be trained and nade to avoid abrasive driving.

Awong the more affirmative actions that would greatly increase TEC are: retum to traffic enforcement levele which prevailed still some $-10 Years ago: @ revised, energy-conscious traffic code; flow-improving en-Gineering, as well as several other cimple adninistrative measures. The initial payof? of practically any set of such affirmative actions ie od-viously very extensive. The passive crisis scenario will not cause the syste to collapse, but will induce ad hoc, spontaneous and disorderly adjustments at great human, social and econonie cost (pages 56-60).

ua

---Page Break---

1, INTRODUCTION

1.1 Objective

Im a policy study of energy conservation in transportation in Puerto Rico, which the Center for Energy and Environment Research conducted in 1977-1978, it was concluded thet the main transportation energy indicators and accounts in Puerto Rico wore significantly higher in comparison with the United States as a whole: that they provided substantial nar gins for energy conservation; and that particularly the data concerning the private vehicle trangportaticn aector should be further developed to provide a base for projections, goals and policies directed at transpor- ?tatlon energy conservation (24,331 see also Table 2.)

?The present study ie & first effort in thie direction. on the basis of consumption data and trends, and the snalyole of various combinations of possible approaches, techniques and preconditions for success, the study poks (i) te identity and define the apparent potential for transportation onergy conservation (TBC), in terms of both specific fuel-econony targets and of systems; (14) to estinate the real prospect for public and private decisions favoring TEC in the innediate future. A consolidated list of re- conmendstions is presented. Elements of and direction for a more detailed follow-up are listed and outlined.

1.2. Scope and focus

?There are several reasons for a cautious, Limited approach at this

such as:

+ The soomingly unlimited faith of energy and transportation plan-

pera inquntified simulation, which dominated in the 1970s, has given way to

® Bore balanced quantitative-qualitative policy analysis. Tt has been

Fecognized that ?much of the predictive powar of any methodology is pro-

vided by the credibility of the...assunptions underlying £¢" (Bib xiii);

and that ?a large margin of absolute error is always to be expected. ..the

caleulation [is satisfactory if] it will highlight if one option is auprox-

imately 2X or 3X as expensive over twenty years as another option"(11),8).

The most specific caveat is provided ty anattenpt at energy scen

rios for Puerto Rico, including transportation energy (121). The com:

of the National Academy of Sciences which authored thi report could,

?toe

---Page Break---

indeed, not f(resee the 1980-81 changes in such backe parameters as fuel

supply, costard federal regulatory policies--and mich less the effects of

Feaganonics or mags transit planning in Puerto Rico. These changes sub-

stantially affected the premises of the present study and forced najor idcourse adjustments. However, the NAS report, at least in the parts dealing with transportation, raises the question of ?credibility of... aesunption

"and ends up with an apparently ?lange margin of error? indeed.
For example, gasoline consumption in the base year (1977) is underetated by 15.7% (almost 13¥b" instead of the correct figure of 15.3Mb). The low figure serves as a base for projections to 1985, as well as to year 2000.
?As to 1985, the expectation that gasoline consumption would by then drop Pack to 1977 levels, might possibly materialize already in 1982-83, al-?hough the rate of decrease of consumption hag hovered around 2. 58/year. rather than the 10f predicted ty the NAS report on basis of smaller In creases in gasoline-pump prices. Other concrete references to the report's data, assumptions and proposals are made below as warranted.

+ The performance and priorities of the government of Puerto Rico in the field of transportation in general, and of energy conservation in particular. As perceived here, these factore favor an open policy ap-proach rather than more or less rigid ecenarios based on too many un-certain variables and speculative assumptions. ?The situation would, of course, change as soon as the decision makers showed interest in the de-

velopnent end evaluation of concrete policy options and alternative scenarios to implement then.

1.3, Polley methodology

No matter what the particular thrust or seope may be, an exercise

in the evaluation of prospects and in acenario construction is always a

particular form of poliey research and developrent. Environmental inpact

assessment offers an example. Tts policy nature is no more in question

(25:26): yet, it is nothing elee but an evaluation of the inpact scenario

(or alternative scenarios) constructed from information about the planned action.

A fow brief comments on the methodology, as related to the pre-

sent study, may prevent sone nisunderstandings, both by officials nd ty other readers. As has been pointed out elsewhere (2§,29-30), decision

---Page Break---

makers tend ty mistrust or ignore polley enalysie. ?They soem to fee! jhat It restricts their decisional freedom. This is no doubt true when independent pricy R & D results in recommendations contrary to a poli-??Aoally preferred course of action which the analysis rovealed as tased

on faulty or ?ncomplete data, or on an inadequate (if any) examination

of possible alternatives. However, ona more detached reflection, it is difri-cultnot to recognize that the policy nethod provides a base for inproved deci. ston making, even under the normal--rather than exceptional--condi tions of gxsst uncertainty. The reagon is inherent in the firet charactertetie of genuine Policy developsents alt the available relevant infornation is collected and ane. lysed Soguther, This improves the definition of the problem; missing data are often spotted (thus,also, gauging the degree of reliability); and a broader vac Se for comprehensive evaluation of possible solutions, constraints, ete. 1s Greased. Sven st Lts minimum level of effectiveness, polfey anslyste at

jeast raises red flags whore otherwise decisions would be nade on often fragmentary and overoptiniatic technoeconomle considerations, without ony Suspicion about the excessive external (social and environmental) cont,

As Mts bost, the policy method functions as applied social ayeten ansiysis (25.2). Tt ie Likely to identify approaches to problene which fective or other-
wise attractive to decision makers because of beneficial saccndary fait. ont. | One example of such a systen approach is the analysis later in thie Study (secs. 4.2f. of an apparentiy narrow and straightforward relation

Setween fuel economy and speed, set in the broader context of causes ond Rftects, These include drunken driving, high-risk driver groupe and ve. Mees, accident cost and prevention, traftic engineering, manasanont fd snforcenent, revised Licencing and renewal requirements, adequate insurance and, of course, also the problen of too slow speed as tne cause of unnecessary fuel consumption (including by other drivera) and Sf Recidents, The simple relation between speed and energy conservacion Regina te Look quite formidable in this set of secondary datas they, in ium represent an empirical base for the reconsideration of najor sorr- fone of the Traffic Code and of enforcenent capabilities ed marcia, OR @ more mundane level of the millions of individual deeieion: whose fun total is the waste or conservation of fuel, policy enalvers sees nets oF shouldnnot, aim at telling anytody, for instance, how sch Bloteure driving he ean or cannot do. ?The objective and task are renner analyticals to collect and interpret data which may indicate

---Page Break---

(4) that the cost of private vehicle transportation is highly eubeldized and therefore not real; (1) that when the market mechanism and/or the government oatch up with this situation, the scope of individual cholce ke Likely to be sensibly affected: (111) what kinds of choices and trade-offs, depending on individual values and intelligence, nay still afford sone meagure of personal freedom in moving around: and (iv) how the transportation system and needs might be restructured in an anticipatory way to make any future adjustments to critical changes in the present situa-?ion lees harsh and costly.

This is allan analytical exercise. It becomes preseriptive--forcing you and ne to act or not to act ina certain way--only when the policy analysis and reconnendations becone an authoritative decision. Its impl nentation is then no more a poliey or a scenario; it becomes an obligatory set of law rules, procedures, administrative measures, prices and tax

rates, incentives and disincentives, designedto balance transportation fuel

supply and denand within the framework of needs and capacity.

2. Adequacy of the data base.

Polley analysis for decision making ains not at mathematical preci.
sion, dut at highly aggregated data or, where necessary, at approximations without serious distortion. Technical data, no matter how hard and apparently complete, do not decisions make, nor should they, at least not in social problem solving (25,21-23). But the policy methed ie very sensitive to what may be called the coefficient of confidence. Aggregation, generalization, interpolation and estimate are all legitimate ways of generating policy data for decision making. But, obviouoly, the quality of ?the end product depends here, as anywhere, on the quality of the raw material: the reasonable completeness, consistency and reliability of the primary data base.

?The uncertainty and incompleteness of baseline and current data in ?transportation and transportation-related energy consumption is noto! (23). Tt was commented upon in specific relation to Puerto Rico in the 1978 study (24,18). ?The problem continues. As the following severn? examples show, the statistics also tend to be blased in the direction of understating the real dimensions of traneportation energy consumption in Puerto Rico, with the inevitable effect on priorities and decisions.

---Page Break---

itl Number of active vehicles. official statistics appear to have

consietontly overstated ince 1979 ths total of active vohicles. In PY'60, when the official number was 1.25 4, the active fleet was closer to 979,000, a difference of approximately 15.5. A vehicle is not dropped from the active roster if its licence is not renewed by the end of the civen fiscal year. The omer may be absent and will renew the licence when he retums. Or the vehicle may be temporarily deactivated and will ve re-Licensed when back tn service. Only when @ licence is not renewed for ?two consecutive years is the vehicle taken off the active list. For this Feason, the number of active vehicles in a given year must be estimsted. The accuracy of, this estimate depends on the use of a realistic so-called Serappage rate, that is the approximate percentage of vehicles that have deen wrecked, abandoned, dismantled or otherwise permanently deactiva. ted during the preceding year. The official figure seens to be the re-sult of arbitrary eatinntes of the wcrappage rate, after the Of rate, gee nevaily used in the United States, was abandoned several yeare ago. And

Yet £8 seens to be relatively easy to estimate fairly accurately the ours Fent sorappage rate on basis of the verified and averaged numbers for the Preceding two or three years. Ae the estimate for any given year is verified against the actual runber of not relicenced vehicles, the new number {e factored into the ?trend? rate for the purpose of the next estinate. ?The Founded trend rate established for Puerto Rico by this aysten Le 7.58.

This fo the base for the estimate of 970,000 active vehicles in FY 1980.

fhe graphic iilustration of the vagaries of the present system a proposed equa
?Son for calculating the scrappage rate and an update note are in the Apendix.

2-42 Total direct transportation energy (1D1E). Direct transporta-
?ton cnergy is the fuel used by the vehicle engine and equipment (auch
a8 power steering, air conditioning of freight Lifting). Two major fuels
are conoused in land transportation: gagoline and distillate fuel oil
(atese2), only the gasoline account ia separate. It is this tetal that
As officially considered to be the enount of enerey cons:ned by voter ve-
bicles. | Diesol of1 consumption (1.75M> in 1979) is statistically inele.
Ged in "Total fuel consumption.? not disaggregated by sectors uch se
Swansportation, industry, agriculture, ete. (5§, Table IT). Tt ts in,
Possible to state with any degree of precision just how much diese)
used in transportation and should be routinely added to the anount of
gasoline to obtain the TDTE account,

---Page Break---

Substantial number of heavy trucks and tractor-trailers, some 6 %

of all vehicles in Puerto Rico, used diesel fuel. In the 1978 study,the

?transportation of freight was

pothetical fuel consumption factor of 2.5, the factor for the passenger

fleet being 1.0. This took into account algo such elenents as visibly

inadequate engine maintenance of many trucks, overloading, and the state

of roads other than toll roads, then only partly open (24,32). The NAS

study arrives at a figure of 11% for freight (121, Table 23; 60,Pig. 3),

without an indication of sources or method. Neither of the two caleula-

?tions/estinates provides a viable base for the estinate of diesel con-

sumption in transportation. Several new calculations were therefore per

formed using the following data and factors:

+ The proportion of heavy trucks in the total motor vehicles in

Eyerte Rico io «32 of that of the fifty US. etaten (7% aguinot

1H)

+ Diesel represents 206 of the total U.S. thuck consumption (19,1-12).

which amounts to 12.28 of total U.S. transportation energy (Id.

Fig. 1.2, 1.3).

+ the average ratio of industrial to transportation use of diesel

in the U.8.,°1977 to 1979, was 112.2 (83,11, Table 27).

+ 1.75Mb of diesel were consuned in Puerto Rico in 1979.

of the present calculations and extrapolations:

+ The vs5. Figures include diesel used by railroads and waterway

1 in sgetoulture i

the U:S. or in the Puerto Rico data.

+ The growing, but still very small, numb

yonision if Puerto Rico using ai

Yes using propane:

?The various calculations of the share of diesel in the total trans-

portation energy in Puerto Rico ranged from 4.7% to 7.0%. The rounded average of 6% is considered to be a reasonable conservative projection.

?This figure represented in the last several years an average of about 2% of all energy used in Puerto Rico. Tt must be added to the gasoline figu-

res to obtain the real share of direct transportation energy in the total energy budget in Puerto Rico. (See Pigure 2 on page 15).

igned, in the absence of any data, a hy-

?The following factors were considered insignificant for the purpose

not disaggregated either in

of other than freight

fuel: and of freight venic-

---Page Break---

?

1.43 Indirect (secondary) transportation energy. Transportation

consunes also a substantial amount of onersy incidentally, indirectly.

Tals eomcalled seccndary energy was already analyzed in the previous

study (24,40, Pig. 3) in the following categor

+ Gagolines Production. Distribution. Evaporation

* Vehicles: Transport. Sale. Maintenance. Tires. Parking and gar:

Bing. Tdministration of the transportation system.

+ Infrastructure: Construction. Maintenance.

* Accidents: Buergency treatment and hospitalization. Repair of

inge to vehicles and property (public, private).

A coefficient of .66 (neaning that if direct energy is 1.0, ti

?otal transportation energy is estimated to be 1.66) was used. This

cosfficient was derived from United States data (29:23). A 10% margin

of uncertainty was assumed. Since the direct transportation energy

in 1977 was 90% of the total energy consuned in Puerto Rico, the total

transportation-related energy was estinated to be J%x 1.66, that is

5K. Even with the 10% margin of error factored in, the total ancunted to

at least 48%. This meant that transportation in Puerto Rico used directly

and indirectly about as much energy as all the other secturs together

(after their transportation-related energy use, mostly electricity, had

been discounted). Subsequent U.S. estimates have been generally in the same range (85, 1-9), espectally if the eubstantial aceident account was added--energency wards and rehabilitation therapies being anone ?the most energy-intensive operations in contemporary hpepitale. The TECNET (Transportation Energy Conservation Network) study, prepared for ?the U.S. Department of Energy, 1s supportive even without any correction Tt concluded that in the base year 1971, "the amount of fuel consumed indirectly by transportation [wae] 47% as large as the

energy consumed directly by vehicles. Over tine, the significance of the indirect component increases? (33,41). An average incret tage point a year would have brough the coefficient of indirect enerey to .57 in 1981, for a total transportation energy of 1.57. This happens to be the figure arrived at quite independently (and using a different methodology) in a study of energy consumption and efficiency of 53 oec~ tors of the Puerto Rican economy (58).

Coefficient 1.57 means that 57% must be added to the total ai-

oct transportation energy in order to eatinate the total (direct and

of one percen-

---Page Break---

secondary) energy used in relation to transportation. This total rangee between 47.1% and 50.2% in Puerto Rico in the last three years, very close to the tentative gross estinate made in 1978. It appears safe to use in the future a coefficient 1.6 (TDTE being 1.0) to estinate the total transportation energy in Puerto Rico in a given period.

Tt is true that the indirect energy account includes many industry, construction and service activities which are presumably targets for

improved onersy efficiency in their proper sectors.

however, direct candicates

cite buttwo examples:

Several others are,

for transportation energy conservation. To

(4) Poor road surface and tire-burning acceleration

represent a oubstantial increase in tire wear. It takes seven gallons of

crude to manufacture an average tire. (11) Service stations account for

36.5% of the estimated five percent of loss of hydrocarbons by evapora

?tion, A good seal at the interface of the punp nozele and the vehicle

filineck saves 90% of this loss (LLL). That anounts to saving more than

1.5% of all the gagoline pumped in Puerto Rico in PY 1981--over 10 milion

gallons:

Indirect energy related to rubrics ?Construction? and "Accidents"

should also be taken into account in any longer-term scenario. The for-

ner, because new infrastructure construction should be weighted against

?the opportunities of no-construction transportation system inprovenents,

considering the whole energy cost: the importance of the latter must be

related to the relatively high accident rate in Puerto Rico, sone 1.7

?times higher than In the United States as a whole.

Lills Other mivsing data. It ie widely recognized that the ultimate

key to transportation energy conservation is the owner-driver of private automobile. Fuel consumption depends on demand and on driving style. ?There are sufficient data on domand (nunber and purpose of trips, their length, vehicle occupancy rate). There are no transportaticn-related gata on driving style and the factor which condition it, such ae applied

?telligence, training, education (discipline, courtesy, civic responei-vility), mental competence and psychological states data on age and sex ure largely available only in the context of accidents and drinking sta. Hetios. Traffic behavior pattern of the driving public as a whole is apparently quite different from other geographic areas with comparable traffic structure and density. One indicator is the relatively high acci-dont rate, ag woll as the number of vehicles with eigns of having been

---Page Break---

°

involved in minor PDO (property-damage-only) accidents, not reflected in ?the statistics. But there is no way to tell with any reasonable accuracy how numerous is the group whose driving style tends to characterize the

vehicular traffic as a whole. It may well bea minority. Here it is only Amportant to note that, whether their behavior is outside of law andrea son, or whether they are sinply unaware, a great number of drivers in Puerto Rico behave ina fashion grossly wasteful of energy.

As a practical matter, this study approaches driver behavior prina- Fily In relation to (i) substantially improved enforcenent of existing tews, (14) adjustnents of the price of private driving so it would reflect ?the real user cost, (111) the possibility of relating law enforcerent

and cost to improved conservation knowledge and behavior (not rush from fone stop light to another or try to beat them switch on air condition ing oniy when necessary: ete.). ?This focue is determined vy the per- ception of the present and foreseeable governnent interests and capabi- lities. It does not imply that nothing more could or should te done. For instance, the vehicular traffic laws and driver licencing procedures are ow exclusively focused on the ?rules of the road? and, less effectively, on traffic safety. The law would be greatly improved if it were made con- sistently energy-conseious. Kigh traffic-risk group:
25 years of age (and to a lesser, but still important degree, under 35 Years) are now identified on the basis of accident rates and insurance clsine. But the more basic collective characteristic of auch groups is

an excessive energy use because of speeding and aggressive highway beha-
vior, whether they have accidents or not.

such as males under

In the context of adequate data, under discussion here, any more drae
?Se measures directed at private drivers would probably require that exist
ing statistics be nore specifically related to driver behavior and that
new data--especially quantifications of particular types of traffic beha
vior based on reliable samples--be developed for the purpose of lezisla-
?Ave and enforcenent justification against genuine or spurious challenges.

1-45 Conclusions. A conscious and systematic effort to correct tne
pervasive wnkness in transportation.and energy-related statistles in Puer

© Rico is called for. It may require a central validation process. Suc

* P¥ocess may not only improve the quality of the statistical series, but

?iso be more cost efficient, as it would eliminate much effort which apres

to be duplicated.

---Page Break---

Such discrepsncies as exist in thewstintes of the active vehicre fleet (plus 15% or more) and of the energy it consumes (minus 6% or more) should de corrected without delay. overestinating the rusber of vehicles has been, indeed, the practice of highway-pronoting agencies. The figures of the Federal Highway Administration were found to be 12-17% too hizh (2B. 5-26). The inprovenent in statistics which happened wen the Energy Information Administration was formed within the U.S. Department of Ener- ay 4n 1977, showed that gasoline consueption. ag caleulated previously on basis of agaregated industry figures, overstated the national ventcle/ gallons average by ore than 100 gallons/venicle in 1975 (Qz.tazch 1981, p-l7). An error Like that is very relevant to Puerto Rico, As compared

with the originally reported U.S. figure of 616 gale, Puerto Rico's per vehicle consumption of 775 was well below the national average (24.35) However, in comparison with the corrected figuce of 712 gallons, Puorto Rico was 8.8% above this average--an indicator which might have given pause to decision makers.

?The preceding evaluation of the existing data bace inno way implies that there is not enough information available for the purpose of forward-looking transportation-onergy planning and cost/benefit analysis. Even extensive changes in government policies for the coming years can be eaei-Se sei Fiad wish ae ele of ealetlng data, Weds of policy snaiyaie 1.3 above) and of ?sketch planning? (e.g. ,112,1-3,4), which do not seguro costly data generation and processing, are well developed for the present needs.

---Page Break---

a

Least a decade. The system focus in this study is consequently Limited

to the possibilities of energy conservation within the existing tran:

tation ayston and its inprovenents.

2.2 Energy imports and uses

ov site ae iso float eh mansorsn eet in

neo te

son ofr te ane se

Me/yr = Mo/yr x 42,

ae

Ps tami testa fee fr gin enntrin,

15.9 Mb/PY'81, translates into an average daily consumption of 1.83 Mg.

Pe stat ti of nese ine hans Hee aoa

$ 3.3 Dillion, the total energy consuned was worth about $ 1.8 billion,

sv tenvtton ans a ane 85

---Page Break---

a

Figure L. ENERGY IMPORTS AND USES IN PUERTO AICO

(titlions of barrels per calendar year)

total enoray inporte

85

83

80

75

Crude imports

70

60

Total energy coneumed

consumed

cy 1974 19751976 1977 1978 1979 yg 298° py

---Page Break---

a

2, THE POTENTIAL FOR TRANSPORTATION ENERGY CONSERVAT

IN PUERTO RICO

2.1 Polley baseline:

?The 1978 study concluded that wide margins for transportation energy conservation (TEC) existed in Puerto Rico. Tt proposed the following four policy baselines for the purpose of planning and implenentation:

1. Trangportation in Puerto Rico consumes directly and indirectly about ag much energy as all the thar sectors put togcehen, tig hare of transportation energy in the total enerey budget pay oe 38 much 108 higher than in the United States as whole. Ch res galoulation based on 1979 data indicates that this relative shave My, de tn Puerto Rico about three tines a5 high as wee roughie inated in 1977. See Table 1, item 4.)

TL, QL the safe essential nobility of persons could be satisfied ith gs Little as 508 of the current direct. trangporsation energy in Puerto Rico, with adequate naintenanes of engines, vehicles and roads, with reduced use and acquisition of convenience cover gquipment? for automobiles, wich reduction cf driver denand (ohect Peis, low occupancy, nonessential driving), and with the uperede Ang of overall driver behavior to the standards of ihe traffic code and of common? set

HIT, The private vehicle transportation sector is highly publicly sub-
gidtzed. That means that the users of autonobiles do not tay ape
full econonie cost of gasoline, highway use yparking, and thay they
are also subsidized on a nunber of other accounts,

IV. Transportation energy conservation cannot be effectively imple-
Fented outside an adequate transportation eyaten management? (ISM) »
inthe broad F sing transporsation planning and ma

and resource aystem, This will
reduce the social and envirermontal cost (that is adverse

Anpacts on public and environmental hoalth, land aise and crate

ronmental esthetics) which must be aazuned? to be squal in pag

tude to ?the energy and economic coats of automobile based teente
portation.

?The quantitative dimensions of Baselines T and IT, relevant to TB, are illustrated by the various figures and tables in the following sect. fons. Baselines IIT and IV are discussed in ch. & and 5. The formation of Baseline IV, cited above from the 1978 study (24,614), was influenced

by the then still active planning of = transit aystem for San Juan, orga nized around a major rail component (sae also 23, advocating light rail against a partially udterranean heavy-rail eystem) and the Lspliclt pcv sibilities of major improvements in the quality of the urban environment ?This opportunity has been allowed to becone a victim of changeo in fede- Fal urban sass transit policies and is, in all likelihood, dead for #t

---Page Break---

ab

Figure 2 shows the dlepoaition of the energy imported in PY 1982, with emphasis on the transportation sector. The heavy Line connects the nagnitudes which chould control transportation energy conservation policles and actions. The about two-thirds of total transportation energy spent in urban driving represent about 11.5Mb, that is some 22% of the total energy consumption in Puerto Rico in 1980-81. At least 70% of

?this fuel consumption must be assigned to metropolitan San Juan. That represents more than 15? of the total energy conaumption on the Teland, despite the fact that according to a 1977 survey by the Department of ?Transportation and Public Works, based on a fairly reliable sample of 1600 respondents, almost 30 of families in metropolitan San Juan were still carless. (The 1980 census data are not available at this tine. The proportion of carlese families in comparable setropolitan areas in continental United States is 17.58. The overall national percentage is 15.3 (9501).

2.3 Past and present consumption trends:

Figure 2 cn page 17 compares the cost of imported crude, the pump prices of gasoline and the average daily gasoline consumption, in millione

of gallons (Me) in Puerto Rico and in millions of barrels (Mb) for the rest of the United States. (Puerto Rico figures in U.S. statistics only as fan importer--that 1s, reexporter--of energy in the form of refined petroleu products.) The figure contains all the essential information. Tt needs only a few interpretative coments:

+ The 1976 ri

ie attributable to the growth of the number of vehicles, from 82,000 new registrations in FY 1976 to 110,000 in FY 1977. The continuing rapid increase in consumption from 1977 through mid-1979 was, however, out of proportion to the increase in vehicle population. It can be explained only by more driving--vehicle-niles per car (VWT). This was the cage also in ?the United States as a whole in 1977-78. The conclusion that the added portion of VM in the United States was in the category of discretionary

(nonessential) driving seems to be supported by the sharp drop in this category, some 13% in PY 1980, largely in response to the price increase of gasoline and a temporary scarcity in 1979.

The great increase in gasoline consumption in the U.S. (1974-78) an:
An Puerto Rico (1975-79) corresponded to a period when the pump prices rose only at the current inflation rate. In fact, crude was in mid-1976,at

in gasoline consumption inFuerto Rico, the highest in U.S

---Page Break---

45

Figure 2. ENERGY DISPOSITION TREE (PY?B1 in Mb)

TOTAL ENERGY IMPORTED

97.5

crust Orie

PeRROLEIM

ses 3

TOnAL Punt

CONSUMED

52.6

srauseSeexctoN Brier seczoas

Industry

oifecr Phetoeweat ® ??_Tecvernatne

Ginpznweny Gonseree Services

Residential

([Disngeregared

values net

svallavie]

TRANSPORTATION

?TOTAL ENERGY

retour PASSENGER

10g.

coutrive

TRANSPORT

7%

vneQy ivttkorry

668 178

(more x .6) >

32.1. (52.58)4 10.3 (19.68)

35.5 (67.58) ©

Notes

* See the calculation in

8. Laz, The total ts

jumed to be unchanged

ince 1979) ?the propert-

honate growth from 1. =

to 2.38-0f total enerey

consuined reflects. the

mown but unguantitied

shige from gasoline to

dieser

2 Soe cec. 2.43

This total includes in-

direct transportation

a energy.

See note * on page 16

---Page Break---

$14/varrel,cheaper that in 1976 at $13.60/barrel.

+ Gasoline cer

imption peaked in Puerto Rico some 6-8 months later
?than in the United States. A partial explanation may be found in the fact
?that there was no gasoline shortage in Puerto Rleo (although it was predicted for mid-1979), whereas parts of the United States suffered shortageo due to distribution problems and refinery policies ained at the * availability of sufficient stocks of heating oil for the 1979-80 winter.

The absence of this problem may exert a gubtle but real influence on conservation policies and awareness in Puerto Rico.

Both in the upward and downward portiona of the graph, gasoline 4 consumption in Puerto Rico exceeded relatively that in the United Stats Thus the 1975 to 1979 inerems in Puerto Rico was almost 22f; in the United States (1974-78) it was 15.58. The consumption drop 1979-1981 has been in the United States over 1.0 Mbd. or 13.6%; in Puerto Rico it ha «

deen only «15 Med, or 7.6%, ?This amounte to only 56 of the decrease

rate in the United States. As the monthly coneumption figures show, there

was no sharp drop in diseretional ViT in Puerto Rico.

Ay consumption period

+ The two high month

which correspond to the summer and winter holiday/

vacation months, have continued relatively unchanged. .

+ The result of these trends is the growing proportion of transporta-

Hon energy in the total energy budget in Puerto Rico. As Figure 2 shows,

gasoline consumption in BY 1981 represented over 30K of total energy: St

was under 28% in 1979. With the addition of diesel consumption, the total ?

?transportation energy in Puerto Rico has grown to 32.5% of the whole yearly

?energy consumption. ©

aggregate figures

was dropping 8 f1

In the United States, on the contrary, the latest

(87,22) showed that energy consumption in transportation

er than the total national energy consumption.

2.4 Comparative interpretation

The relative dimensions of energy consumption in transportation in Puerto Rico, and the implicit potential for conservation, can be further illustrated by the comparisons presented in Table 1 on page 18, .

?

According to {inal official figures for CY 1980 (50,18), the gasoline

gonsumption of Se

?presented of the total

52.9 A

Alnoat ongcthird of all eneray was directly commuted ta trangorieeee

---Page Break---

Te6t cast 6eet weet LT gket ust tet

5 THE -9 «

corpses,

stto9 SS 9

\

coke Nes guar ?

op thers a

\ wag ©

Sette9 \ ? a

\ oe

---s serv

uorrdunouog

?tosey ser

Spnagrooqag

pastor

SH

mye

?Tones only

worraaRETES ae

(00ry oas0ng pur saqeag pozyun)

Noduewnswoo aNY sora SNYIosvo "COT

---Page Break---

2

.

Table 1

Comp dimensions of transportation energy consumption

aunv.s.

(except where sp:

cited otherws.

Potroleun share

in total energy 475K

+ Highway-node

transportation me

Petroleum share

in TDIE 53%

4

?Transportation share 25 (direct)

of total energy

28g (inafrece)

(2980)

Ruerto Rico

98.856

(6'1978-80)

Almost 100g

200%,

32.58 (direct) Y

915% (indirect)

Se

ten by Ratios ho Directs 1.28

Potal's 50 (was. ?

. Fagsener to froight

venicles ean pa Y

Fer capita gasoline ia 0.62

ao.

- Per capita gasoline

?soneumption (aa (w. Europe 0.3)

wtton (eai/aay) (¥-Bukcpe 0.3) 4g

Gasol. £ 496 gal.

(ag6 of U.S.

22008 of W.Eur,

530% of Japan)

225 ga.

(Sapan.

terper'eas.Cicons? $0 9 $368 FES

ck" ie (ois. 27.09)

Seno" gat hEtHas

seated amare

se Sere? $4350

(lowest in U.S.)

Fuel consumption 7h5 ga.

por vehicle #0 For (u.8.) Sebo

rug the quantitatively insignificant share of energy consumption ty

ferries, domestic air travel and pipelines

See Figure 2.

Passenger vehicles include ?pablico? sedans and vans. as well
almost 100,000 LpTs (?eamionetas" and other light tricks used
for private transportation).

Now York Times, 16 Sept. 1979, Sec. 3.

?These figures mean that consumption ia Puerto Rico, if proportionate to
PCL, would be 17.48 and 3.2% less respectively, or 2.? tines smaller.

---Page Break---

ag

Tens 7 and 10 in the preceding table acquire additional dimension
when combined with other data. Thus the relatively small per capita ea.
sotine Conoumption in Puerto Rico Le n line with the relative populatton/
ENGME Ration 9-31 An Puerto Rico, 1.2 in the U.S. thio relative pari
ty As confirmed by figures on per-vehicle fuel conoumption (iten 10). sox,
over: while the P.R. consumption is close to the U.S. average, the acea

Cf Puerto Rico, about 100 tines 35 miles, is not cloge to the national average, Dut rather 46th in size among 51 state units. This te ancther indicator of the high transportation energy conoumption in Puerte Ries,

?Te distance around the Island is about 300 niles. The

rage of 32 trips around Puerto Rico for
each of the 935,000 vehicles active in 1978,

The interest of the comparigcns based on PCI lies in that they ahow Ske extent to which private vehicle transportation has been allowed-.it not also actively nudged-?to becone a real or felt necessity alnost irres-Pective of economic level. Some additional coments may be helpful

don eats the comparison in Sten 9 of the table--that gasoline consump. ?Hon 4n Puerto Rico in 1979 exceeded by 3.2% that of Mississipi, it com pared in terms of PCI--coincides interestingly with another figure arrived at by @ completely different methodology. In the voluntary state gaveline cinservation targets promulgated by the federal Department of Enorgy,Puerto Fico was requested to conserve in 1980 13.7% of gasoline, the second Righoat target in the U.S. (Alaska was highest with 16K). Wiestesini'a FRrset was -208. Added to the 3.28 calculated above, it would target Puerto Rico at -13.2%--almost (dentioal with the DO request of 13.9%. sondern rey it, 2 BEEtial explanation of the real need for the nigh private yehtole mileage, It is the great anount of commuting to work whieh senate. Tex e yar tain aepecta of econoate development planning. A 197h study (HL,6A1-4) found that in 5h of 78 municipalities, more than so of Libor cenreiea in (wniie the rest of the lator force was resident). In 13 mnioi-paittles, more that 50K residents commuted out to work and more that som oe he laber force commited in. In two instances (Catafo and Carcline, both at the edges of metropolitan San Juan), the rate of cut-comutees ere aa high ae 63.8% and 65.68 respectively; the in-conmuters accownsed £0 50-58 and 68.7% of the total local labor force. The fuel cost ar trie sxcepttonally high mobility was roughly estinated at 20% of the total fuel

---Page Break---

consumption. The study suggested that the Intereity collective taxi system ("pablico") be expanded and that its service level and public image be Amproved, But the wajor reason for commuting in low-occupancy private vehicles was then, and is still, the convenience at relatively low cost, both in fuel and in highway user costs. For instance, the toll collect fon on expressways is too low to cover even the annual payments of principal and interest on the borrowal funds. Such economics invite unnecessary driving in all categories. The making of 140-mile rounds trips (at speeds exceeding the posted Limtt, thus further increasing fuel consumption) to seo a movie in San Juan = few weeksearlier that in the local ?theater, was docunented already in the 1978 study (24,52). A more recent exanple 1 the revelation in legislative hearings that unlicenced street food vendors commute to San Juan over the same or comparable round-trip stances (59,10 dct. 1981).

* Thore still remains the question of economies. Considering the low ievel of "Labor participation? (the official percentage is in the low 40s, some 45-508 below the U.S. national level) and the large numbers of welfare participants, where does the money for all this driving cone fron? Two major sources suggest thomselves, in addition to a sufficient taxable income:

(3) the extensive underground econo:

estinated to be in the $3 billiona-
year range (59, Sept.1901); (ii) the about equal yearly amount of federal programs and transfer payments. Of this money, particularly the food coupons (approximately one-third of the total, or $1 billion) have becone to an important extent a second currency which found its way algo into the ?ransportation sector. This aspect of transportation economic in Puerto ico not only increases energy conoumption because of the number of ve. hleles; it also causea fuel penalties on account of the relative age and ?the minimum maintenance of the economically narginel portion of the fleet.

2.5 Major TRC categories and targets

Table 2 lists the major categories of fuel penalties (that is, cone

sumption that ean be eliminated or reduced) and the corresponding trans.
portation energy conservation potential for Puerto Rico. The contenporas
ty data and estinatediffer very little from the 1973-78 information

(alts 43-54), extracted and reconciled from some twenty sources. Addition.

a more Pecont reference 1 (18: 42s 591 Zs 78; 861 92s 921 981 LO}: 1021
S61 62).

a

---Page Break---

Table 2. Si

a

Of the categories and estimated potential for

ipportation onery

rarey HY conseFvation tn Pyerts Rice

CAUSES OF POTENTIAL

Pury ranavetes | mec In ¢ | COENTS

MAINTENANCE

Vonictes

?Tuneup 10-35) Bag. a new sot of spark plugs, 3.

Rev tear 25° |) The? cumulative ostinates tance? trom

Adjust idling} ?2 1g borage

Iubricants 2.55}

2.55 | Radial ply tires, av compared with bias

ply tires. the rdiling resistance of tias

belted Somewhere in the middie,

15-6 | he upper value correspends to tinea te
fated to maxinun recommended P51 (29-20 in
3580} i
Cumutative maximum value corresponding to
optinum tire quality, maintenance and
alignment averages dog"

25 This is probably a too conservative in.
gfease trom the 1978 estinate ot 25. 5h,
because of the massive deterioration of
Foads in Puerto Rico. Driver use up to 56%
Bore fuel when driving on substandard roads
[due to loss of traction and uneven power
Flow through the drive train becauve? of
vibration" (66).

POWER BQTTPRENT
Automatic as EPA 1981 tests range from 7 to 19K. Exurban
?transelssion ariving averages 1-58 loss. Weight adde ie
e 0 This Lethe Pied penaity hotewoath:
Alreoolin 2 is ie ?the fuel penalty in urban hot-woath-
* gr operation. ?Added weight represent 28,
A qut-off device during acceleration can
Feduce fuel consumption by az much as 456

Go1.69).

Other power cont 1.5 {Weiene)

venience equipme ?i (Operation)

Vehicle gettis

10'npg more "| 8 ¥-8 engine uses 18.56 nore fuel that ¥-6.

marrie EPEEAETS (+= tncrease in

ow Fier sconsay eas

soe

ao ?25mph va. normal? stop-

62, traftic (or congested, slowae

down traftic @ # 10mh), soe

+ Right-turn-on-red, «oe

>

---Page Break---

(able 2 cont'd)

fT qpaceoe | | Semeur | HEOSE | coments

castes | Tee | Senne

RAPPIC

| Flow (cons'a)

[Paranevera]

+ Two slowdoms fron 4omph over one nile,

and reacceleration (due to not synchro-

nized traffic lights), -16%

+ Two stops and restarts undor sane con-

ditions, -326

Enforcenont + Smph in 35-4ompn zone

| 7%

{ Fomph in S0mph" zona, 25%

| {Acceleration to ?beat? a traffic Light

or to pass another vehicle ata speed

| ? above urban 95-4Onph limit, -20f each

tine. If the violator has $o stop at the

next traffic Light, the fuel lost in

| Stopping and conguned in reacceleration

L

1

is another -258, for a total -45%,

Entering an intersection on *yellow"and

Slocking the "grect? croas--

20 vehicles. iaiir

hicle ?travelling

Flor

1 minute equal one vo-

Sai @ 15mpg, 3.7501 @2smre.

Style/sehavior

Following 25(minim, | According to actually carried out pilot

simple rides progrens, this figure applies to any ari-

r instructed in proper acceleration,

mmooth driving naneuvres and anticipation

of stops and slowdowns. ?The economy of

fleet drivers can be improved up t0 208

02). Urban braking is estimated to use up

?orgy. The pow

(is higher in the cage of erratie/

aggressive drivers, Each ?rabbit? start

19%, fuel. as? compared with norma

adder SESE, Aare LEN normal

Deiving w/in

ed am te 275 See the enforgenent parameters above. Page

* eetinatest -78 for Som of urban Very ?158

for hog? intereity vier? (pacaengers and

freignt)."708 drivers violate speed Tint ts

in the Uls.1 the hard core (sultiple specd-

ing arrosta) is estinated at 3.5%) 1.

S million G02. Truck fuel penalty is

calculated at # -2.2% for each nph over

Ssmpn. (3)

Exee!

woignt Reference is to unnecessary objects perm-

z

(ea.50 kg) | nently carried in the venicle.

Tehege qed. cfteg gereantages vere epauited with jhe help of equipment, wit

gghrte, instalied fn any car; A ?oruiae control? (governor). Gye Saint

SH rien Soonony at 'stouay Aighway spend cf Soeph. Waaitola vecden ga

Drove

Seton oh oad Righeess

Sarto ele GF east aes. feet

---Page Break---

(ravie 2 conta)

Causes of Posentiat

tueT penattion | HEE SEE | coments

DRIVER

Style/tenavior

Unnecessary ? |

lating

Demand

Yehicte

occupancy

{all trips)

Short trips

?Trip purpose

Egsentials

Sto aehoot

40 ahap.

(GongoLidatea)

smedical-dental

Non-eesentia1/

?Satness

-social,

iFecreational

20

10

25

Defined as letting the engine run for more

than 30 Secs. when stopped for other pure

pose than traffic lignt. Eetinatel cone

sumption is 608 of typical urtan driving:

OF +25 to .4 nile for each minuve of dit

Ang. depending on vehicle mpe and tuning.

An average occupancy for work trips

5 Yo 1.94 that means, for euch 10

te reduce ing

fron 6 ti y-and triple

ecupant veliicles trom 2 to-J-acchy fae ee

total of 19 peraone in 10 vehiels

Hf a vehicle needs to be used at all, the gongolidationof ime 1mile trips into one Senile trip ?increases fuel sconony vets ween 2 and 2.5 timos, depending on the num ber and length of stépa. (A one-mile trip is only .5 mile thore and back; and it may be. shorter on foot, depending on the pedeste an ve. traffic ayoit).

Pus pon-pleasure category totals only Son gf private auto travel (home-based, means ing starting at hoe andr directly, ang non-none tased). ?The Fepresent 40K of all such trips, the rest Selig made ty Sone other mode? (ous pint 90, Disyole or just plain walking), "th fuel economy potential coincides with che

gategories ?vehicle occupancy" and "short

trips" above, in addition ta a anift to pube

Lic transportation, ae mich as aveilatle.

UsS. estimates are trom 35% upward. The

P.R. total for home. and non-home-based trips

is probably closer to 40S on basis of the

following data and onpir?eal observations:

+ Regular gasoline consumption increase hy

a5 much 43 158 during two yearly heli? s/

{gation periods (ouinar, Ghriovmas).

+ ity and intercity trattic density out-

ido the daily peaks for essential tr 1

apghtorelty traftic on weekends.

This discretionary driving represents about

50% of all private auto travel.

---Page Break---

2h

2.6 A oummary evaluation

?The inportance cf the estimates of TEC potential in the preceding
?table does not primarily lie in their numerical values. Sone of these
values are difficult to axpresswith sufficient confidence, given the
Present state of data and art. Other potentials are knowingly understated
in the table. An example is the 10% ascigned to ?Essential trips? because
of the lack of public transportation ard to, so far, apparent unprepared-
ees of employers, public and private, to organize vanpooling on a scale
?that would make 9 difference. Still other potential economies, thous
real and substantial, are not inherent in transportation as such, but in

?the priorities and attitudes of the police. U.S. data support the empir:
eal hunch that the hard core of willful, systematic traffic violators in
Puerto Rico ts relatively small. The great majority of other lawless éri-
vers follow the example of those who are ?getting away with it." Thus a
Feturn to "normal" enforcement would probably have a quick multiplier ?
effect. But the decisions necessary to mobilize this TEC potential make
it proportionately more difficult. only etrong and determined govern
ments dare to tackle the effects of the social Greshan Law.

For these and other related reasons, the principal value of the esti-
mated fuel conservation potentials is not in any exact nunber:
is to de found in two other aspects of the table:
(1) Tt suggests the comparative ordem of magnitude and the relative pay-

offs of various energy conservation actions. ©

(34) Tt dicaggregates as well as confirms the global conclusions expressed

in policy baselines I and IT, cited at the beginning of thie chapter

(aoe. 2.2).

The 1978 estinate of a conservation potential of 50M of ?current di-

Fect transportation energy?, while providing "all the essential cafe eoti-

ity" in Puerto Rico,? was admittedly heuristic, that is, desiened to sti-

sulate more intensive analysis and precise enuneration by technical spe-

cialists (2b, 53,65-66), Bven without this follow up, it must be assuned

?that the very tentative original estinate is now confirmed and oupported '

vy the inventory in Table 2 (which te simply an updated synopsis of the

original data). For instance, the following fuel economies add up to 50x:

butrather

---Page Break---

fore careful vehicle maintenance and driving

Fecreased ocoupancy (work trips)

Selective airconditioning +.)

Reduction of discretionary driving? 111)

Other (traffic management & enforcement)?

Shese are very congervative estimates. The 15 eatinate on account of

dee entry driving and faiiure to form carpools, was nade by the former Gireetor of the office of Energy in July 1979. several inelecneet count during the soming rush hour (0730-0830) showed that almost one-half or fhe passenger vehicles had their airconditioning on. The list abow does not

Snelude euch substantial fuel saving measures as better road naintenanc: other ites from Table 2 could be added or substituted.

?The 50m estimate has been subsequently also supported ty:

(4) a mumber of general and specific studies of energy futures, all of them emphasizing conservation as source of energy, and identifying transportation as the principal conservation target, specifically alse with reference to Puerto Rico (21)

(14) concrete, quantified demonstrations of the extensive fuel economies that can be achieved by relatively elsple improvenente in naintenanc driving style and awareness (C2);

(444) the increasing recognition that, beside massive technical fixes such as CAFE-~the corporate average fuel economy standards nandated by ?the Energy Conservation Policy Act of 1975 [27.5mpe for 1985 models]-- Substantial fuel savings can result from the sum total of separately in- Significant conservation practices. For example, one million minutes of unnecessary idling (equivalent to one minute idling by every vehicle in Puerto Rico), due to poor timing of traffic signals and to carelessness of drivers, represents about 17,500 gallons of gasoline or the yearly mileage of 35 cars (335,000 miles), worth $ 26,000 (at $1.50/gal). This amount of fuel Se lost by idling several tines over every day in San Juan.

(4) Recent global setinates of possible fuel economies, published in information material by the U.S. and P.R, governnents (78,53), range from 30% to 50%, depending on the age and efficiency of the vehicle and on the engagement of ?the driver. The individual concern and attention are becoming sore critical ar ?the federal technical fixes (e.g., CAFE) may be postponed or nade less effective.

(v) sti11 another similar estinate (40-60% saving) cones from an urbar.

Planner (J.B.Gibson, Designing the new city (1977), quoted in The Futurist, Pet

1979, page 61.

---Page Break---

3+ SCENARIO ANALYSIS AND CONSTRUCTION, AVAILABLE CONCEPTS AND TECHNIQUES

3.1 Synopsis

?The preceding Table 2 represents an inventory of the various causes of fuel penalties and of the corresponding estimates of potential for transportation energy conservation. Although it was shown to be sufficient for the purpose of a rudimentary but significant global estinate, this

is only the first stage of scenario making.

?The actual implementation of planned fuel conservation requires nore ?than a classified diagnosis of what causes fuel waste. Drivers must ve made to act 60 a to conserve. No other mechaniom cones even close to the effectiveness of the cost of driving that hurts. Tn that sense, TEC is ?the function of various incentives and disincentives. Sone of then are outside the control of the government, euch ae the cost of crude, refi- ning and distribution of motor fuels. Othera can be controled by the go- Yernnent: gasoline tax: exeise tax and/or lleancs fees directed against fuel wasting vehicles or accessory equipment; parking fees and tolls on low-cceupaney vehicles entering congested area

Another group of TEC-promoting mesgures and actions falls wider the headings traffic system sanagenent and enforcenent. The various cost-oriented and managerent/enforcenent measures also need to be inventoried and evaluated for the purpose of TCE scenarios.

Finally, it is necessary to put together and analyze various pos. sible combinations of measures, the identification and quantification of specific conservation targets. the poeaible priorities, sequences, levels of intensity, and time horizons and limite. The concepts and methods re

lated to the second~ and third-stage scenario inventories are explained

and illustrated in the following sections.

3.2 Inventory of TBO-promoting measures,

One of the tetter examples of such an inventory appears in a 1979

Study by the congresolonal Office of Technology Assessnent (78,116-117),

Entitled the "Petroleum conservation case,? it liste the following meas!

res and policy options:

1. igrway construction: decline by YOR ty the year 2000.

2 Masa? tranaitr oubotentially inefeaced Prenerely route (capital

Invetaent, operations):]

---Page Break---

7

. gangatery fuel economy: 33nps by 1990, 40 apg ty 2000

+ Spaeds Bigid enforoerent ct asic

Safety Caccidant prevention?

PEpMoleay: 25% nore diesel cars by 1985; 60K more by 2090

Taxes: Gas cuaaler ban/tax

High gasoline tax

Bfficlency incentive tax

Annual Vat tax

5; atonal 1/M { inapection and saintenance] program

9 Inprovenent of tratfia tow

10. Carpooling promotion,

LL: Auto use controls

15, Ubpidtzed selecommication networks [to aibetitute for auto travel]

13. Public education and appeals,

fhe let contained also the derogulation of fuel prices, whten was Ranioted ty legislation as of 30 September 1961, and aotually wea tmeie Tented early in 1901, The ot alsomakes it possible to oo how extensive iyo-thoush not necessarily forever--sone of the most affective Is mene cat aro reduead oF Dlumted on the faderal level, thut 1s, for all practi. cai puxpests, ronoved from the state-level conservation repertory.

A Simpler Inventory of neagures waa proposed in the federal Depart pent of Energy's project of ?productive conservation in urban tranerortas thon" (29, Dee. 1979),

sEnhance group travel

reat speeltic tuel-eeonomy targets (29. 20, 308)

wlan ton, of number and length of trips (Bromstion of home work,

with the help of communication tachnotang

Beer gene gong EY intensity (change of travel mode [car to tranatt,

ares agsered Rours lessening trattic conseteen

{Growing of policy and technology elonents. Se reinforce each other.

Fisewnere, the ?techniques for reducing in-use automotive fuel con-

Sumptton? were conceptualized in thrve categories (101,00):

2; Modification of the vonicles

2: woaificasion of trartig ft),

3+ modification of aniver tehatior,

?The minimum conservation progran proposed in 1979 vy the Puerto Rico

Office of Energy contained the following neseure

] Abittyedtete [perteherar] parting, to continue work ?rij in vanpeote

+ Redcturn-oncrlyne [ihe law wan regeeg Soha

Reet tattle eneineorhng, sheluaing?traffe Wants activated wv

frat tie thew ? ?

EpProved public transportation (tuses, pfblicce)

md eegsly Ofoiee, tax and Licance fens fo Fedise the taport of bir

and Mediun-size models. °

The last measure was ir

nded to produce about 55% of the expected

2:88 of transportation mergy conservation in 1980. As Flsure 9 (page 17

Stove) shows, the effective drop in gasoline use in 1980 wae lose than

---Page Break---

3.9 Reference inventory for Puerto Rico

In comparison with these and other references, the most complete and ° evecttic inventory of TB0-promoting reasures ig the one gummatized in Table 2 above, based on the 1978 policy study. The various neagures can Se serrated an erphicaly orderea a8 som in Pigry 8 onthe ceponite ase. ?

The figure brings out again inevitably the predominant role the driver plays in an effective conservation effort. Of the three categories of ?nodi-fleations" cited above from the DOT study, ?vektele? corresponds to "tech-ical innovation" (left top of the ?spoke wheel"); ?traffic flow? corres-ponds to ?TS¥/Road maintenance? (right top) ?driver? corresponds to all

?the remaining categories, with "cost" being the major incentive/disincentive.

Sven the initial disaggregation of the category ?cost? in the denand-
Felated colum (left botton) indicates the variety of levels and functions «
of cost. Tt also implies that not all of then are equally effective or easy

to implenent. Table 3 on page 30 shows a possible ranking of various meas

ures using the criterion of difficulty. Diffieulty is the function of the

ogres of decisional discretion, that ie collective and individual hunan

control over the various TC measures. It hae been most frequently assuned

in transportation energy analysis that, in view of the difficulties related

to Individual discretion, only ?automatic? tachnical fixes ought to be re-

ied upon for TEC. Such an assumption extensively reduces the scope of

Possible action. Tt is not an adequate policy premise if the tasks of po- ?
cy analysis for decision making include the prevention of future mobility

orises.

---Page Break---

Figure 4, fe91

and TEC.

Driverscondi tioned

P/e HRY

HN CAL

VARTON

DEMAND,

BEAVIOR

INCENTIVES

DISINCENTIVES

INFORMATION

EDUCATION

DEMAND ?RELATED BEHAVIOR-RELATED

cost ENERGY-SENSITIVE LAW

+Fuol. Operation. ENFORCEMENT

lexcige tax (vehicle, PERCEIVED FUEL PENALTY

Power equipment) (Driving style)

-Highway use. Parking. ACCIDENT PREVENTION

?Lowaoogupancy. tol]:

TRANSORTATION ALTERNATIVES

?Public a

Institutional (vanpool) Transportation system

Private (carpool) p Mnsgenent

?Parkeand-ride Inspection/Maintenance

WORKTIME ALTERATIVES © pe fuer

«Staggered houre, Flextine. + fuel economy

OTHER. INCENTIVES/RESTRICTIONS

Alternate daye driving

---Page Break---

»

tabie 3

?EC measures ranked according to assured difficulty

in enactment and teplesentation

As AUIOMAOTG FIXES [External/Pederal]

I. Gost of isported energy

TT. Federal laws and regulations

TIT, Innovation (e.g., federally mandated fuel economy for new cars)

DISORETIONAL SIXES [State government: subject to political decision

?making and related pressures}

I, Technical-management

1. Infrastructure

» Maintenance

+ Non-construction improvement

2 Construction

2, Traffic engineering

3+ Comprehensive inspacticn/naintenance (nechanical-omissions-

fuel economy)

4, ?Transportation/mobility alternatives

5. Worktine alternatives

6, Government vanpooling (supported by witholding of parking

privileges or by high parking cost)

TI. Legal-adninistrative

1, Traffic control

+ Bnergy-conacloue traffic code

{ Baforcoment

sdraftie

: Parking restrictions

2. Piscal incentives / disincentives

Travel restrictions

(erg. alternat

ther than by cost/taxes

?days driving)

©, DISCRETIONAL BEHAVIOR (Total or substantial individual control]

1, Individual £/e measures

a) Vehicle maintenance

») Reduced use of energy-intensive convenience equipment

©) Reduced vehicle mileage

4) Travel during less congested periods

vehicle occupancy for work travel (carpooling)

fed nonessential/pleasure travel

4, Alternatives to private venicle

---Page Break---

2

3.4 Structure of alternative scenarios

Structure of alternative scenarios

final phase in scenario raking is the selection and combination,

or alternative combinations, of the available elenents

of the following criteria,

3-41 Combining measures and sequences. What combination(a) is(are)

possible, practical? vow much fuel is it likely to savo?

?The rudimentary scenario in sec. 2.6 above is an exazple.

3-42 Quantitied fuel targe:

tion or absolute quantity (Mg) can be

ures would achieve it?

Assuning that the conservation plan proposed by the P.R. Office of

Bnergy for 1960 (9) attempted to comply with the then minimum federal

Sarget of 58, the scenario quoted in sec. 3.2 (page 27) would be an example.

3:43 Combined approach. What combined measures and at what level

of intensity would be necessary to achieve altemative numerical conser-

vation targets in a given year (e.g., 7%, 108, 15%) or in a sequence of

years (30% the first years additional 10f the second year; additional 5%

in the third year)?

using one or more

What percentage of past fuel consump-

should te, conserved? What meas.

3.44 Alternative Levels of intensity or assumptions. Finally,

alternative scenarios can be developed by postulating various possitle/

desirable levels of conservation effort and intensity, of tine frames and

Limits, of inevitable/tolerable impact:

This structure is illustrated, for example, by the altemative scena-

rios developed for the study of U.S. energy denand and conservation to your

2010 by the Committee on Nuclear and Alternative Energy Systens of the

National Acadeny of Scieneea G2d. The various scenarios are deccrited

im terms of the following energy conservation policies

A ~ Vory aggressive: deliberately arrived at reduced demand requiring

sone life-style changes

~ Aggressive; ained at maxinun efficiency plus minor life-style

changes

§ 7 $oderate: slowly incorporates more measures to increase efficiency

D - Same as C. but 3 percont average annual SP grorth

= - Unchanged; present policies continue

?The difference between A and E is 16 quads Btu (or 1628) in the trans

Portation sector, 77 quads (or 132.5) in total energy projections. ?The

?assumed cost of energy 4s four tines higher under A than under E.

---Page Break---

22

3:5 Possible scenario structure and levels for Puerto Rico

?The following four levels of possible TEC effort and of the corres

Ponding policies, planning and prograns were tentatively defined in the

early stages of this etuay (Fall 1979)1

SCENARIO I. Unchanged policies: minimum or passive response to price 6

Bhangea and Fedora candatory:epandardor minigames

ents in infrastructure and public transportation: soken

Anformation/education actions: waiting for the crisis to

? Me Pepreves government performances ng real changes, in pottcy,

?aw and Fogulations, management and existing institutions. ©

Sone effort to respond beyond the minimum; return to enfor-

cenent levels of 3-10 years ago. .

? om.

?Sf the pul ?Private-vel

trensportation; increase of gaoline sax beyond the inflas

thon factors active promotion of vanpools ad carpeols:

the beginning of real transit (bus and/or rail on separate

guldoways): changes in law and ingtitutione, continusus ex-

planation of individual conservation measures that can offoet

cost increase

? 1. Activigt uo podicies: the most rapid feasible implenenta-

?fon oP the various wonsuree ?tatulaved in fave 2 Sbeve

3-6 Godification. agency Task Shee!

3-61 The purpose of codification. Detailed elaboration of alter-

native scenarios requires that sany variables, possible groupings, alter-

native quantified conservation targets (percentages, cardinal nunbers),

lead tines, agency tasks and rates of implementation te handled. on the

evel of magnitude represented by Puerto Rico, this can be done without electronic data processing. But some aimplified method for easy manipulation of the varisbles--especially the development and comparison of ? heuristic flow charts--1s required when the time horizon is more distant ?than in the present study,

or with regard to those scenario levels which

Fequire sustained system approach. The latter is the case of SCEN IIT

and SCEN IV ag defined above (although they are obviouely not realizable \ within the 1981-85 span).

?The following simple codification scheme was designed and pretested in the course of this study. It is included here for the sake of comple- ?teness and as a point of departure tor a possible follow up.

---Page Break---

3.62 Proposed schame. The complex of variables was organized on the following levels, with letter or number coles acsigned as is indicated below.

Major groups: A - Administrative implementation, regulations, institutional coordination and changes. Enforcement.

© ~ Cost to driver other than P (cost of vehicle, operation, maintenance)

D - Driver demand and behavior

- Education and information (Oriver demand and behavior noditication omer thn through A, C, Py feb, and Vitype mansures)

F ~ Fiscal/cost measures and controls: Puel-econony oriented Incontives/disincentives. Fund raising for transportation-related government activities

Gy Bet, Ly Rand 2)

T = Imoyaston (s/aconbansing techotoal flxaa, 6.

speed governors; now/inproved transport nodes

L - Legistation

R - Road Ctransvortation intraetructure] maintenance

and ifproverent

T ~ Transportation system management

Y= Vehicle fuel economy, equipment, maintenance

Subgroups (types of measures or behavior):

Group codes with arabic mumbersattached. For exanpls

Tl, 7, 73, ete. stenity vartous aspects of traffic

systen management. Further breakdown inte more

specific categories or measures is achieved by

means of adding numbers or low-case letters: if

23 4a public transportation, then

?7b ie buses, 13p is "piblicos" (urban feeder and

intercity system can be distinguished as T3pu and

Topi), THe is transit (separate guideways for

wages? or rail).

(groups, measures, agency responsibilities) 1e.¢-,

LP - Legislation necessary to enact a fiscal measure

FV ~ Excise tax favoring fuel-efficient vehicle:

Lf ~ Legiclation aimed at traffic minagenent (ener

sensitive traffic code); Ufa - adnintatrative/r?

gulatory measures to implement Uf Uta} = chang?

in Leeneing of professional drivers.

---Page Break---

»

Quantified targets: expressed by percentage or quantity following

?the coded measure. Bg

WV27. # (speed Lait onforcenent]

DE2/208 [instruction of fleet drivers in simple rules

of econonie driving}

Tanot youre, ¥ is the target year. The lead tine In yeare is oxpresced

as Y-2, ete. Thus, eg.

¥3 = mactment of enabling legislation and regulations

¥:2 = adminiotrative preparations, budgeting, See,

¥id = implonentation begins; pubtie information/education

3, 7 the easure is implemented and effective

(Ya - monitoring and adjustments)

9-63 Agency Task Sheets. Under the system approach which is impli-

ott (and Ss further elaborated and illustrated in the next chapter), ene

Scenarios group the measures and actions in function of the targets or

ether desired results, not by implementation seators or agencies, However,

for the purpose of inplenentation, the existing agency structure suse ve

lised unless and until it can be adjusted as energy manag.

vation might indicate. the scenario

nt and cons

?systens" must be therefore broken

fom Anto ageney-by-agency eubscenarios, here styled Agency Task Sheets (ATS).

The function and structure of the ATSe is summarized here for the eake of

complotensss and as a possible tase for follow up.

Eumpose. Each ATS defines and explains the rationale, alternatives

and the individual or cumulative effects of each proposod f/e measure,

fechnical questions of timing, sequences and interactions with other rela

Sed Beagures: and the anticipated difficulties of political, socio-payeho.

logical and managerial nature.

Form and language. ATSs aim at middle-level adninistratore and

program managers, on two assumptions: (i) that it is their information and

Gititude that most innediately determines what in fact happens, (11) thet

Addressee agencii

would be, in the alphabetic order of codes:

AGAA ~ Qbiigatory Liability insurance (participation in accident provens,

Hon and driver education) ® ®

$Reo x Paplis Service commlasion (regulation of trucks, pitlicos, taxis)

Bip? > bkce controd (gnaotine, parking, interest shasges op eee 1s}

BIE? - [ublle instruotion (yougrdriver? education; inforsasioe ot eee te

yep _ Phoveh their school chidarens

~ Federal agencies (with specific sub-identirications)

---Page Break---

35

HAC - Treasury (excise taxes on gasoline, vehicles,equipzent: traffic

ture (various commissions: Transportation and public works)

'81 Socio-economic: Health and environmental quality:

jury Eduoation; Consuner Affairs--repreaenting tne broad

Support system effective TEC would require)

ELAN - Planning Board

ERE, - Traffic police and support (0.g., computerized driver records)

Fide 5 office of Energy |

TRE? / AG) road constuction and maintenance; traffic engineering

Fe re eae en evar tienes,

ords, driver Leeneing

FIR: Transportation planning (transit)

Commi:

ty sion

Other jurisdictions, appropriately identified, until given separa

Feedback function. ?The proper

rio building effort would require three principal steps:

(3) Dratt model scenario

(44) Transformation into ATSs (subscenarios) and field testing in

the agencies;

(441) Pinetuning of the

?She real-life users.

jenarios with the help of feedback from

---Page Break---

%6

?4. THE NEED FOR SYSTEM APPROACH

aa developments in transportation planning

Technical analyeis and planning have traditionally tended toward re-
auctionisn and sectoral perspective. Provented as a superior, probl
oriented way, this "engineering approach" (20) at best solved one problem
without regard to--or aven awareness of--other existing or potential prob-
lems. Even if planning was systemic in the technoeccnomic (22), it
concentrated on one-half of the real system, neglecting the other. Tf our
problems, many of which can te traced back to the limited and ckewed plane
sing vision, are not worse, the reason is that the real-world systema are ?
in fact very complex human ecosystems (21) with all the adaptability and
Feeilionce of natural ecosystems. Much that ha happened in response to

new changing circumstances was due to the automatic built-in socio-economic Rechanions. We have managed not because of the oversimplified echenes of 7 government planners and decision makers, but in spite and outside of them,

Ne need to bail this system dimension inte our thinking and decision

seking. The natural adaptation is better than no adaptation. The Lini-

?tations of hunan-political wisdom are euch that we mst rely on the in-

herent capacity of systems to bounce back. But the new equilibria es- ? tablished in spite of errors and lack of foresight ere never at the level

or in the form which would result from willed, comprehensive poliei

Just think of the difference in our transportation,

+ energy and environ

ont if 20 of the $550 million, spent on highway construction in 1969.

1972, had gone into the beginnings of an effective rail-bue transit in

San Juan and on the island. The ideas (e.g., TUSCA) were there.

Tt was the premise that transportation planning and managenent is.

cught to be--just a specific example of econanagenent, that guided the 7

1977 analysis and critique of the ongoing "Metro" planning for San Jusn

23). 1 emphasized the relations between transportation needs on the one

hand, and energy, air quality and urtan hunan environnont on the other.

Under the color of the mandatory environmental impact a

gene tn 1980 the direction of a new planning stage (see Figure 5, where

?the group "Cost" represents the bulk of technoeconomic planning; under

the Limited traditional approach, recommendations based on these parane-

ters would connect directly with the decision on the new aysten,

cirouiting all the other loope, or at best

after-the-decision, environmental impact "

jsnent, this b

short

going through a fornalistic, .

?analysis"). Since this was the

---Page Break---

C37]

Covst son ?spay oxer}

suszra19 .

ra 4 |

Precrn)

AUT urtey

\

Nit : * T4 a

suoyEzeo wsuoaTauo eng auoztaze

eked weet ri ree

a ee

voy | aabvacanr uous ~sodbindy

SL

oD

sykignbo moy-

?SOTUVAIROS

Erertctety

| awori iat vont

| tevorsEB ov "|

remy

---Page Break---

first really systemic effort in the history of planning and decision ma-
king in Puerto Rico--not only in the transportation fleld--it is parti-
cularly regrettable that it was allowed to become a victin of changes in
federal policies and funding. Tt should be reinstated in its full intended
Scope a6 carly as possible. The ?cost of no-action alternative?, though nct
quantified, are obviously very substantial.

In the specific context of TEC, Baseline IV cited in sec. 2.1, cor-
responded to similar system considerations. Polley planning elsewhere has
Roved in the same direction in the last few years (2+ 101 2s 35: 40:27:
22: et al.), At its low reaches, transportation system management (TSM)
is essentially a set of separate programs and actions with sone effort at
coordination. Combining TEC with air quality is very recent (20); yet
emicsion control tuning represents sone 758 of the total fuel econony achiev-
able through engine maintenance QON. Two TSH levels are cbvicusly ne

ceseary: (i) Trancportation system planning (as discussed above) and (14)
?Transportation system management in the narrow, operational sense. The
following set of figures and tables is an exercise in analyzing a very
specific TEC managenent problem--the reduction of fuel consumption through
?speed control--in its syatem framework. Tt shows the difference tetween
the policies, justification of the control measures, and the effectiveness
of such an approach as compared with single-track approaches to TEC
through traffic control and speed limit enforcement based only on traffic-
code ?rules of the read."

Figure 6 on the opposite page featuros the TEC-related components of

?the system in question (except driving while intoxicated; see Pigure 7 for this paraneter).* The whole system is schenatized on page 40.

VFIREG S uses the speed of 4Omph ac the average tage value. The nost fuel-efficient cteady speed varies in fact from stout 35mph ko about Usmehs according to the size and power of the autonobile, Experimental vehicles have shown even more dramatic increase in fuel consumption thi that chown in Fig. 6. Viking IV, which averaged 67, 5mpg during a cross country rally (Seilinghan WA to Washington DC\, achieved vest fuel econ? my, 109mg, at 35mphy at 4Ompg conaueption increased already by 12,28; at'70mph Uf was 38.8% more (Popular Science, January 1982, page 60).

---Page Break---

Sor sor 9% °9 og $9 ay kot wy

oe s9 09 5 0 Cr a)

?2 oanyg_aag

Tehatss ee

wor - $

sxovtcs puv sosst pot, vo0g ?sveuot wowestt09 (49)

~~ atapsa seduce pupae Crngatuy tion ?Aausnbasy Sonroy ote

2

ws AHL) S308 S2< sx0ATIP ?94 ~AVOP_¥ (QOT) Lats)

_ =. SoEdaooane gezom ?Aouoboas Aantu g (aCT)

svouduooqns a819K ?500907 GOTETELOD (CHT

vos ane a6 SETTLOD (CHT)

o/s

f7

wey x

f _ - Savoqiods 48iom ?sossot uoTsTTtoo (S22) __

822) BHO8 Sen B20N5 IP ?848 H2OE (3E2). (coreg 6)

(mns9idace = Berea? syueprooe

massruiscn =) oarteres ote

voce ana Porderes 0d Siguog

ny TeUOTSEU ?s*n)

SINRGIOOV NT Se USONGSSV 40 E2TS QNY SUBATHO JO SOV

SGILITVLYS ?NoIaWASNOD ?End ?aRSES 0 NOSTAvENOD

yar

---Page Break---

{Continued from

page 387

sn

& :

airecr DOR Hes,

onerey

EERsY Indirect agorneves

(ec) "ners

ArtePnate Paranal

use and neonttety

investnent, Egonomic

tart

Orne

*oriving waite

intoxtoatea .

4.9, Interpretation of Figures 6 and 7.

The inplications of U.S. national figures are even sore significant

for Puerto Rico, due to the substantially higher accident rates in all ?

categories, as weil ao the faster crowing fleet of subcompacts--especially

nodele with the worst collision safety record.

4.21 The apeod factor.

Figure 6 shows why low speed is also a proper target for TEC through ?

traffic rules, engineering and menagenont. Policy analysis and decision

aking concerning high speed are nore complex. There {s an alnost Linear

relation botwoon fuel diseconomy and the average rate of fatal accidents,

?This rate grows exponentially when low driver age, DWI and their conbina~

tions are factored in. It is paradoxical that a change in the fleet compo-

sition--the rapidly growing share of mall passenger cars--desirable from

the viewpoint of fuel economy, ie adding a aerioue accident factor, Ia

addition, the very fuel economy of small ears may be a disincentive when

At cones to driving at slower, fuel-saving epeeds. Thi

complex interrela- ?

?tionships, simply expressed In the schematic figure above, represent but

one example of the insights not readily available through eine)

hese

analysis, The resulting traffic managenent mandate then reflects the sev

val dimonsions and brings then into a common focus. TEC requires sh:

to sualler/lighter passenger vehicles. It should be fostered directly

?thrown excise tax, indirectly through gasoline tax. But this policy also

---Page Break---

ways

ert/oc cafes ?aaeas

FeroKT ap yoetageaias: Sonat

S8008 $¢-S2 ?Guowentoauy suaptooe

---Page Break---

ha

increases the governments responsibility for the prevention of the more

severe traffic risks. These mst be controled at their origins excessive .

speed and other traffic violations that cause collisions between vehicles

of increasingly disparate size and weight, particularly freight and pas-

Senger vehicles, Additional statistical data illustrate the last point

28 well as other aspects of Figure 7. a

4.52 Vehicle size. The most critical data are these:

+ The proportion of compacts and cubconpacts in the total fleet in Puerto

Rico is about two-thirds--almost 50% higher than the U.Scnatlonal ratioy

Cumulative data on 99K of all accidents (the U.S. Fatality Accident ¢

Reporting Systen) established already in 1975 that the fatality rate

gf ,oubcompacts was 1.93 that of full-size care. According to 1979 data,

S58 fatalities occured in srall cars that crashed with biager care

in crashes between small cars and truck 97# fatalities occured in onal

Tractor-trailers represented only 0.9% of the fleet, but were involved

in 8.98 of the fatal gecidenter the? fatality rae of Seick aie Nes .
Folatively low, even in collisions with other trucks. Of ¢ total of

oak fatalitios involving trucks (U.S., 1979), Lese that 7 (322) wore

4.33 Fatal accident rate grows' proportionately with speed beginning
at about SOmph/S0kah, The average U.S. ratio of fatal accidents to all
accidents 1s 11470; at speeds above 6smph it Se about seven tines higher,
1:67. An analysis of 270,000 accidents (North Carolina, 1973) showed a
fatality rate 15 tines higher at speeds above 50mph (28% of all accidents)
5 compared with accident speeds below J0mph (45% of all accidents).

4.94 Drivers below 25 years of age have a death rate 2.36 tines
higher than drivers 25 years old or older. Males below the age of 25 have
?almost twice the acoident rate of fomales in the sane age group (Dut algo ac-
count for about twice the YWTs.-95a). Drivers 35 years or younger are involved
in 36% more fatal accidents than those older than 35. The age separation line
of 35 years also corresponds to a sharp bend in the DiI-related curves.

4.95 Driving while intoxicated. There are interesting relationsh
Yetwoen DWI, age and accident involvement, with Important implication
for possible policy and law changes with regard to licencing (and su
Pension) of young drivers. For instance, the overall ratio of driver/va-
hice involvement in fatal accidents ie 1.3 (meaning that about 27% of

drivers in such accidents are killed).

to drivers younger that 25 years

KA1L 85% more occupants of the vente:

Sps

However, the ratio corresponding

is 2.4, That means that young drivers

?19s in collision, while they thenzely

---Page Break---

survive, than drivers over2s. (In comparican with the J5-and-older zroup,

?the rate is 100K higher, that ig about double.) The relation to DAI ip
AUluotrated ty thece Figures: the poreentage of OWI drivers under 25 years
in ali accidents (figures for fatal accidents alone are not available) is
36% 20 comared to 25% in the 25-94 years group, and an average of 10? for
drivers 35 years and older. That means that .6 tines nore young drivers
Anvolved in accidents are intoxicated. ae compared with drivers over 35.
?The statistically unavailable connection to fatal accidents is isplicit in
the fact that OWT is responsible for more than one-half of fatal accidents
overall: and that drivers in the 20-24 years group (12% of all drivers)
were involved in 214 of fatal accidents in 1979, i.e. 75% more than corr
Ponded to their nunber. It has been suggeeted that ?young drivers are
poasiply? less able to drive adequately azter drinking" (28, 42,52, 5b:
908 also reference * on page 45).

44.4 The corresponding scenario model

The following set of tables shows the development of a concrete cce-
nario based on Figures 6 and 7.

11 4s @ comprehensive policy analysis which integrates the control-
Ang data and paraneters in Figures 6 and 7 with other praviously cited

and supporting data and pareneter;

4.42 18 a conceptual model which organizes the policy data for the purpose of their transformation into a scenario.

4.49 18 the possible scenario matrix, the base for detailed recon-mendations of measures, combinations, sequences, time frames and f/o estinates, ag well as institutional responibilities and coordinatios

---Page Break---

os

os Poucy ANALYS/S

Y OBJECTIVE

control at the slow and the fast extrenes ie an dnportant

pouree =f fuel economy wid, therefore, one of the principal TB5

Zraffic engineering and managenent.

Driver education and warene:

Susperting Les

/rogulatory.

it setting, considering also the

oaramevers.

Speed lisit ontozcenent.

anisess In addition +0 fuel diseconomy, fast ceeds

enuse four-fiths of cevere/tatal accidents

Young age and intoxication are the princinal

cause of accident causing speeds.

In the absence of other braking factors

(rory nigh fuel cost; stringent traffic controls),

the Improved t/e of new, smaller cars could

act as a disincentive to driving at more economic

speeds.

Spall cars ouffer disproportionately in collisions

with bigger vehicles.

Trucks have an overall record of higher-than-

average negligent/reckless ariving.

low speeds and excessive idling (£0 seconds

Teting S-Weile driving 9 #36ch) are the source

of also another externality: the impact of the

increased fuel consumption on urban air quality,

Conclusions: The prinary objective of fuel economy needs to

be analyzed and attacked within the whole set

of factors and parameters,

?Three najor categories are involved and need to

be bazanceds ,

+ Technical fixes: improvements of £/e (decreased

Vehicte weight: better engines and traneniseions:

Rerodymamics, tires, etc.) independent of driver

Bekavior:

+ Economic fixes (gas-punp prices: taxes, dic-

Tneentives), indirectly driver pehavior

« Digect conerol of SSM RGIE® (huvan/eselad

?es

---Page Break---

4s

The resulting incidental benefits are secondary to
the sain TEC objective, tut important on thes Own--
ainly the reduction of the hunan and economic eoste
of severs accidents.

Teinforcenent of the prinary objective
land the ?secondary? control measures, ana the
total resulting pay-off, should footer positive
decision making and inolenentetion.

AlL other data and factors being comparable with
those in Figure 7, based on U.S. aa a whole (age
factor, Dill, proportionate growth of small car.
fleet, truck accident ratios--see additional rete.
Fences in Notes*), PUERTO RICO HAS SUBSTANTIALLY
HIGHER ACCIDENT? RATES:

FATALITIES PER VETOES AEGISTERED =
ATALITIES PER TOTAL ACCIDENTS
INJURIES PER TOTAL ACCIDENTS

A composite picture of a typical fatal sccident in
B.R. as culled trom police records Cite

Gaily press (1979-80), includes gone or sll of chese

characteristice,

+ Unlicenced driver + Yeers into the oppo-

: fag belo 25 (often site lane, causes

Excessive :

1 Early nome foure other vehicle

ESET Suneny, | - Ho "Incornation avattante

(probability of OM on charges against the

sharentty ifabie driver

Zigtes: Dik, South Carolina Commission on Alechol and Drug Abuse,

fcohol and fatal accidents in's.5., 1975-77. cited ty the tational

safety, Counc, 1979), a8 the contrailine? G8. stuay, Per capiva alco.

?ol consunption in P.R. and the U-S, is approxinatsiy equal? seuch

gocidentsr Listed athe top iseus for governnent savers reguteti ens

Srtevae 1ageteungjand,controts) ln warSe. tational traneportation

Policies through the year 929) spp. "48,239. De Frequent

falls for raieing ninioum age to 1d, Soec cal Peneoe eee reat

0 require minimin age 21 (in mid-1990). *

---Page Break---

CONCEPTUAL MODEL

opszenrves : ?TYPES OF Focus oF

+?????__| xos-zccnoxre CAUSES CONTROL,

PATPARY DRIVING MEASURES

ving fuel ty Exceeding Violation

initing driving

?speed Linke

at non-economic a ae

traffic

Laws

sSpeeding between

Semaphore.

- Prequert change of

lanes to pace

-"Beating" stop

Lights

Drivers: General

Trade

Youth eur

TOTAL, sAggreasive dri.

aansrontarron | || ?ving in general

EXERGY Drivers Leeneings

sedueation

Relatively ?training. | Standards

Low speeds attention | Renewal

n 2clene coats; | .0eial Routine 2apee:

on Btane condo: | ?Ee Rlae | RESIERGEESSS.

driving below poo- + Suspension:

fed opeod Lintt (or | ararqy ?Spae.condi tions

Feasonable maximum TAfficn

speed) in Left-hand! riaaineering

SeeenDARY y ratte

a fone nanagenent

= condi tien

indirect enerey]

Soctal/economie coat

Bas of

ACCIDENTS

Growing

punber

af Only 19% accidents or Les

gnall care

are ascribed to mechanical defects.

2 Possible contributory factors better surface in left lane:

---Page Break---

4

8 SCENARIO MATRIX

MAJOR CATRGORIES

OF

CONTRCE, MEASURES

?

NDIVIDUAL

?SEASURES

EstiMare|

AGENCY

PESPONSISTLITIES

AND INTERACTION

p SYSTEUATEG ENPORCHEN?

OF PRESENT TRAPPIC LAW |

aT OF a

NERGY-SENSITIVE.

VENECURAR SRASEIG: foo

a

PUBLIC TWPORMATION

AND,

CONTINUING EDUCATION

[See the follow

---Page Break---

48

4th Comments. The next step would be to enuzerate the varlous diserste measures under the several major categories, code then for easter handling, and estimate their direct effect on fuel economy or their influn ence (indirect effect) on other conservation meagures.

Comparable scenario matrixes could be developed with the help of the sane methodology with regard to ouch other TEC measures as are listed or implicit in Tables 2 and 3 (pages 21-23 and 30 above). These measures tend to fall into three major categories. The elaboration of the full al-?temate scenarios could thus proceed on the basis of the following four ratrixesr

A, Fuel conservation through speed control (the policy analysis and

conceptual model for which is developed above);

3. Transportation system managerent (ISM in the narrow sense, sce

4.2 above)

©. Euol econory related to vehicle equipment and maintenance; and

D. Cost-conditioned driver demand and behavior.

Several considerations add up to the conclusion that inatead of an exerel:
in detailed scenario construction conducted in an implementation vacun
it ts more useful at this tine to offer an illustrative open-ended list
of Reasures from all the four categories. The gelection of the ites for
Shig consolidated list has been determined by the oxtent to which shies
Sample could illuminate the opportunities for THC improvenents between
?now and 1985 on the level of SCENARIO II (sec. 3.5).

?te major consideration for this approach has been ctated at the out-
Set of this study (sec. 1.2)1 "the performance and priorities of the go.
Neminent of Puerto Rico in the field of transportation in general, and of
energy conservation in particular...favor an open policy approach ratnes
?Shan sore or less rigid scenarios based on too many undertain variables

and speculative assumptions. The situation would, of course, change as

S00n as the decision makers showed interest in the development and evalua

ation of concrete policy options and altemnative scenario,

As Table 2 shows, the initial payott of practical!

actions is patently very extensive. The prise purpose of the policy

ethod as applied in this study (the introductory explanation

2.2 and 1.3) Ae precisely to provide ab

?the progr?

sot of einp)

is in see:

for the selection, as well a»

"ively wore detailed (including quantifications) avalyere of

?he various concrete decisional options ag they nay becone feasible, me

---Page Break---

4

TEC monitoring curve over the first 18-24 months of application would

show the real effectiveness of the various ne

initial expectations. This would be the bi

selected and detailed stratesi.

sUF@B, AS compared with the

for further, progressively

A subsidiary eet of considerations is technical. Despite the apparent-
2y continuing faith of rany practitiones in the nagic of absolute nustore
arranged in reat colums, there has been = growing nunter of disappoint.
Bente in various fields, fron economies to environmental assessrent to
Ghersy Prosections. Experience has often show the useleseness of efforts
ke arrive at exact quantifications valid beyond the following ix te twelee
months. Even computers can not gimulate beyond the quality of the ras
fata hey are fed. (any of the data for Puerto Rico are insufficient or
Jacking, Including such first paraneters as the number of active venicnes
srygt Gkesel consumption in transportation in a given year; seca 1b] ane
2042s But ove also the sunnary conclusions in wee. 1.45, laat paragraph, +

favanced quantitative analysis has begin to leam fron this experience.

ihe Aasees prediction of crude oi price for 1985 ranges from 8397/0 (tne E(ntomporaneous average price) to $50/s, a margin of 358. the estimates seat derlying paraneter, the predicted U.S. econonte growth during ene four yasre in question, have a range of WOf.* It ig difficult to dee Shear Line of distinction between such gross estinates and the order of, magritude nunerical base of policy analysis. Except for explici? meine dolegy, the two appear practically identical.

T'RngrEy projections to the Year 2000. Divieion of Analytical Services, UsS. Department of mergy. Septenber 198i"

---Page Break---

5. THE Prospect

5.1 The decisional and implenentation environnent

?The decisional and implementation environment in Puerto Rico is unfavorable to any meaningful, systematic transportation energy conservation. Anything significant that nay appreciably reduce the excessive fuel wastage in the next several years will be the reeult of more or less autoratic adjustrents of the system to external crisis factore, not of any deliterate

Sustained government policies and actions.

5.12 The worsening situation. The basis and frame of reference

an effective TEC has, in fact, worsened even since this study was firet

Sentatively designed in mid-1979. At least four major areas or factors

can be pointed outs

(4) The loss of the rapid transit option. the importance of rail

transit lies not so much only in direct TEC, but in the viable alternative

it provides to mich commuting (Jobs, schcol) ag well as some discretionary

driving, If properly designed (as was, for example, proposed in 197: 23)

4% also physically controle private vehicle traffic and provides a rajor

opportunity for the improvenent of land use and the hunan urban environ

ment. The light-rail concept was, in fact, the main component of several

leading options in the last effort to put the San Juan ?Metro? on track

(ee sec. 4.1 and Fig. 5, pages 36-38). Even with the dubious original heavy

vail denign (1967) see 20), and despite the rejection of two private conatruct-

ion offers, San Juan was in the mid-19708 still one of the primary can-

@ldates for a federal grant. It could make a much better case than such

cities as Denver, ieni or Atlanta where new federally supported systena

were approved. The opportunity was aborted in favor of an all-bus alter-

hacive which was then not mple

in the meantime.

inted. New-construction costs skyrocketed

The najor consequences are not only thomrelated to TEC, nor even the Sockal considerations-~there are still close to 30% families in San Juan who depend entirely on public transportation. Rather, the most worrisore consequence is the drastic reduction and qualitative change of available options. The "Agua y Guagua" project 1s admittedly not a rapid transit, but only an incremental improvement of the present system. Even that ia un-Likely to be in operation before the late 1980s. Any major improvenent of public transportation in the metropolitan area, even without the rail conpo-

---Page Break---

rt, would require coparate guideways for buses on the express trunk lic

Rev, plus an elaborate integrated feeder systen of call tuses and pfbli-

sess Considering the lead tine, cost, Life expectancy and already tested

Rew technologies (trolley buses without an overhead wire, bi

avery 5-6 sles fer about 90 seconds by running through a catenary segment

Like that needed for light rail), the differences betw

?shat worked on in 1980 are not very significant.

recharging

this system ana

on the other hand, the coat or the no-action alternative, conpletely overlooked in present decision nakinc, io staggering. The nost obvious, ?hough not the only aspect ts the fact that the present tus/pfblice systen could cinply not handle even the minimum essential transportation requ! Fements in the case of any prolonged scarcity of gascline, it ie of 2ittle confors to know that the ane is true of several major metropoli- ?tan areas in the United States.

(14) Tassie lawlessness. Compliance with traffic laws was linked to particularly in Table 2, Figure 6 and the related text. Over the lest several years, enforcenent has dropped down to a level on which 1 nas virsually no seaningful relation to the need for control required by the principle of public order, not to speak of the additional enerey saving

Ginension. Yet, even erratic token enforcenent seened to have meaguratle effects. The following figures, related to speed enforcement on the two felt roads (PR 52, Expresso las Anéricas, and PA 22, Expresso De Diego) and on sho rural collector road which also have a pooted $5 mph Linit, illustrate the points

+ The average nunber of speed citations on PR 52 and PR 22 in the ca jendar years 1960 and 1981 was 21, 509 a year. An average 70,000 vortoin SEG fhe fot reads, each day. ?Monitoring has shown ?that over Be of them exceed 55 sph. This amounts to some c-§ million voliele feipo/year during which the speed limit is exceeded. The 21,500 cl- Fations ?thus anoint to some .355% of the total of violations. Thos it can be said that the enforcement is merels tokens

F roads (e.g, PR 30, Caguas-Hi

nce-Hayagtien: te.) nava'a trarfic di

Yehicie niles iravelied (ir) ainest thoes ies

Foads (73.58 of the conbined total); but only sone 30.a% of ?the ?eeeaL

}d citations were Leeued on th

year during FY 1980 and 1961). This represents a 50% vetter rate of

ton toll roads in terns of absolute numbers of citations,

* fhe severity of violations was appreciably higher on the collector reads: 124 more drivers exceeded 55 mph, as corpared with the sein Fgadsr almost twice as many drivers excceded 65 mphy and the tos 15% speeduters traveled at an average 2.3 moh taste

---Page Break---

Speed was monitored during day hours. It does not reflect drunken

speeding which occurs mostly during evening and night hours. Citations fare issued on a 24-hour basis. On the basie of this comparison, the rato

of citations, particularly on the collector roads, nay appear to te oven Jess adequats

(144) Decrea

?The pool of

ki11, caution and discipline of the average driver.

?cated drivers, regularly using their intelligence when they Grive, appears to have been stabilized at sone absolute nunber many years ago, while the total driving population has grown by several hundred ?housand. The practical collapse of regular traffic enforcenent has not only eliminated the constraints on naturally aggressive and undisciplined, mostly young drivers, but has also produced a completely new phenomenons ?the middle-class grandmother deliberately epeeding through a stop Light with @ station wagon full of school children--future young drivert cheering her on, if not also making threatening gestures at other drivers who barely managed not to get hit. This is not the kind of driving popu.

lation naturally inclined toward reasonably disciplined and intelligent driving style which alone could conserve as mich as 20% fuel for the sane total mileage driven. Only enforcenent and high enough cost (that is, gasoline tax) could begin to have any effect on TEC. Meanwhile, if the federal food money comes in a block grant and is distributed in cash, this will mean more money also for gasoline (not only $7 in cash for a $10 food cou Pon) and without even a shade of illegality.

(iv) The relative decrease of motor fuel cost. The price of gasoline

has beon otable or even slightly decreasing in the course of the last 12 te 28 montho. Even stable price means a decrease in the real cost, ince inflation hae been running at around 10% during this period. Although ?this ie most likely a temporary phenomenon, it sends totally wrong signals to most drivers, at least ag far as TEC is concerned.

5-12 Record of official TEC actions. Even the little that has been

achieved shows how mich could be done.

The record with respect to the 1979 conservation program (Listed on Page 27 above) is as follows

* A park-and-ride pilot program ended when the fede:
A SEEETSoSaapeten tases ebaten Conch reer eee
tine. At the present tis

Seland have regular vanpoo:

fed only a short

only two industrial enterprises on the

service for their employees.

---Page Break---

3

?ed-tumncon-right" law wes passed two years before the 1979

Evarlon program. Although She yield is cclatively Sedett: even

snis potential 5 not being achieved for two main Teasiner ti) Ieee
of funds for the necessary geonetric changes to provide a. free 10h
for tight tum eniys {iis Egnorance on tie part of afivers ae neh)
ae institutional nanagers, Por example, simple gurtace saseines Se
{yeee exits ton the io Piedras campus of the Iniversity would. so~
Wide free turning lanes; in their absence, hundreds of care sate
fuel every day ding tenind the first ar which Mat walt for the
wrarrie Tests

+ The system of ta gets
at tha Expresso fare io"ts a najor
achievenent due to. the past diffioulties with the underground? sont
gore, It has had measurable TEC impact, Sut much Fonsise $0 be Gone

sleewneres

Eublic transportation has not teen palpably inproved.

nile there has been a rajor shit to stall care (wich is probably

fhe one factor which has caused whatever reduction tn fuel bomueey,

thon cegured--see Figures I and J), 1t was not due to the reimeey

Im Addition, the government has conducted since the fall of 1980 re-

clinies as a part of 2 ?three-year progran designed to help

S%s reduce fuel consumption and cost by providing advice and techni.

?si assistance on automobile maintenance and driving habits, facta to be

lered in choosing a new car, and planning efficient use of the autono-

Bile to avold unnecessary trips." Sased on the number of pamphlets distri. buted in shopping centers, schools, municipal centers and private enter prises (which guaranteed the attendance of at least 50 persons for one day), it was estinated that some 200,000 persons participated during the firet 12 nonthe. Additional impact through spoken word was ascuned.cn the level of 200,000 conscious participants, the program would have reached less than 208 of licenced drivers. Despite the comprehensive description, the ini= ?ial progran was limited to fuel conservation through better vehicle maine tenance. Maste through indiscriminate equipnent use (for examplo, the use of sirconditioning without respect to the temperature or exceptional safety precautions or the failure to adjust airconditioning for the noat economic Performance when using it to reduce drag at a steady expreesway speed) or ?through uneconomic driving style was not included in the program. It may be added in the future.

---Page Break---

5.13 Institutional end other major o

factors, most of then dealth with in detail in the previous studies (23
?to 25), axe briefly discussed here to complete the perspective and to add
sore fresh information.

£) Tack of an institutional focus for policy developnent and ixpte
rentation in the field of transportation eneray-

(44) Major gap between available empirical and analytical knowledge
and the public capabilities to recetve and apply it.

(11) otter political and executive priorities, partly contemporary
(changes in federal grant policies), partly projected to 1964.

(Le) Strong vested interests. the private vehicle transportation sec
tor (PITS) As relatively stronger in Puerto Rico as compared with the U.S.
as a whole, The 89% of transportation anergy it conunes 16 about 308 more
than the corresponding U+5. share. Tt has generated a powerful economic
?motor-vehicle complex." Such a complex represented 23% of GNP in the U.S.
tn 1980. No euch global figure is at hand for Puerto Rico, but sectoral
figures Smply the size. Thus, the value of gasoline used in FY 1981 was
$575%, 60% of 1¢ supplied by an ailing saJor refinery for which this was
?the oniy reitabie source of incore. The outstanding loans in the motor
vebtele sector were alnost $600% the outstanding instalnent debt by buyers
was approaching $500M (P.R. Treasury report, 31 March 1961)." In a leg?
lative report on lobbying, prepared in 1978, auto manufacturers and distri.
butors, auto finance companies and gasoline station operators were Listed
as the thres ost intensive lobbying groupe:

(v) Transportation welfare system. As was pointed out in detail in the
previous studies (23, 35-38: 2b, 57-60), PYTS in Puerto Rico is highly pubd-
Ascly subsidized. This fact was considered important enough to TED t0 rr

mnt one of the four policy baselines (item ITZ, eited on page 11 above
only the price of fuel before tax has risen to its real narket level since
January 1981, when the price equalzation systen--the averaging of the pri-
ces of donestic and inported crude petroleun--was abolished in the U.S.

The result has been, In fact.a massive welfare systen in favor of private autonobiie owners. It has, for exanple, created unfair competition for public transportation the cost of whieh depends also on raising salaries

THIS Wictor received an unprecedented bo

vyerning the invogtnont in Puerto Bloo sf the soccalied "936" companies (See-eonp? subsidiaries of U.S. companies). Sma only exception fren the

principle that tne investment mist sein productive sectors was nade favor of financing automobile purchase loans.

pre!

st in the new regulations go-

---Page Break---

55

in. renard tohishway user eost, the tolle on PR 52 and 22 would have to be
ty 608 to cover the full ecet, including the debt service. (This would
core to slightly over 22 for th whole length of the Las Anericas expresa,
in 3.12 of the neurietic calowlation tased on a user-cost ana.
made for urban expressways in the UsS.s see 2k, 60, note.) With thie

wit

\nereace, the total toll income would rise to $33M a year; the direct

enefits to the driver

javings on fue, ofl, tire wear. naintenane:

Geprecisticn, travel time; lesser accident rate: convenience and

cendort~-were calculated several years ago at $80X a yoar: vy now the ton

1 cust be well over $100% a year. With reference to the whole road sya~

?to Rico, the user cost was estimated to be 25% lege than the

average user cost in the U.S. It was then (1978), based on the total of

excice taxes (vehicles, gasoline, liconces), an average of $233/vehicle/

year. the amount rose to $258 in 1929, but dropped to $236 vy 1981. The

vagcline tax hag remained at 16 ¢? since 1974. It represonted then about

4° of the pump price of & .50/sal. At the present averare price of $1.45/5

the ?ax represents only 12.5%. If it had kept pace with inflation, it

would anount in 1981 to come 26 ¢ per gallon: at the percentage level at

"it was enacted in 1974, the tax would be now about 68 ¢ per gallon:

© amount would still be in the lower range worldwisey gagoline

?taxes range between $1.59 and $2.25/gal. in many countries in Europe az welt ag in tho Third World.) Ae distinguished from the toll roads, the cost Renesit ratiofor the general highway user in Puerto Rico is strongly nega. ?ive. The average driver spends $950/year on gasoline. The latest studies (SE; 62) show that even on ?fair pavenent (as distinguished fron ?very food" or "good"), the average fuel consumption increases by about 354 on account of lost traction, uneven power flow through the drive train due to vibrations, and the need to periodically slow down and reaccelerate. Om subotandard pavenent, which is now connon on Puerto Rican highways, the tomcan Increase to well over 508. Taking the conservative lower figure Gf 35K fuel loss, the increased cost to the average drivarin Puerto Rico te $300/year, ?That does not include such itens ao the more rapid wear of ei Fes, danage to the drive train, shock absorbers, ete. A 10¢ increase in gasoline vax (representing only adjustnent for inflation) would cost the average driver 967.50 a year, but would yield 967.5H for road maintenanen, Sraffic engineering and enforcement, and leave a substantial sus for incre rental inprovenent of public transportation.

TE the toll road users were

charged the full cost, it would add another 11M to governnent inoomes

---Page Break---

and it would put an end to an irrational welfare-within-welfare system.

At the presont, the uncollected sargin of the toll road debt service cost

ts paid from the cagoline tax: the toll road users benefit at the cost of

alL road users. The road maintenance cost is covered from the general funds

witenoblle drivers benefit at the cost of all tax payers. Even if all

3 mony comes eventually largely from the sane pockets, it has ore

ted distorted cost perceptions w!

sh are a great cbetacle to any reform.

) Finally, there are two unfavorable peychologically legacies fron

the past. One is the exacerbated derendence on federal funding, This was

already critically analyzed in the 1977 study (23, 3-9). The Agua-Guagua

project is still expected to te financed by 80% federal and 20%

matching state funds. The other is the continued emphasis on supply-side

solutions (new energy sources), rather than on a balanced approach which

includes denand controls, that is conservation, Although the old econonie

srowth model has not deen valid for quite sone time, it is deeply in- «

arained in political thinking and in the expectatione of the consuer

Society. It is also more attractive to do prestige studies about energy

sources for the next century than to insist that drivers should not

?spend more than ten gallons of gasoline a week--and, in fact, make it aiffi- ?

cult for them to do ao.

5.2: Inplications for realistic expectations.

5.21 Be ?crisis scenario" which was tentatively defined at the beginning

of this study (Fall 1979; see page 32, Scenario I. above), played in part,

?ured out worse for the rest. Tho elenente of the present scenario ares

+ Rapid rail transit for San Juan was lost.

+ No bue-baged mass trangit is considered, In fact, the almost Sui

g.vaae (federal oubuigy (avout one-third of the ?operational cost)

Br the present bus service will be withdrawn beginning with FYi969,

and will have to be absorsed by the state government which already? Subeldizes the tus authority by another about Sue No substantial expansion or inprovenent can bo expected.

+ The ?publigo? system is effective, but is completely gasoline dependent,* inadequately regulated and supervised, and has been able Yo resist integration with the buses.

+ The publie, policy has not only accepted the excessive reliance on vrivate venicle transportation. bus has provided an unprecedented contive (aoe the note on page 54). The! extemal costs of this

course of action (see seo. {pGRLENGS, st) s Practically ifre-versible and contrary to any? conceivable Long-term transportation

[ihe note is on next page]

---Page Break---

3?

Policy, are being ignored.

"SOO etry Shy fateerertgtion tot eteh prtrace auscconhi, ne go-

yemment is unwilling to face the cost of thie system in serte ot

infrastructure, maintenance, traffic snginecring anda chistes

public order, not to speak of exeise taxes wich would aetineny

Promote conservation and provide funda for major Inprovenentes?® *

* Saving snything--water, electricity, money, gasoLin

integral part of the sdolal ethic, "re ons? ve tod

in the case of erectricity, only by adequate cout disineenttyy

5:22 The expectation, Ae far as public decigion making and actions

are concemed, the prospect is for the ?worst case" as defined in the

crisis scenario: ?nininus or passive response...; waiting for the crisis

to cone."

Any improvenent of the trangportation system sufficient to make it

operate ina manner which would contribute

?thal additional funds. me

coming from the outside.

5:2) Gongervation through automatic factors and technical fixe,

The public position means that thore will be no deliberate effort to fos-

ter systeratic TEC. It does not mean that the small gradual reduction of

fuel consumption will not continue. The following

?technical fixes are Likely to contributes

to TEC would require eutstan~

are neither sought internally nor forth.

automatic factore and

"Continued switch to small, fuel-efficient cars. Since about 90%

of ew vehicles introduced to Puerto Rico are non-1-S-, ery rete

27-2 wpe by 1985) would not consideraély affect the? situation here.

+ Progressive decrea:

will reduce, perha

Saft!

aes .

Tye closing of CoRCO"s refinery, announced in February 1982, shows how

the island supply is vulnerable evan if the contemporary glut Of fuel will

ot cause shortage of imported gacoline in a foresceabie future.

Took Amerease in gasoline excise tax, considered since the beginning of

1981, was presented to the Legislature in fetruary lose, sh

grease by S¢/gal. does not even adjust the

{see page 35 above). An announcement of an adequate tax increase to te

Agplenented in instalments and then pegged to the gasoline price 4s a ror-

gentace (a practice adopted by several states and in force in various

Hnobean countries), hae apparently never been considered. Yer, the aor

finuing price stability, if not slight decrease, makes the present tine

Fartioularly favorable for the mich nore substantial needed tax increase

See also below, sec. 5.3, (ii).

of federal transfer payments (welfare funds)

guite substantially, the total mileage driven

Plesoure driving and increasing vehicle occupancy for euesne

---Page Break---

+ tefortton omeemine futons wash satetantatty sect fuk com

iulsenattey sqpeurine seceare ghigh smetaraiatay tect tet

SEEHSCte Sete, © gPeeed and eho gine eeulont 22 oon

sal anil ae Shier itanatiniit nuiaowit Se

Be ctetacreddh Bed bert sfreepe eninge ewbeelaa sha

3 Soomeert Ci te ates cee) So cain tnpene a peretion

Ldual Level zZ

?Oved performance and soordination 0)

8 Of all the agencies involved (see pags

ary to get this message acres!

* Hygineering, fixes: sileage increasing gasoline additives and sotor

eile: up-shifting dashboard signals for nest effecient acceleration, ?

eter

vie

Alternative fuels: gaschol, ethanol, LPGe (propane, etc.). The:
Yay have at best a very small fractional effect in the foreseeable
future. in addition, LpGe are nest suitable for use sy comercies
Yenicles and fleets. 'It is being streseed in technical titerature
{hat the use of LPds requires ?many more precautions than in th
normal use and handling of gasoline; drivers must be trained £0,
avoid ?abrasive? driving.? ?A great deal of training would oe n

gessary, considering the widely noticed driving site? of wan
Puerto Rican truck drivers. ? ¥

* The slectric-hybrid vehicle, a good candidate for the fleets of

auch enterprises as the telephone company or the water and electric, authorities, or for use within closed compounds. (low speed, sncet distances, frequent stops), began to be tested for use in Porte

Rico, but'the project depended completely on federal funds, These were also terminated: a

5:3 More advanced affirmative 780 actions. ?

To do anything better than to repair broken roads and rely on autoz: tie fixes for some fuel conservation would require that transportation in Puerto Rico bo put on a self-suataining basis. That means that primarily

the private sector (but also trucking) would have to pay the full high- may user cost:

This is not ac difficult as it nay look. But it would require a

Passive effort on the highest levels of the government to explain to pri- vate drivere

(A) that they are in fact losing, by a wide margin,
?welfare? syston (see page 55);

(44) that and how they can compensate for even major tax incre
nore careful and discriminate driving. It has been shown by practical test

Ang that any average driver can cave 20% fuel vy following a few simple

Fules (which,by accident, aleo contribute to public safety and courtesy).

under the progent

2 by

---Page Break---

9

Since 20% of the current cost of gasoline is about 29¢ per gallon, the

Sax could be progressively irereased to 45 ¢n1., rather than the presently
Proposed 2146, without any effect on the total ywarly gascline bill. At ene
56 leven, the tax would still be Low in comparative terms, and it voula
Reduce gasoline consumption perhaps even by nore than 20%, Taking the 198)
consumption of 655 gal. as a tase, oven the decreasing consumption sone
yield at 600H gai. about $270K yearly: at 550M gal. Lt would anount to
247. sn.

Very sensible inprovenents would, in fact, cost much leas because the
various services suffer at the present tine only of lack of qualifies
Personnel and relatively minor saterial supplies. This ie true in partl-
cular of two services the increased efficiency of which would rake erent
Aifterence also with regard to TEC.

One is the traffic police, at tines with fewer than 300 patrol cars covering the whole island. Many severe fuel penalties anong those listed on page 22 above are also viclations of the traffic code in force. lerely teretum to the medivere enforcement levels of 5-10 years ago would re Present substantial contribution to TEC. rt should be determined why «ne system of citizen denunciations of najor traffic violations not observed by the police, instituted sone 12 years ago, did not function; it shovad Be properly reforned and launched. Alchough 1t would be a great inprovenent Af the police went by the law as it is, a revised traffic code would facili ane fe the Job by (1) incorporating technical considerations relevant to the present conditions, (14) making the fines adequate to the enforcenent neds, (iit) facilitating temporary or permanent renoval trom the highways of chronic Fepeaterand dangerous drivers. The traffic law revision prepared in 1978-79 (and not enacted as of this tine) was merely a coneolidasion of fhe existing statutes. It was inadequate in the terms outlined abover it was completely blind as far ae TEC is concemed.

The other service is tratfic engineering. Besides the obviously

led Geonetric changes, traffic flow could be greatly enhanced by car-

ful revision of existing traftic light series (even without the advance:

Seohnolegy used on Expresso Norte); shift of stop Lignts to internires,

fea/yeliow signaia, with a switch vack to standard signaling during hes

Sraffic hours where necessary (which means that sary signals oouid ren,

oo Rg internittont sode persanently): change of all possitie "Stop" si,

to "Yield", which ie the way they function in tae!

removal of all nuisance

---Page Break---

signaling (e.g. left-turn arrows: these should be replace wherever feasi-

ble by intermittent stop-and-go signals), and perhaps still other measur

Drivers should be encouraged to suggest possible flow improvenente.
Simple interagency agreenents and administrative eotions could bring

about many measures making traffic nore legal and therefore favoring 750.
For exampl

+ The problen of running red lights (see the fuel diseccnony

on page 22) is that many drivers do not obey--or even know

?Llow-light signal requires the driver to slow down to stop. The

law gives the driver too much discretion. Traffic engineers have dig-
nified it in the concept of the so-called ?dilenna zone.? Most dri
vers face in fact no dilemsa. They simply charge forward. Until a
solution 1s worked out waich is appropriate both technically and
legally, a simple expedient could be worked out between traffic en-
gineors? ana police, and given adequate publicity: a yellow line,
Painted at the proper distance from the intorsection would eli
te the ?dilemma? and advise the driver that, if he already ero:
EE wien the yellow signal cones on, he can proceeds if he didn
12 must stop.

?til a functioning computer menory can quickly identity repeated

violations, T0P, the police and the courts could establish a aysten

Of punching a hole in'the venicle or driver licence whenever 2/noe virg violation is established either by paying the fine or by cons viction in cours. 8

+ the yery fuel-coutly heavy rush-hour traffic can be aliuted by ge-

neralining the aysten of foxibie working houre throughout the £9. Effective enforcenent of Lega parking (aolf-liguidating throu Hie, Hlnee and ?owing ava. charges) ands, ax on toga paring feos invoongested areas sould greatly? conetituse eo ised ERE, £ flow (not to speak of pedestrians): mes

+ trough a simple adninistrative decision, knowledge of basic prin-ciples relates torte through driving supe could? te aaied to" the Fequirenents for learner perait

shone

?driver Licences and their rencv

+ Last ut not least, an extensive urban piblico" system in San cuan, esa crowded (enforced naximus secuparcy) and operating Longer houre, would provide the fuel-efficient flexibliity and decentrals? ted private initiative the public buses cannot provide. However, it would have to be planned and coordinated, not just allowed to spring Up and then legalized ex post.

Tables 2 and 3 (pages 2if. and 30 above) provide the elenents and Justification for numerous other measures and combined subscenarios of + orderly and deliberate nature. To follow--that ig, to let happen--the crisis scenario will not lead to a collapse of the systen. It merely inv tes ad hoc, mostly spontaneous and disorderly adjustnents at considerable human, social and economic coat.

---Page Break---

a

APPENDIX

Note on the calculation of scrappage rate

a5 the base for estimating the current active fleet in Puerto Rico

Serappage rate is the percentage of motor vehicles discarded ina year. An 8? rate has been used in the U.S. national eta-tistics. In the absence of more precise different figures in Puerto Rico, the 8 rate was used to estinate the active fleet in a given year, between 1971 and 1977.

Tt has been the practice of the Bureau of Motor Vehicles (2Kv) ?to consider a vehicle active unl

Ate licence is not renewed

fon two consecutive occasions. (Even then a vehicle renaing in

?the register for additional five years.) This means that all ve-
hicles discarded during a given year are included in the total
active vehicles until next 30 June. Some vehicles not renewed at
fend of the preceding FY say be activated when their owner returns
to Puerto Rico, or when they are repaired/rebuilt, Exverience of seve=
ral years could produce an?expectancy rate? for this relatively
?onal group. The key to a reliable estinate of the whole really
active fleet is a reasonable accurate estinate of scrappag

In 1973, the official serappage rate estimate was rail
to 108, without any explicit or obvious rationale.

When it appeared
to result in a too low total of active vehicles, the rate was
@iscreticnally lowered to 5% in 1979. This is apparently the rate
Used in the 1980 estimate. +

The following Figure 8 shows the recent history of vehicle
registration figures in Puerto Rico.

On the basis of a preliminary draft of thie Appendix, BMV began in 1981 to use the rounded trend rate of 7.5%. tho "recalculated total for FY 1980 of 1.133M venicles, and the eotiaate of 1. isis for FY 1981 are, however, still gone 15% too high. Zo arrive at Correct figures, it would Se teccsaary-c0'ge So af Ieeet tony and calculate from then on, adjusting the trend rate ae proposed in the formula on page 53 below:

---Page Break---

(62)

FIG. 8. VEHICLE REGISTRATION (P.R.)

(000)

NEW TOTAL VEHICLES

REGISTRATIONS REGISTERED

us 7 > aso

no = = 1100

105 =~ = 1050

yoo -? = 1000

95 959

0 900

es 850

80 ° = 800

a6 77 17819791980

PRIP_ Puerto Rico Planning Boara

?SP/DK PR. Treasury via PRIP

PCB VS. Consus Sureau via PRIP .

BPPR Banco Popular de ?Progress in Puerto Rico"

ly) and other consolidated figures

Unported (new and used)

8 taxed (import excise tax)

Comments

@ Wote, the discrepancy between new registrations and

9 the increase in total. vehicles registered.

Vehicles taxed > vehicles Imported (by some 40,000)

Comparing the rate of imports and of taxed vanie~

Jes with the official estimte of the total fleet,

the Gap marked a8

nt nost of that part of the total

flact that was reactivated (ire., repaired or re-

bulle) after an at least two-year Ispae in ative

Pegistration.See the comment on page 64» 109.

The estimate using acrappage trend rato? (roxt page)

fe only 4,000 vehicles (00-52%) higher than the

srph flatts ?of 3691500, (Pr'6o), En C490, the "eal.

ulation ie only 3000 vehicles Lower than? he 3P2

Heute of ¥78:U0b fora total margin of error t 88k.

would repre

---Page Break---

8

?The following formula was developed using the conflicting avail-
able data, with the agsunption that by calculating every year
?the serappage rate for the preceding year, it aight be possitle
te develop @ trend rate which would allow reasonably reliable
current estinates and projections.

Tf vehicles decone inactive after failing to reregister

for two consecutive years, the serappage rate and the estinated

state of the active fleet can be determined ae follows:

92 ye my Ry

Ayo Ny) - os

mere

S = scrappage rate

AS = scrappage trend rate (i.e. the average of several

previous years, corrected to reflect new paransters,

2:8; Ancrease in old voniclee being rebuilt and ty

activated after a registration lapse)

total vehicles in the register

fotal active fleet

fetal new registrations

She year being calculated (consequently, y-1 is the

preceding year)=

cupe

Thus. for example(in thousands of vehicles)

Spq * (901 » 108) - 934 = 75 = 7.43% (of 902)

For 1979, the rate 1s 7.518. The official figures for 1977 show

only 4.758 rater however, if the trend of FY 1977 to 1979 ie

projected backwards, the rate 1s 7.58% if the 1975-1977 trend

in vehicle imports is sinilarly projected, the rate is 6.636.

Using a rounded trend rate of 7.5%, the estinated number of

serapped vehicles in PY 1980 would be 72 (960 x 7.5). The esti.

mated total active fleet would then ber

Ago = (960 + 87) ~ 72 = 975,000 vehicles

Adding a purely hypothetical 25,000 vehicles as having been re-activated during PY 1980, after not being active for nore than two years, the maximum estimate total of active vehicles is 1,000,000. This {9 150,000 less than the official estinate. in order to arrive at this estimte of 1,150,000 active vehicles, it would be necessary to aasune that the scraprage rate was only 58 in PY 1979, and 2.76 in PY 1980, that is about 65 and 35% respectively of the historical rate. To justify the official esti«

---Page Break---

oh

nate, it would be necessary to cubstantiate that between 35 and 40,000 vehicles were reactivated in 1979 after being out of circulation for over two years; and that the number for 1980

vas between 79 and 75,000. *

Too high official estimatesof active cars are apparently
not unusual. The 1980 estinate in Puerto Rico would be 15% or
nore above the corrected trend estimate. In United State as

a whole, an overestinate of 12.3% was found in 1977, comparing
Federal Highway Adninigtration data with those developed at

Dot Transportation Research Center (IIs, $3-12). Difference esti-
nated two years later was ?up to 12 (18, 5-26)

FTE estinated average life exnectancy (that Is, the age which

of a given year reach oF exceed) of
and light trucke wae tyoleally calculated to be 10 years
or 100,000 miles (16,2-20, based on U.S. statistics 1966-77).
Recentiy it has boen raised to 125,000 by sone analysts (@.g..
72,5) and up to 18.5 years (the advertised life expectancy of
FAighaquality midaize Suropean car). The longer vehicle life
ray require major repaire in the final years. These are unli~
Rely to deactivate the vehicle for nore than two consecutive

years, except in sore unusual eases.

---Page Break---

sir

ir

PP oe

SOURCES OF REFEREXCE

American Automobile Association. Your driving cost. 191 ed.

Auspanaler f+ et al. The urtan transportation systems Polities and

and policy innovation. Cambridge (iele7.1 19%

Angome Mational Laboratory. | Prodectione of direct energy conaumpt-

Yon'by nodor 'Lo73-2060 Eaaelings heetsy fost

Peyry, D, The eagoline siteace took. Shell ?012 Co.7 Anewer Book

#5. ?houstan Bie 38,3

BAC. TLL, ?American tn transits A setage to the new on

Transportation 84, Sunace 1575 bb,

Brom Ti8:,0t,1: Bunning on empty The futuro of the qutombite in

av olbsanart words Hon tore test

Sygea Baqfow to drive smarter and save gas (Pive-rart series). vss.

B08 (Greice of Pintle Rrtetrat ?asne 1588,

Cappel 3.. 4 D.¥. Reinfurt. Relationnin between driver ersah

injury aid! passenger oar weight, chapel Gill Woe Neeeeee TaeS

Capter Lis. The big shortfall in auto fuel eecnony,? selon

?2g, 13236 TIPO,

Cocper Mik. snd J:0. Wldinger. ?Integration of air quatity and trang

Rorigtion planning.* Report, alr Peliution ontrol ater amngat

Heoting, ?clneinnati of sins $3568

Prorgy Rovearch Council. the taport by the Federal Taak Force on

soter vehicle go1ls boyemisel, Waskineton Gone)

Ford Foundation Shergy Folicy Project. A tine to chooser énerica'e

nergy futures Gaadelage Bas aeE*

srgh A: 4.1, Bishop. Anatyais of fuel savings through reduced

speed Limits. washington (hita): Dees A595 Sey Turn eS

EEE GOEp: jReperton the coat of owing an wtdsabite en 1979,

iow York. Juiy"1se8"

"envy Lose Data Ingtitute, laine frequeney results for 1977 and

Lore wodete:?waanineton‌s sestadtee USNS

Tete SAt°qsBMe sneurence Iossess Coliseion coverage. Initian

Feaults for 1560 models end ESSE"

Tngurance Institue sor Highway Safety. the Mighmay loss redvetions

Status report, KIV/S.? Wasningson,? cote Ne!

Rupp G.08,91, transportation energy conservation data books diction

fe Rida ois "RIEL Oh sE5hs eptonior iodo nego eke Magy

Tandsbere HH. (ed.s Resources for Future). shorag,

Yearecy Cambridge Har Eg35°

Mayda J. Environment & resources Pro conservation

Rfo Piedras Rr 1367" T9se"

Gent (econmnageeatyfnatétutionsl tranenork tor environmental manage

ment se°guaraeerent).~ (19761. tne Legal protection oe the ann ee

ment in developing countries, 11725. Wéxles Behe 1st6*

3.

?The next twonty,

?to ecomanagenent

---Page Break---

esoy

a

6

vayda J. "Eeolosy of change? [29/47. Ini Creating the futures Agendas

182 Loncrsins ?dolunbus SH (Sateolie Insts) 2973.

??. san Juan Transits Outline of a policy analysis for dectston

Taving. GE5R. Getober 1977.

=, meray conservation in transportation in Puerto Rigor

Tooticy study. ce8Ne9, Cetober 1978 [CEER-X-72, June 19797

???. Poticy #4 Dy Cutline of a methodology with reference +9
decision eakisein she fields of enecdy. srandportation and
Snvironment. REN Aou9, august 1979.

??. "Brvizonnental inpact assessment as an instrument of public
Bebigys? fe Eigpocto. Dopartonente de Recursos Haturaies. San wath
1980, ppe 1-2be

(U.S. Moter YohSelos Manufacturers Assn. Motor vehicles facts and
Figures, 1978.

National Acadany of Selence. See U.S. National Academy of Science.
Rattonal Safety Council. Accident Facts - 1979. Chicago IL.

+, Factors contributing to the decrease in motor-vehicle

fatalities from 1973 t9 1977. Way 1979.

National Transportation Poldey Study Conmigsion. National Transpor-
Yation Polistes through the Year 200,? Waghingten, June 1979.

New Sargay. Dopartnent of Trangportation. Mew Jersey Transportation
Pian. September 1979 (draft).

Now York Tines (file)

O'Conner T.P. & AS. Toebl. "Data requirements for transportation eneray conservation research.? Conference on Technology for Bnerey Conservation, Albuquerque NK, January 1978.

organization for Economic Cooperation and Development. Environment Directorats, Policy toward the creation of vehicle-free areas in cities. Paris 1972.

. Managenent-oriented urban transport policies to improve
che environment. Doc. ENV(78)18. Paris 1978.

O'Neill B. ot al. ?Relationships between car size, car weight and
dpash thjuried An ear-torear spvshee.? TIL. International Congress
on Automotive Safety. San Francises, 197%,

?the effects ofvehicle size on passenger car occupant death
rates," Passenger-Car Meeting, Society of Automotive Bngineers.
Detreit, September 1977.

Page, 5, G. "Speed te the name ot the cane." Technology Review,
August-September 1960, os

Pollard J. et al. A summary of opportunities to conserve transpor-
?tation oneray, ?Washington (U.S. DOT, Office of Transportation
Energy Policy) August 1975.

Portland OR Enerey Conservation Froject (vartous materials). 1979.

Puerto Rico. Administracitn de Fonento Eeonémico. La movilldad
Taboral en Suerte Rico, San Juan, bay 197i.

---Page Break---

PS BP BBR EBB EBS ERB REE £ &

Puerto Rico; Departamento de Asuntos de Consunidor. Oficina de Edu.

factgn. Al auton6vil y el ahorro de conbustitie. ?Gutliaes of cen

lectures to youth leadars.] San Juan. ed. (1969),

Freairekepaztanonto de Transportactén y Obras Piblicas. Autoridad

$e Gaureteras. Estadfsticaa relacionadas con corretersa. Ate Teed

579.80

Tre Sin Zighvay,tthority. Transportation system Management for

the SiMAr 1976-80. April a975-

32 SERPS del proyecto de transportacién colectiva répida

Para el Area Hetropolitana de San Juan. (Reve) Soper Layre

Finn? ig izepoditan Sus authority. ergy Snergency Contingoney

Plan. Novenver 1979.

Giro Znbfleine de Erergfa. conservaeitn de enerefa: Un conpro-

iso con el futuro de Puerto Rico. July 1978"

Sey Topol Politica energStica de Puerto Rico: th priner paso.

May 1979.

T+ Ea situacifn energética en Puerto Rico on 61 1978. June 1979.

<., Bstadfsticas

ral 1980.

re el yetrSleo y sus productos: Aflo natu-

indieadores cnorgSticos mnsuties de Puerto Rico / Monthly

energy indicators, Decanter 1960"

~fuip dsel@? PT*eios de easotina el nivel de consumider (Cot. 1980

?uly 1981).

Ahorre gagolinar Ahorre dinero {Information folder]. Ned.

(2980),

{Planning Board. Sactoeconi

Fiscal yoars 19ho to 1980.

Statioties on petroleum products and motor

Informe social 1960,

Robertson 1.5. & S.P. Saker, "Motor vehicle izes in ikMo fatal

erashoe.? Accident analysis and prevention (tendon), Vere" (3576).

Rutz A&P, talscain. ?snergy a

Ricoi An input-output approach

statistics of Puerto Rico:

nleles. 1979.

Beonomic developnent in Puerto

Carivvean Studies, 17(1981)115,

San Juan STAR (file).

Shackson RH. Asgeagnont of opportunities for conservation in the

Srasportation sectors and strategies for implementation, Papen

Prepared for Energy in Puerto Rico's Future. See 12 belo

Schurr S-H. et al. Energy in Anerica's futures The choices before us

Baltimore (Jonna Kopkins) "2979.

Stanford Rosoarch Institute International (by R.H. Thulllier et al.)

4 methodology for making a quantitative asgesanent of pascenses

transportation altematives. April 1373. Uoaste Tost,

Stobaugh R. 2D. Yorgin (ods). Energy tutura: Report of the Energy

Project at tho Harvard Business Senool. lew York i995,

Syaten Design Concenta (by i. Petoreilia et al.). operating multi-

Boda urban transportation systens, washington (oes ONf. bees i977.

---Page Break---

g

Bp Ss

62,

2.

De

BR

cm

2

Ds

he

cry

2B

2

Au

ey

aa

2,

eh

2B

cy

MultSeystem, Inc. (for International Taxicab Assn). Taxis, the publie and paratransit: & coordination orimer. Distributed by B'S, Bot/Technology Sharing Div. , Aug. 1978.

Road Information Program, The [TRIP]. The effect of substandard roads on vehicle operating cost in Colorado, Washington, June 1980.

?The effect of substandard roads on vehicle operating cost in Masgachugsets. Washington, August 1980.

U.S. Congress. Congressional Budget Office. Urban transportation enorayr the potential savings ef different modes. Decesber 197?-

???._ Transportation financer Choices in a period of change. March? 1978.

????. Guidelines for a study of highway cost allocation (As required by Public Law 95-599). February 1979. See 117.
The decontrol of donestic oil prices: An overview. May 1973,

???. The world ofl market in the 1980s: Implications for the United States. Yay 1980.

/ Office of Technology Ausessment. Snargy, the economy and mass transit. Decenver 1975.

. Technology aesesenent of changes in the future use and acteristics of the automobile transportation system. 1979.

. Gouneil on Environmental Quality. Regulations for imple-
Renting the procedural provisions of the National Environmental

Polley Aot. 43 FR 55972-56007, 29 ov. 1978; WO CPR Parte 1500-1508,

U.S. Devartnont of Conmerce. Sureau of Cens

Of the United Seatea. 1980.

U.S. Department of Energy. Environxental development plant Transpor-

?ation prosrams. April 1979.

How to save gasoline and money. May 1979.

A technology assessment of productive conservation in urban

?transportation: Froject description (Doc. DOB/BV 0070). Dec. 1979.

? Securing America's enersy future The national energy po-

Liey plan? (Report to Congress). duly 1981.

???. meray Insider (biweek1y).

Statistical abstract

??/_ morgy Information Agency. End use energy consumption

asta Sage. Sefies {1 Tables. June 1978 ®

Annual Report to Congress. 1979.

???,, A comparative assesanent of five long-run onergy project

ions (vy A.S. Kydes et al., Srockhaven National Laboratory). Dec. 197

7. Bhd uge enerey conausption data vases Tronsportation aec-

tor (by J.N. Hooker et al., ORNL). February 1980. ms

?. Energy Facts Sheets. Auguet 1980 -

Monthly Energy Review, February 1981 (Bxecutive summary

of preliminary 1980 data).

U.S. Department of Transportation. Parking managenent policies and

?auto control zones (by iletropelitan Washington Counell). Peb. 1376.

---Page Break---

U.S. Department of Transportation, Potential of non-construetion methods end their Implications to reduce congestion ind save energy major U.S. airoorts (with 5. DOB). 1977,

2, ???. Transportation energy initiatives Summary. Aucust 1979.

Bh: ??~-. Trucker's guide to fuel savings (Publ. HS-805-256).Mar. 1980.

9%, ????, The car tock: A common guide to car buying. 1981.

cn 7 Fedwral Highway Administration. Right-turn-on-red. Vol.T1

technical report (sy He. ?legen et ales May 197E:

4, Highway Statieties 197%.

25a 1977 Nationwide Personal Transportation Study:

Report No.1 Characteristics sf 1977 licenced drivers and their

travel. Ostobar 1980,

240, dem. Rep. No. 21 Housenold vehicle omership, Decenter 2980.

Ha. dom. Rep. tio. 3: Purposes of whicle trips and travel. Dec.1960.

26k: Idem. Rep. No. by Home-to-work trips and travel. Decenber 1980.

2: ~~ "7, National Highway Traffle Safety Adninistrotion. Another

look at car uize ard sefety. Ootover 1973.

28, ~??. Three ulus for paxinin tire Lis, tneluding load and

Figtion tabtea (face sheet). Wareh 1055" Coprintea Sytssety

See

2% T=. A atatiationl relation between car weight and injuries.

Peoruary 1573:

10, =. The Life anvine benefits of the 55 moh natlenal speed Limit

port, TATSA/FIIA Tati Forse le Sstaber foeht

Io, ==. ?Bremsy conservation coportmities for the in-use autensbtte

flowt; | Draft Tackefores report (oy transportation gyatens tenes

Gaabriage HAY. dnuney 1985.

102. ???. driver enargy conservation program (Peospectusr ty J.W.

Boorhird): ed. (ise5), * *

13 =/ Usban Mass Tranatt Administration, Guidelines to reduce

gneray censtunption through tranapsrtarion? aetlons {Oya wefoseee

Resee! SSay bone

ot, Eransportation Syaten Managements The record and a Look

shad: Janusey i3re:

05, Tranoit actionss Techuiques for inproving productivity and

Performance. Workbook (uy Public Technology, Ines). Setter A979,

106, ???/ ofeiee of the Secretary,

changing America. February 1993,

202: U.S. Emergency Bnersy Conservation Act of 1979.

?Transportation policy for a

198, U.S. Environmental Protection Ageney. The need for and tenefits of inspection and maintenance (F'# ¥) of in-use motor vehicles (8.P-Walah, ed.). Sovenber 1974.

Parking managenent strategies for reducing automobile enissions. September i976. ?

Research outlook 1978 (by Office of R & D). June 1978.

---Page Break---

BREE EE

& BE

EE

U.S, Bavironsental Protection Agency. Hydrocarbon control strategies for gasoline marketing cperatisns:, Deer wse-37B0017" April 19s) (with u.8. SORTA: by Canbridce Syetesation)® Decentes 15

The alternative 1s conservation. August 1980.

+ EPA/DOB 1961 Gas mileage guide.

B.S. Bnerey Polley Conservation Act of 1975. P.L. 94-163.

S. Energy Research and Development Administration. Transportation nergy Conservation data beok. Ed. 1 (D-3. Shonka at al.) October 1976. Supp. IIT (k.S. Loebl), May 197. See algo i

U.S. Surface Transportation Agsistance Act of 1978. P.L.95-599.

U.S, National Acadeny of Science/Transportation Research Board. ?Transportation programming, economic anslysis and evaluation of energy constraints (TRRecord 599). Washington 1976.

Urban transportation altematives: Evaluation of federal policy. (Spectal report}. 1977+

7 Committee on Nuclear and Alternative Energy Systems (CONABS). Energy in transition: 1965-2010. Washington 1980.

/ Energy Engineering Board. Committee on Future Energy Alter~

natives for Puerto Rico, nergy in Puerto Rico's futures .

Wohl M. ?Increasing the taxi's role in urtan Anerica.? Technology

Review, July-Aug. 1978, 45-53.

---Page Break---