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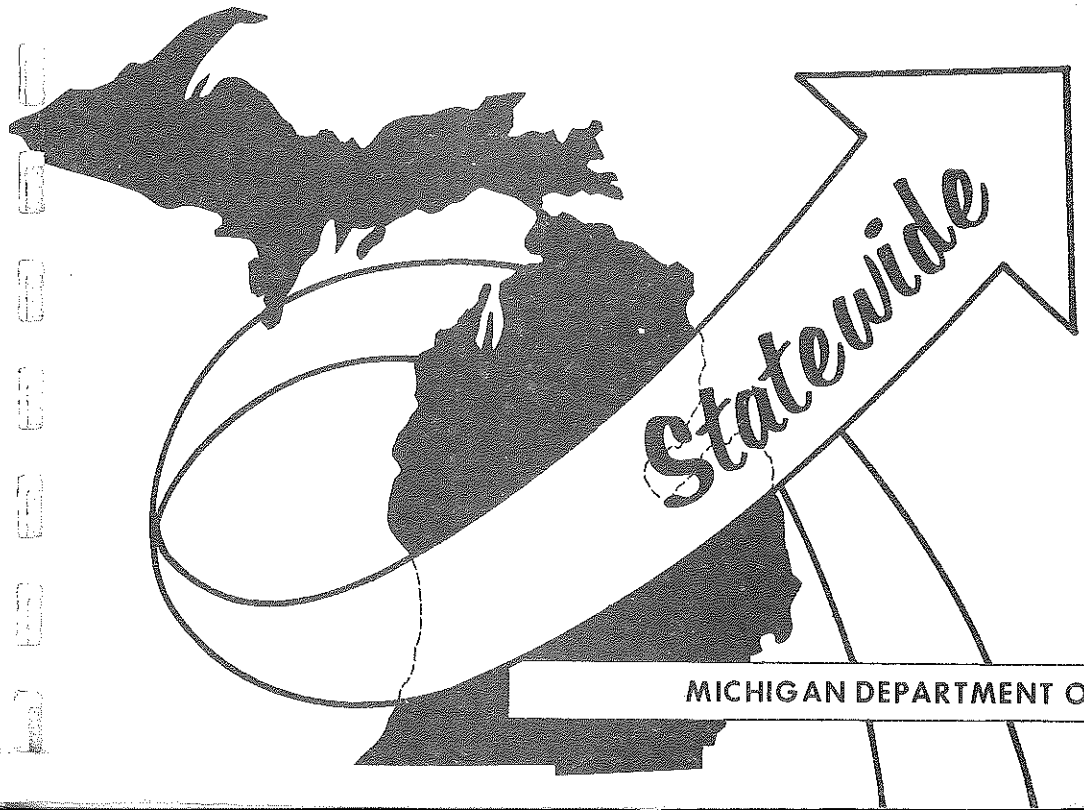
Statewide Transportation Analysis & Research

LONG RANGE
TRANSPORTATION REVENUE
FORECASTING

Volume XIX

September 1982
Transportation Planning
Procedures Section



MICHIGAN DEPARTMENT OF TRANSPORTATION

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF TRANSPORTATION PLANNING

LONG RANGE
TRANSPORTATION REVENUE
FORECASTING

Volume XIX

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Procedures Section

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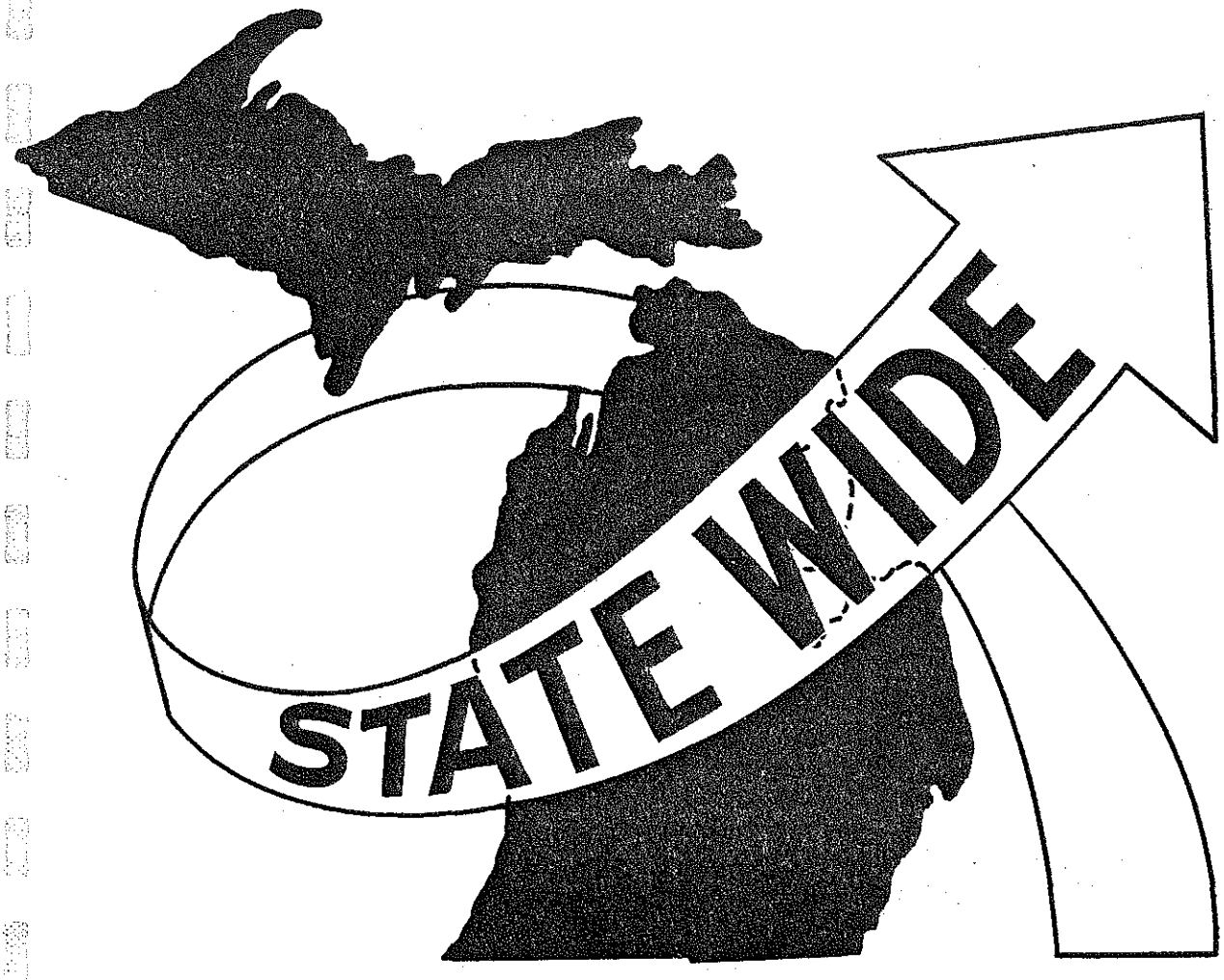
LONG RANGE TRANSPORTATION REVENUE FORECASTING

by

ALAN R. FRIEND

INTRODUCTION



INTRODUCTION

Characteristics of society, transportation, and the economy, which suggested the present forms of taxation to finance transportation, have changed. However, the taxation schemes in Michigan have not changed. Revenues from these taxes are decreasing and are expected to continue decreasing while costs of providing transportation are increasing. Revenue decrease and cost increase estimates have become extremely important so that ways of dealing with these problems can be addressed.

Revenue forecasts have traditionally been prepared for the Department by the Bureau of Finance's Dale Bock and John Dorsky. These forecasts are based on vehicle registrations and fuel usage trends. Long range forecasts are produced, but the primary emphasis has been on short term forecasts for budgeting of the next fiscal year and for keeping watch on the cash flow situation.

At the other end of the spectrum in the Bureau of Transportation Planning, Charles Carroll and Richard Lilly, both now deceased, played an important role in focusing on the need for long range revenue forecasts for transportation planning to use as a compliment to transportation needs studies (i.e., comparing estimates of revenue needed with revenues to be received).

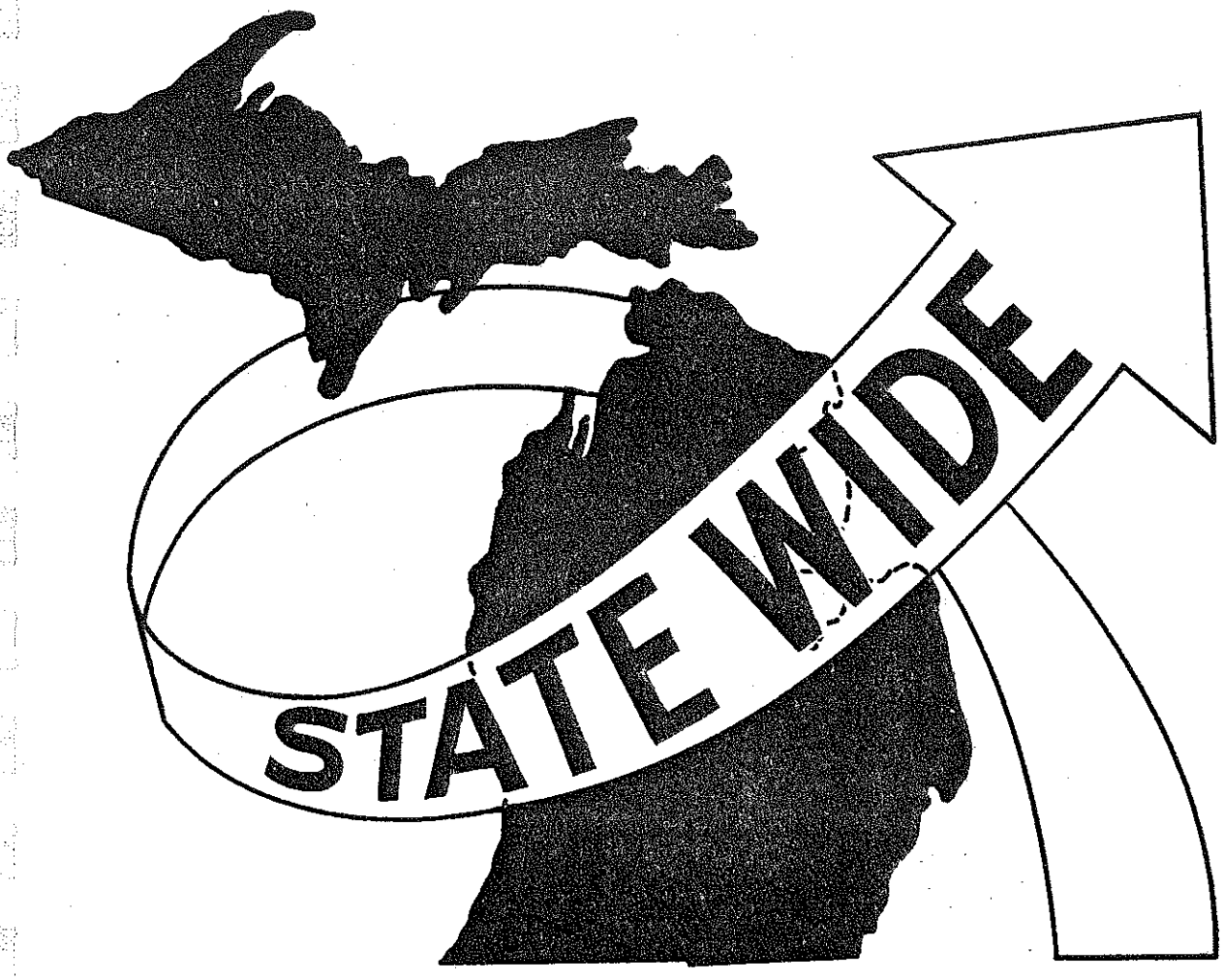
These early methods were similar to the Bureau of Finance and were based on the recognized increasing fuel efficiency of vehicles and forecasts of travel which produced forecasts of fuel usage. The fuel usage could then be applied to a per-gallon tax for the revenue forecasts. Weight tax

forecasts were based on average fees per vehicle and estimates of future vehicle registrations.

The cooperation and assistance from the staff in the Bureau of Finance has contributed significantly toward the completion of a computer-assisted revenue forecasting process that can be used in a "real world" atmosphere.

GENERAL

INPUT-OUTPUT



GENERAL INPUT-OUTPUT

The basic results of this process are revenue forecasts from gas and weight taxes. Input requirements are some type of tax structure and a forecast of several transportation related variables such as vehicle registrations and vehicle miles of travel. The results can be presented in a simple list such as Figure 1, which shows by year the fuel tax revenue, weight tax revenue, other revenue, total revenue, and the percent change of total revenue from the previous year.

All output results are stored on computer files which are later used as input to report programs or graph programs. Figure 2 is a line graph of the revenue from Figure 1.

Another graph (Figure 3) shows a percentage comparison to 1977 for not only revenue but for two transportation related input variables: vehicle miles of travel and passenger fleet miles per gallon (MPG). The graphs can be used for in-house projects or more professional finished reports. For a more finished report, color reproductions are available as seen in Figure 3A. The color diagrams are made from a 35 MM slide taken of a color graphics computer terminal. Figure 3A also shows an additional output option expressing the revenue adjusted for three different inflation rates (blue = 0%, yellow = 6%, and red = 10%). Figures 3 and 3A will not have the same shape curves since they are for different tax alternatives.

The transportation revenue is divided between state and local agencies based on a percentage split after certain deductions. Figure 4 shows the

TRANSPORTATION FUND FORECAST

YEAR	FLEET		REVENUE				
			WEIGHT	FUEL	OTHER	TOTAL	% INCREASE
76-77	4890094.	987822.	$164,940,827.90	$425,950,748.30	$15,554,381.40	$606,445,957.59	0.00%
77-78	5126907.	1081990.	$174,361,567.56	$438,474,353.89	$17,409,791.00	$630,245,712.45	3.92%
78-79	5162138.	1122898.	$235,652,470.46	$503,404,363.86	$22,315,860.34	$761,372,694.66	20.81%
79-80	5220972.	1095634.	$236,391,482.52	$473,842,041.12	$28,852,639.66	$739,086,163.30	-2.93%
80-81	4848924.	1047504.	$210,619,599.11	$438,129,578.41	$33,992,580.56	$682,741,758.08	-7.62%
81-82	5000000.	1100000.	$211,736,397.60	$421,504,714.23	$29,432,988.00	$662,674,099.83	-2.94%
82-83	5200000.	1140000.	$218,514,213.22	$415,617,867.98	$28,280,637.00	$662,411,918.20	-0.04%
83-84	5400000.	1155000.	$220,685,970.96	$416,068,973.32	$29,386,191.00	$666,141,135.28	0.56%
84-85	5470000.	1170000.	$221,786,606.57	$409,296,375.67	$29,264,078.00	$660,347,064.25	-0.87%
85-86	5530000.	1170000.	$221,426,946.00	$403,698,934.84	$28,874,073.00	$653,999,953.84	-0.96%
86-87	5600000.	1190000.	$222,319,679.40	$397,807,677.90	$28,861,528.00	$648,988,885.30	-0.77%
87-88	5664500.	1200000.	$222,777,913.41	$383,467,454.58	$28,874,944.00	$635,120,311.99	-2.14%
88-89	5699750.	1210000.	$222,143,583.58	$370,408,947.41	$28,890,638.00	$621,443,160.99	-2.15%
89-90	5735000.	1220000.	$221,481,786.24	$358,656,407.55	$28,921,658.00	$609,059,851.79	-1.99%
90-91	5770250.	1250000.	$222,372,105.64	$347,226,567.91	$29,335,184.00	$598,933,857.55	-1.66%
91-92	5805500.	1280000.	$223,234,957.53	$338,958,685.91	$29,786,323.00	$591,979,966.44	-1.16%
92-93	5840750.	1310000.	$226,345,956.53	$330,958,395.12	$30,267,652.00	$587,572,003.64	-0.74%
93-94	5876000.	1340000.	$229,456,955.52	$322,945,710.53	$30,748,831.00	$583,151,497.05	-0.75%
94-95	5911250.	1380000.	$233,357,746.64	$316,545,237.59	$31,438,835.00	$581,341,819.23	-0.31%
95-96	5946500.	1410000.	$236,468,745.63	$315,241,449.22	$32,000,522.00	$583,710,716.85	0.41%

FIGURE 1

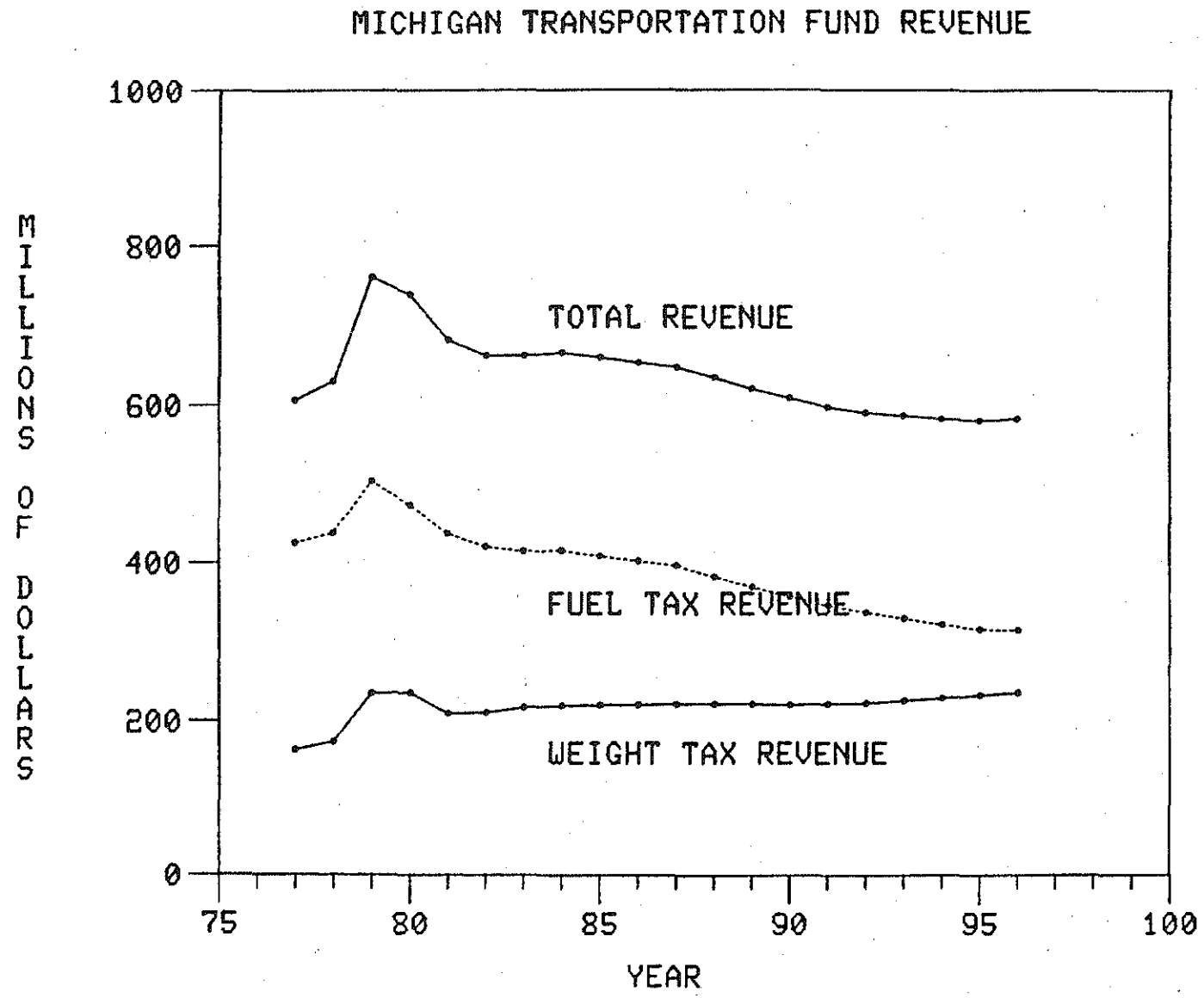

MICHIGAN TRANSPORTATION FUND REVENUE
1000
800
600
400
200
0
MILLIONS OF DOLLARS
TOTAL REVENUE
FUEL TAX REVENUE
WEIGHT TAX REVENUE
75
80
85
90
95
100
YEAR

FIGURE 2

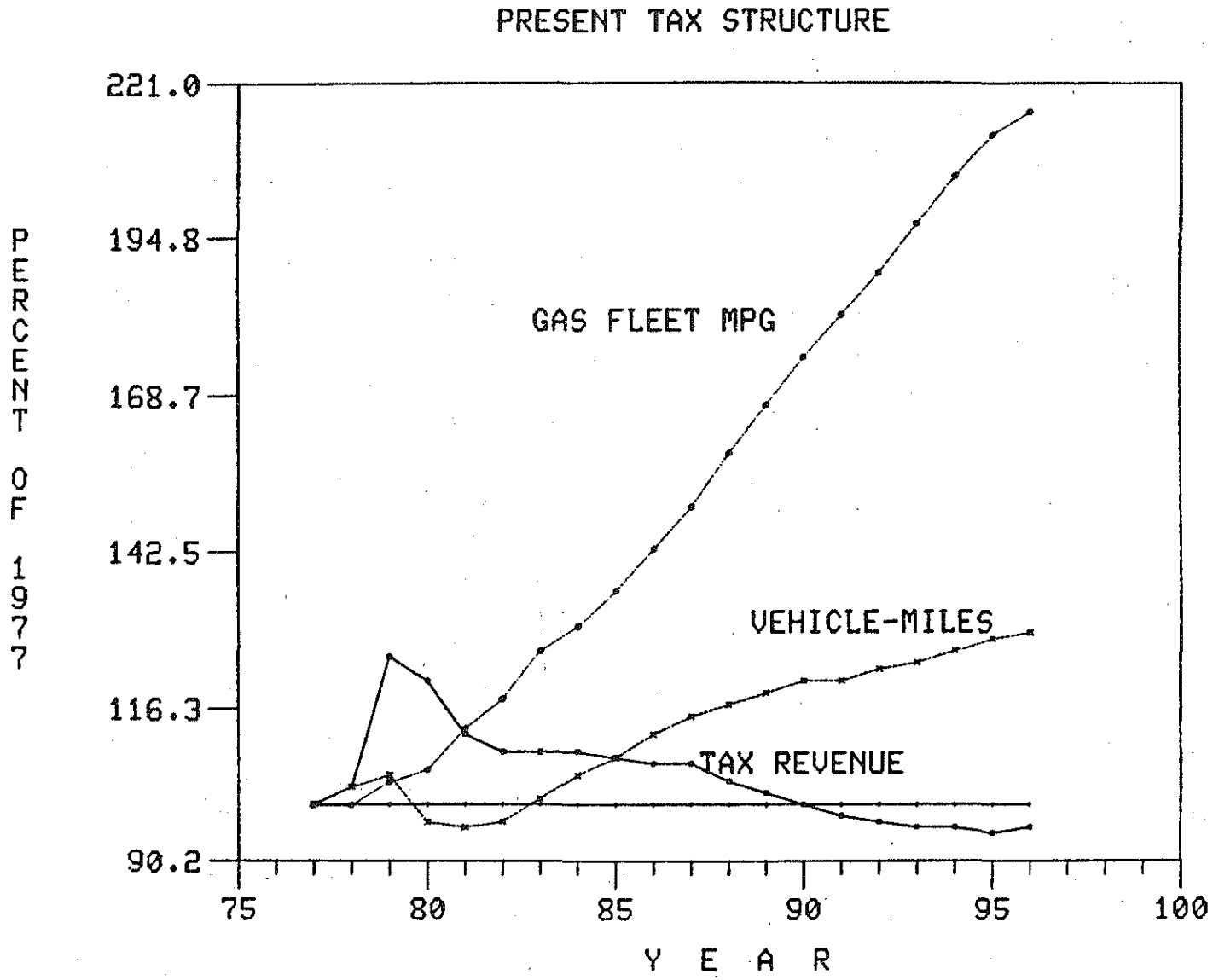

PRESENT TAX STRUCTURE
221.0
194.8
168.7
142.5
116.3
90.2
PERCENT OF 1977
GAS FLEET MPG
VEHICLE-MILES
TAX REVENUE
75
80
85
90
95
100
Y E A R

FIGURE 3

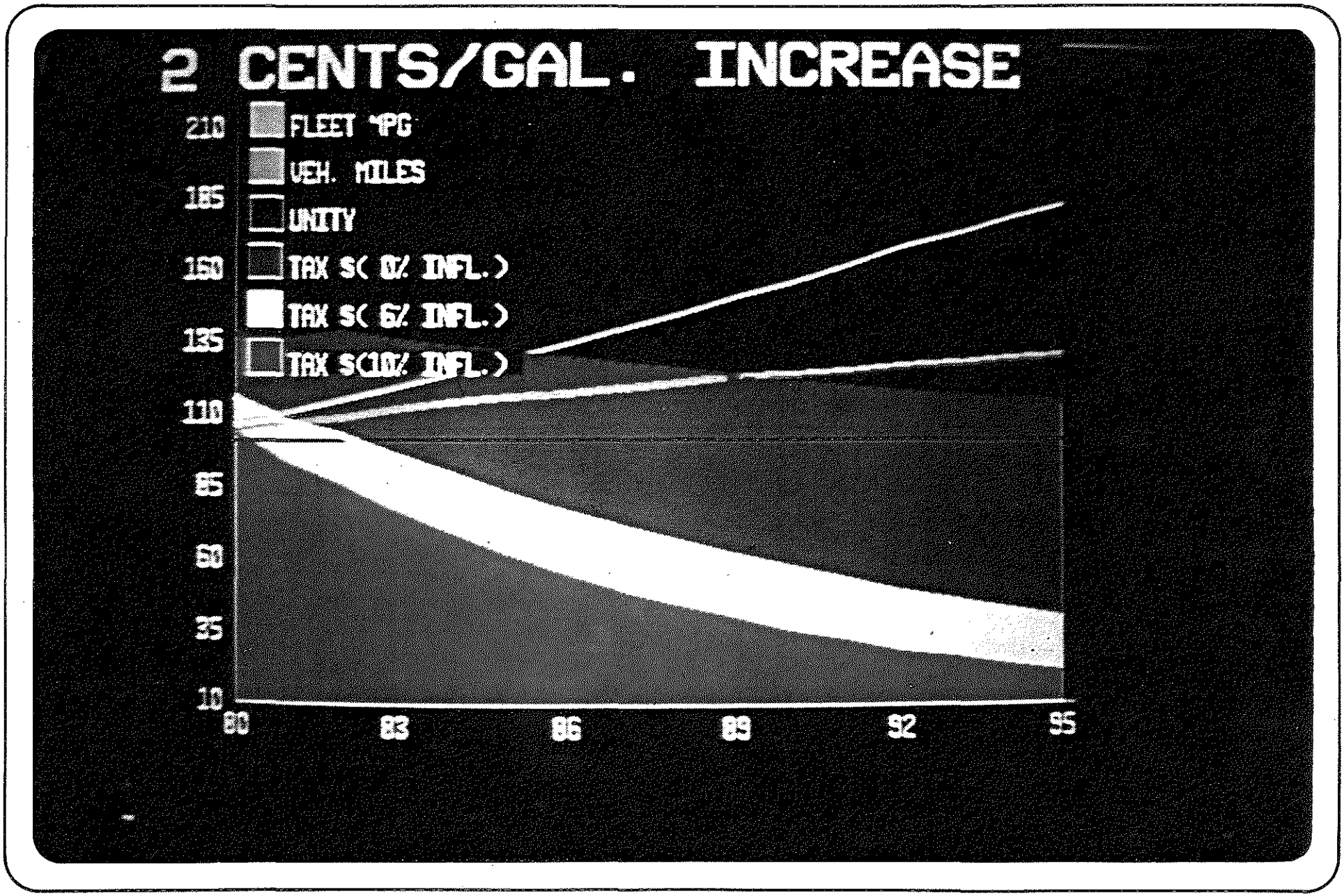

2 CENTS/GAL. INCREASE
210
185
160
135
110
85
60
35
10
FLEET MPG
VEH. MILES
UNITY
TAX $(0% INFL.)
TAX $(6% INFL.)
TAX $(10% INFL.)
80
83
86
89
92
95

Figure 3A

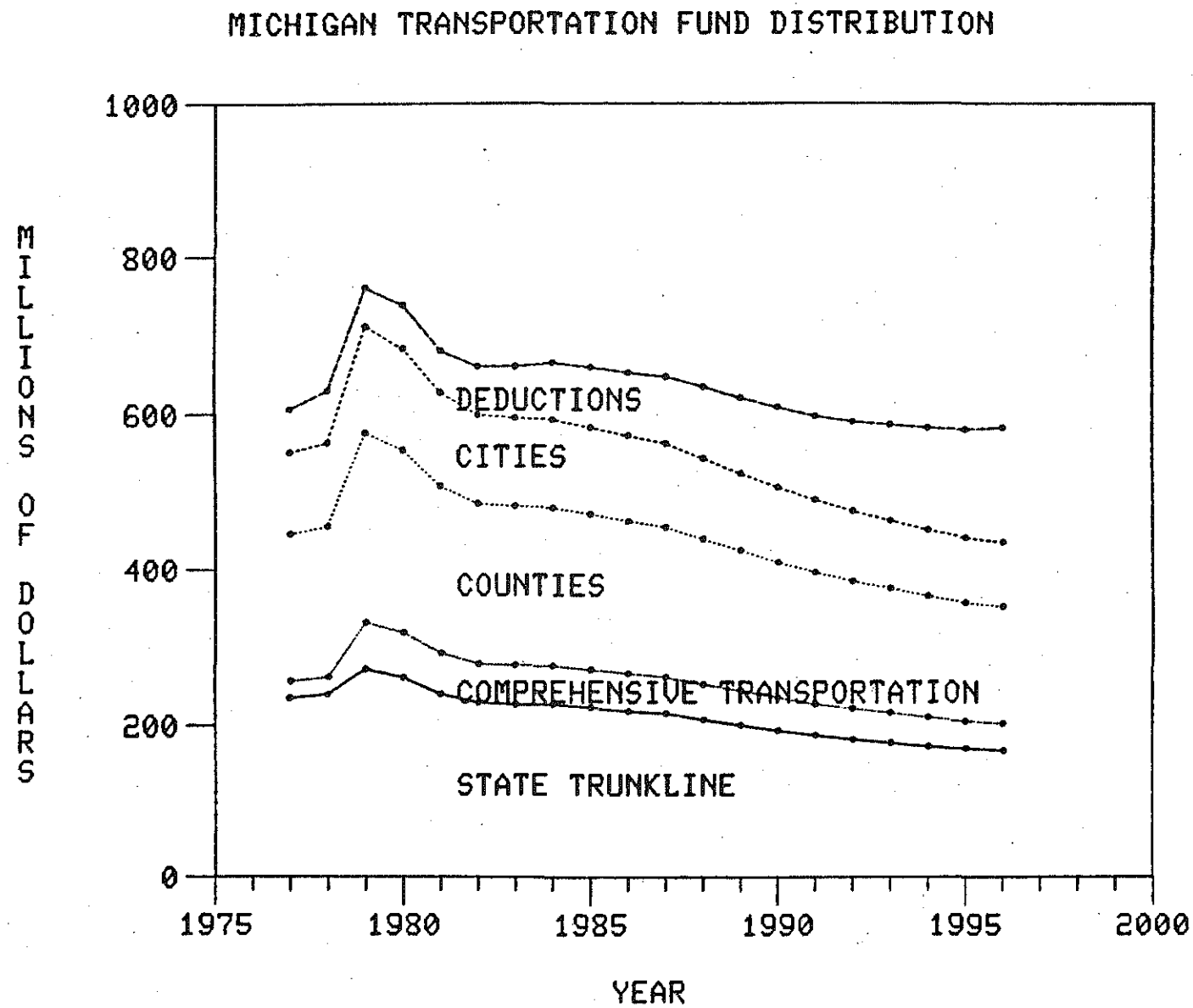

MICHIGAN TRANSPORTATION FUND DISTRIBUTION
MILLIONS OF DOLLARS
1000
800
600
400
200
0
1975
1980
1985
1990
1995
2000
YEAR
DEDUCTIONS
CITIES
COUNTIES
COMPREHENSIVE TRANSPORTATION
STATE TRUNKLINE

FIGURE 4

distribution of the total Michigan Transportation Fund to state and local funds. Figure 4A shows a different tax alternative using color graphics.

A more detailed report is available for the Michigan Transportation Fund and two state funds, the State Trunkline Fund and the Comprehensive Transportation Fund. See Figure 5.

A summary of most of the input variables is available for all years of the forecast. Figures 6 and 7 show these variables, all of which can be changed to examine a particular "what if" question about future conditions and tax structures.

Since a portion of automobile related sales tax is available for the Comprehensive Transportation Fund, a forecast of the sales tax is needed. These are obtained from the Office of Revenue and Tax Analysis, Department of Management and Budget. Their forecasts are based on a computer model driven by interest rates, automobile production, and wages and salaries.

The transportation revenue forecasting system, which has produced the charts and graphs in the preceding pages, is composed of several computer programs which perform all of the calculations and produce the output lists, tables, and graphs. A general description of the overall system is contained in the next section and followed by a more detailed technical section.

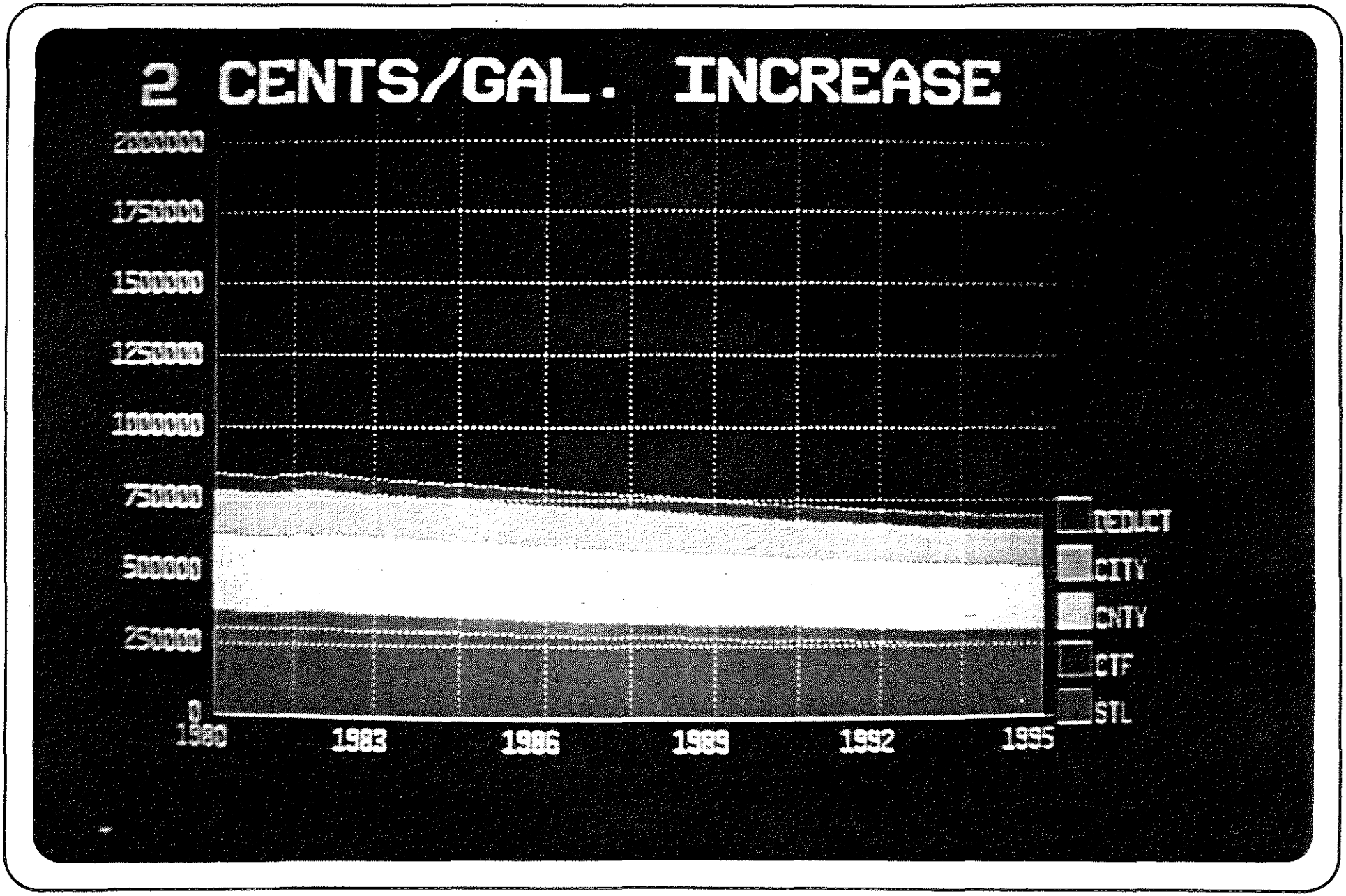

2 CENTS/GAL. INCREASE
2000000
1750000
1500000
1250000
1000000
750000
500000
250000
0
1980
1983
1986
1989
1992
1995
REDUCT
CITY
CNTY
CTF
STL

Figure 4A

STATE OF MICHIGAN
DEPARTMENT OF TRANSPORTATION
LONG RANGE REVENUE FORECASTS
CURRENT DOLLARS IN MILLIONS

	1982	1983	1984	1985	1986	1987	1988
MICHIGAN TRANSPORTATION FUND							
GASOLINE TAX	$398.2	$390.2	$388.8	$381.0	$373.4	$365.9	$350.6
DIESEL FUEL TAX	$22.5	$24.3	$26.1	$27.1	$29.1	$30.5	$31.4
MOTOR VEHICLE WEIGHT TAX	$211.7	$218.5	$220.7	$221.8	$221.4	$222.3	$222.8
MISC TAXES & FEES(INCLUDES LPG)	$10.3	$11.6	$12.7	$12.8	$12.9	$13.4	$13.4
DIESEL FUEL LICENSE	$8.5	$8.9	$9.2	$9.4	$9.4	$9.5	$9.6
EARNINGS ON INVESTMENTS	$11.5	$8.9	$8.6	$8.2	$7.8	$7.4	$7.3
TOTAL REVENUES	$662.7	$662.4	$666.1	$660.3	$654.0	$649.0	$635.1
LESS: ADMINISTRATION & GRANTS	$63.1	$66.5	$72.9	$77.1	$81.5	$86.3	$91.3
NET REVENUES	$599.6	$595.9	$593.2	$583.2	$572.5	$562.7	$543.8
ALLOCATIONS FROM MTF							
TO COMPREHENSIVE TRANS FUND	$49.8	$49.5	$49.3	$48.4	$47.5	$46.7	$45.2
TO STATE TRUNK LINE FUND	$230.2	$228.8	$227.8	$224.0	$219.8	$216.1	$208.8
TO COUNTY ROAD COMMISSIONERS	$205.6	$204.4	$203.5	$200.1	$196.4	$193.0	$186.5
TO CITIES AND VILLAGES	$113.9	$113.2	$112.7	$110.8	$108.8	$106.9	$103.3
TOTAL ALLOCATED	$599.5	$595.9	$593.3	$583.3	$572.5	$562.7	$543.8
COMPREHENSIVE TRANSPORTATION FUND							
FROM GENERAL FUND(SALES TAXES)							
MOTOR VEHICLES	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
FUEL	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
ACCESSORY DEALERS	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
GAS STATION NONFUEL SALES	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
TOTAL TAXES	$389.3	$463.3	$523.5	$575.9	$633.5	$696.9	$725.0
ALLOCATION TO CTF	$27.2	$32.3	$36.5	$40.2	$44.2	$48.6	$50.6
FROM MTF	$49.8	$49.5	$49.3	$48.4	$47.5	$46.7	$45.2
MISCELLANEOUS(F.AID NOT INCLUDED)	$7.8	$8.3	$8.7	$9.0	$9.4	$9.7	$9.8
EARNINGS ON INVESTMENTS	$2.7	$2.9	$3.0	$3.1	$3.2	$3.3	$3.3
TOTAL CTF REVENUES	$87.5	$93.0	$97.5	$100.7	$104.3	$108.4	$108.8
STATE TRUNK LINE FUND							
FROM MTF	$230.2	$228.8	$227.8	$224.0	$219.8	$216.1	$208.8
MISCELLANEOUS(F.AID NOT INCLUDED)	$21.8	$21.7	$21.6	$21.2	$20.8	$20.5	$19.8
EARNING ON INVESTMENTS	$6.0	$5.9	$5.9	$5.8	$5.7	$5.6	$5.4
TOTAL STATE TRUNK LINE FUND REVENUES	$258.0	$256.4	$255.3	$251.0	$246.3	$242.2	$234.0

PRESENT TAX STRUCTURE

FIGURE 5

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF TRANSPORTATION PLANNING
PLANNING PROCEDURES SECTION
ASSUMPTIONS FOR LONG RANGE REVENUE FORECASTS
MICHIGAN TRANSPORTATION FUND

PRESENT TAX STRUCTURE

	1982	1983	1984	1985	1986	1987	1988
VEHICLE REGISTRATION							
PASSENGER	5000000	5200000	5400000	5470000	5530000	5600000	5664500
COMMERCIAL	1100000	1140000	1155000	1170000	1170000	1190000	1200000
AVERAGE WEIGHT TAX/VEHICLE							
PASSENGER	24.60	23.90	23.10	22.65	22.20	21.76	21.46
COMMERCIAL	70.99	73.00	73.44	74.12	74.80	75.00	75.00
VEHICLE MILES (MILLIONS)	61900	64700	67200	69200	71300	73600	74700
MILES PER GALLON							
PASSENGER	16.53	17.59	18.30	19.20	20.10	21.10	22.30
COMMERCIAL	5.46	5.65	5.75	5.93	6.29	6.67	6.87
DIESEL DISCOUNT ($/GALLON)	0.06	0.06	0.06	0.06	0.06	0.06	0.06
PROPORTION DIESEL GALLONS TO WHICH DISCOUNT APPLIES	0.84	0.84	0.84	0.84	0.84	0.84	0.84
FUEL TAX - GASOLINE							
FIXED $/GALLON	0.11	0.11	0.11	0.11	0.11	0.11	0.11
FUEL TAX - DIESEL							
FIXED $/GALLON	0.11	0.11	0.11	0.11	0.11	0.11	0.11

FIGURE 6

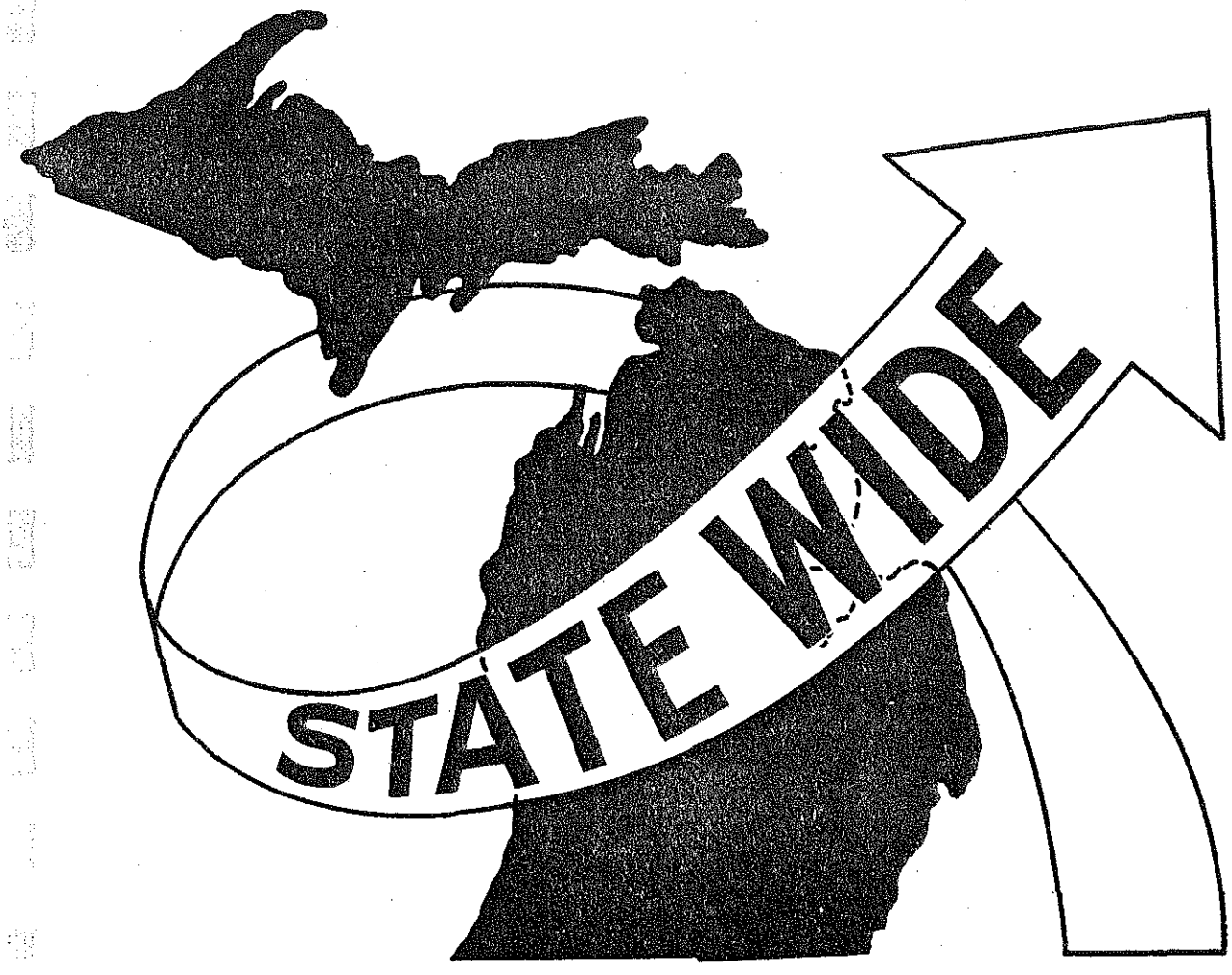
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF TRANSPORTATION PLANNING
PLANNING PROCEDURES SECTION
ASSUMPTIONS FOR LONG RANGE REVENUE FORECASTS
MICHIGAN TRANSPORTATION FUND

PRESENT TAX STRUCTURE

	1982	1983	1984	1985	1986	1987	1988
LPG REVENUE FACTOR	0.00191	0.00270	0.00280	0.00288	0.00298	0.00353	0.00375
DIESEL COMM VEHICLE MILE PCT	0.03330	0.03560	0.03750	0.03900	0.04310	0.04640	0.04850
INTEREST REVENUE FACTOR	0.01820	0.01400	0.01350	0.01300	0.01250	0.01200	0.01200
MISC FEES REVENUE FACTOR	8.56000	9.21000	10.00000	10.00000	10.00000	10.00000	10.00000
DIESEL PERMITS REVENUE FACTOR	7.72000	7.81000	8.00000	8.00000	8.00000	8.00000	8.00000
AUTO RELATED SALES TAX (MILLIONS OF DOLLARS)	389.3	463.3	523.5	575.9	633.5	696.9	725.0
CTF SALES TAX PCT	0.279	0.279	0.279	0.279	0.279	0.279	0.279
DISTRIBUTION OF MTF							
CNTY %	0.343	0.343	0.343	0.343	0.343	0.343	0.343
CITY %	0.190	0.190	0.190	0.190	0.190	0.190	0.190
STATE %	0.467	0.467	0.467	0.467	0.467	0.467	0.467
STF %	0.822	0.822	0.822	0.822	0.822	0.822	0.822
CTF %	0.178	0.178	0.178	0.178	0.178	0.178	0.178

FIGURE 7

SYSTEM DESCRIPTION



SYSTEM DESCRIPTION

The transportation revenue forecasting system can be divided into three main parts. Phase I involves forecasts of revenue into the Michigan Transportation Fund (MTF) from taxes, fees, and interest. Phase II involves distribution of the fund to state and local governments. Phase III uses these MTF revenues and some further estimates of revenues to present the total revenue for two state funds: the State Trunkline Fund (STF) and the Comprehensive Transportation Fund (CTF). See Figure 8. For a more detailed diagram, see Figure 9.

The system has generally been used in three different ways. First, it is used to monitor the long range implication of keeping our present tax structure. Second, it is used to evaluate various tax changes such as raising the fixed rate per gallon fuel tax, instituting a percentage tax based on the price of fuel, or indexing the fuel tax to maintenance costs. To evaluate a flat fee per vehicle instead of the present vehicle tax by weight, the same input structure is used except the average vehicle weights by year are replaced by a value of one and the average tax per hundred-weight is replaced by the flat vehicle fee. Third, the output of this revenue forecasting process serves as input to another process used in the recent State Transportation Plan (STP) produced by the Department. The STP uses the forecasts of future revenue to compare with future transportation needs which are also expressed in dollars.

The next section discusses in more detail the operation of each of the three phases.

FIGURE 8

MICHIGAN

LONG RANGE

TRANSPORTATION REVENUE FORECASTING SYSTEM

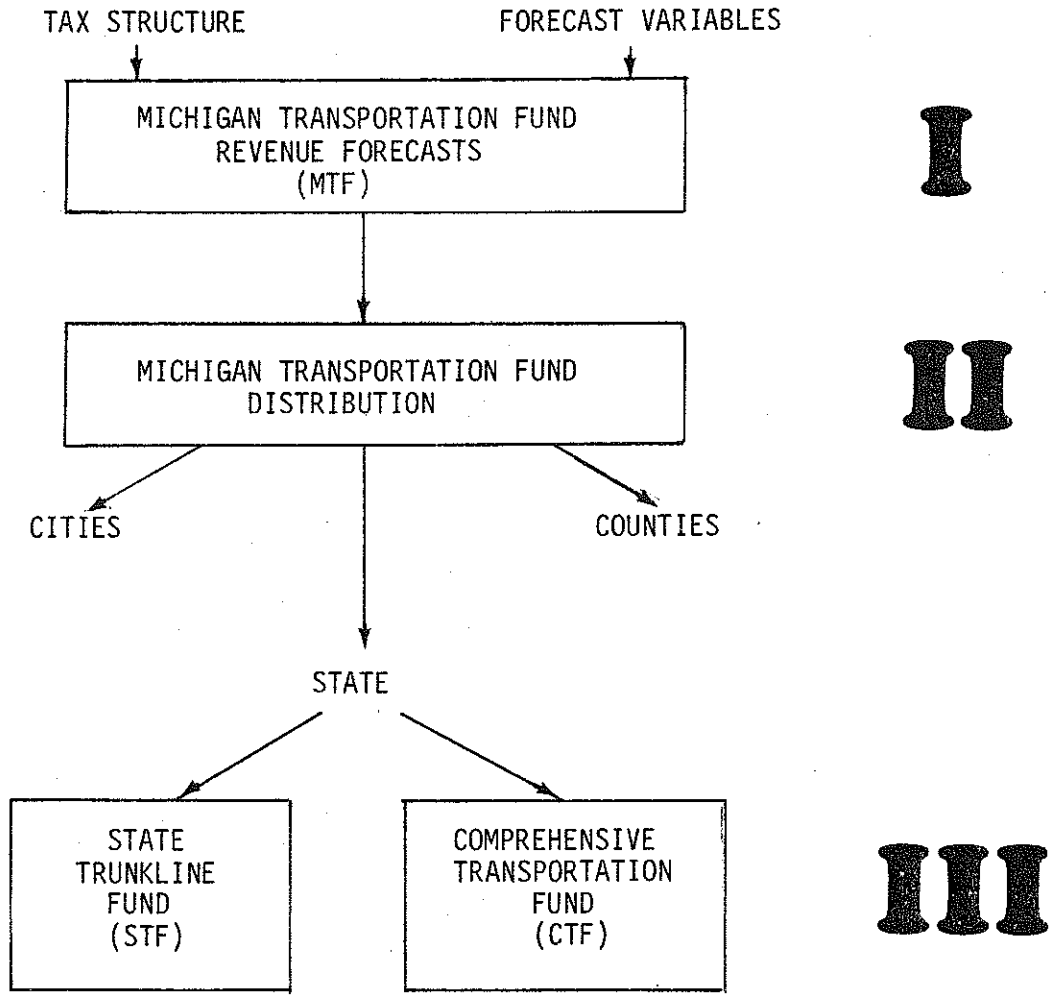
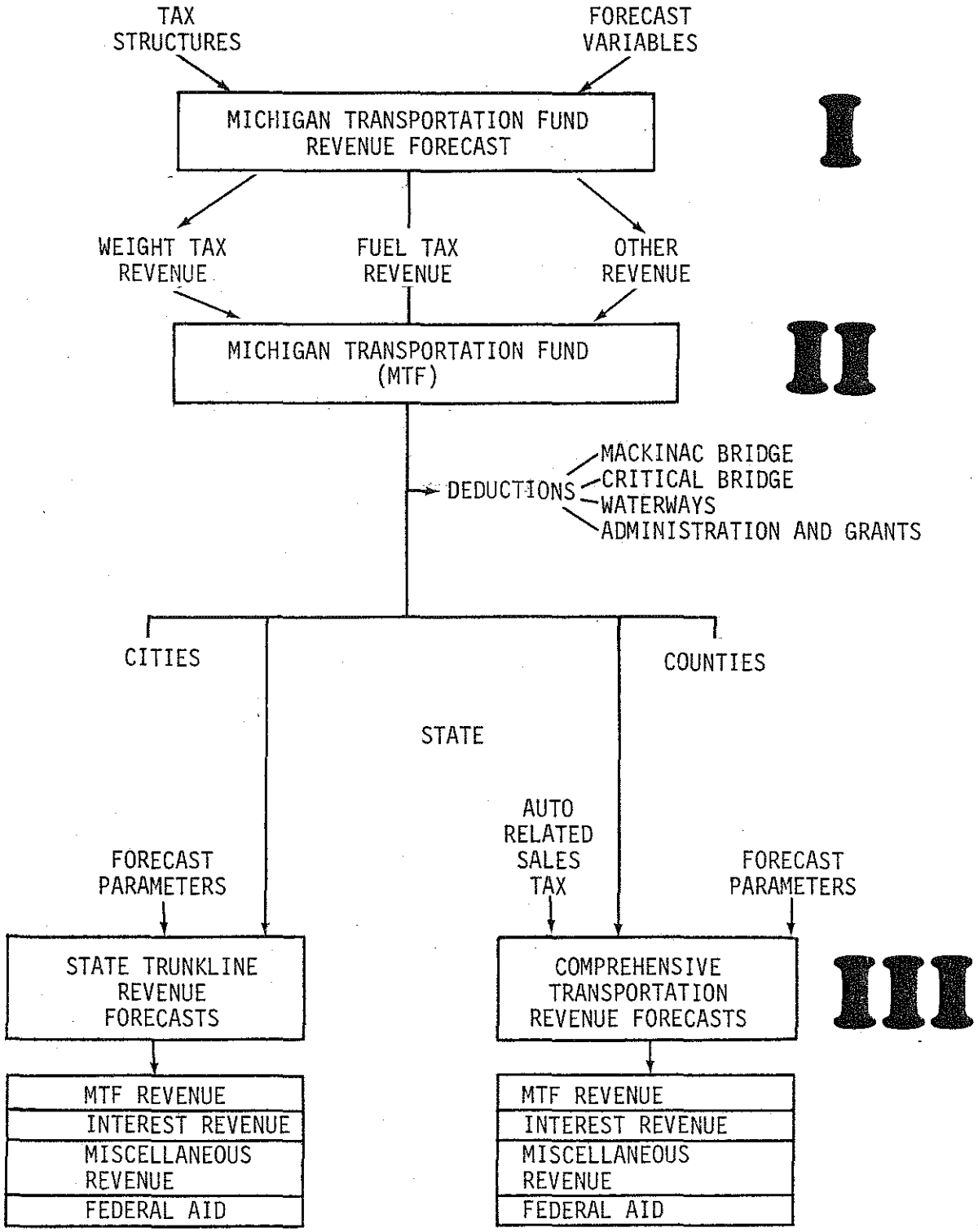


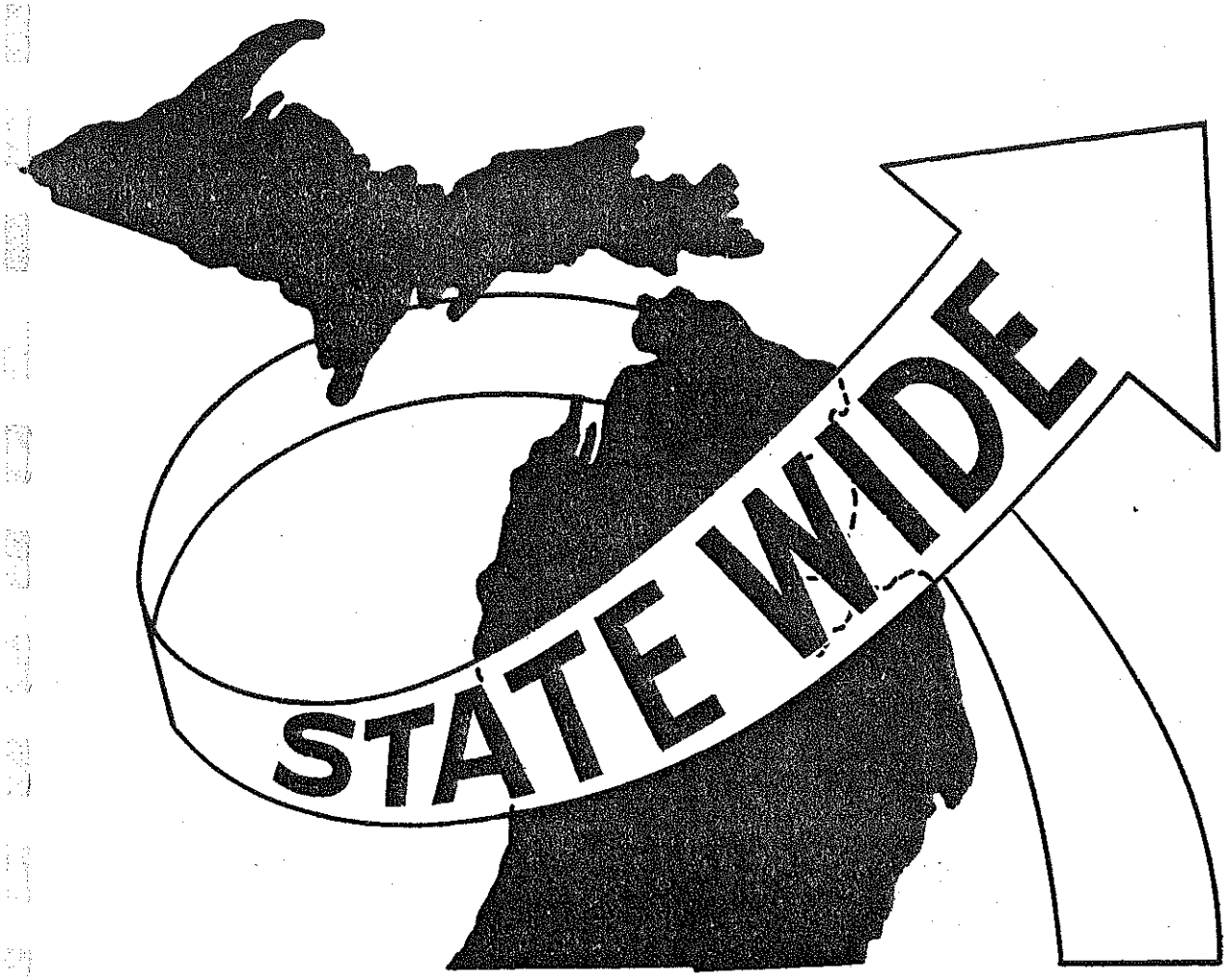
FIGURE 9

MICHIGAN
LONG RANGE
TRANSPORTATION REVENUE FORECASTING SYSTEM



TECHNICAL

OPERATIONS



TECHNICAL OPERATIONS

The programs for all three phases are written in FORTRAN and run on the Burroughs B7700. Revenues are forecast by year for each year in the future for which forecast variables are supplied. At present, forecasts are not completed beyond 1996. Although there are a lot of input files (eight input files for the first phase of forecasting fuel and weight tax revenue), all are small files containing input parameters or forecast variables. Each file with forecast variables contains one record for each year of the forecast and from one to four variables for that year.

Phase I: Michigan Transportation Fund Revenue

Most of the analytical capabilities for examining different options are contained in this first phase of forecasting transportation revenue. This capability is related to the wide variety of input data which require the variables by year and by state totals for Michigan. The input variables are listed in Figure 10. Output items forecasted by year are listed in Figure 11.

When all input files are ready, the program for the first phase is started at a computer terminal. After approximately 30 seconds elapsed time and five seconds of computer processing time, a preliminary report is printed at the terminal. Gallons of gasoline and diesel fuel are also produced. The report is a summary by year of the forecasted revenue by three broad categories and the percent change from the previous year. See Figure 12 for an example directly from a computer terminal showing the running of the program with its associated files. Most of the outputs

Figure 10

MICHIGAN LONG-RANGE

TRANSPORTATION REVENUE FORECASTING SYSTEM

Input Variables
for
Michigan Transportation Fund
Revenue Forecasts

Tax Structure Variables:

Average Tax per Passenger Vehicle
(or average tax per 100-weight and average 100-weight)
Average Tax per Commercial Vehicle
(or average tax per 100-weight and average 100-weight)
Diesel Fuel Tax (per gallon or percent of price)
Diesel Fuel Price
Diesel Tax Discount
Gasoline Fuel Tax (per gallon or percent of price)
Gasoline Fuel Price

Other Variables:

Passenger Vehicle Registrations
Commercial Vehicle Registrations
Total Vehicle Miles of Travel
Passenger Fleet MPG (gasoline)
Commercial Fleet MPG (diesel)
Percent Commercial Vehicle Miles of Diesel Usage
Revenue Factor for Interest Revenue
Commercial Vehicle Factor for Miscellaneous Fees
Commercial Vehicle Factor for Diesel Discount Permit Revenue

Figure 11

MICHIGAN LONG-RANGE

TRANSPORTATION REVENUE FORECASTING SYSTEM

Output Items
from
Michigan Transportation Fund
Revenue Forecasts

Total Fuel Tax Revenue

Total Weight Tax Revenue

Total Other Revenues

Total Transportation Revenues

LPG Fuel Tax Revenue

Interest Revenue

Diesel Carrier Fuel Permits Revenue

Miscellaneous Fees and Permits Revenue

Revenue from Diesel Fuel Tax

Revenue from Gasoline Tax

Commercial Weight Tax Revenue

Passenger Weight Tax Revenue

Gallons of Gasoline

Gallons of Diesel Fuel

```
$FILE (STUD)TAX/ALT1/DO ON STATEWIDE
$
R TAX/PROG/MTF/INCOME/APR82;PT=10;%
FILE FILE2(TITLE=TAX/ALT1/INPUT/VEHREG/MAY82/DMB);%
FILE FILE3(TITLE=TAX/ALT1/INPUT/WTTAX/MAY82/DMB);%
FILE FILE4(TITLE=TAX/ALT1/INPUT/VEHMI/JUL82);%
FILE FILE5(TITLE=TAX/ALT1/INPUT/MIPERGAL/JUL82/NATL/MICH);%
FILE FILE6(TITLE=TAX/ALT1/INPUT/GASTAX/RETAIL/OCT81);%
FILE FILE7(TITLE=TAX/ALT1/MTF/PLOT/4014);%
FILE FILE8(TITLE=TAX/ALT1/MTF/PLOT/4027);%
FILE FILE9(TITLE=TAX/ALT1/MTF/PLOT/LABELS);%
FILE FILE10(TITLE=TAX/ALT1/MTF/INCOME);%
FILE FILE11(TITLE=TAX/ALT1/MTF/NARRATIVE);%
FILE FILE12(TITLE=TAX/ALT1/INPUT/OTHERPCTS/MAY82/DMB);%
FILE FILE13(TITLE=TAX/ALT1/INPUT/LPG/PROPORTION/MAY82/DMB);%
FILE FILE14(TITLE=TAX/ALT1/INPUT/DIESEL/DISCOUNTS/ALL/APR82);%
FILE FILE15(TITLE=TAX/ALT1/MTF/GALLONS);%
FILE FILE16(TITLE=TAX/ALT1/MTF/WTTAX);
$RUNNING 1948
$?


ENTER NARRATIVE ("END" TO GO ON):
PRESENT TAX STRUCTURE
END
```

PHASE 1

COMPUTER TERMINAL DISPLAY

YEAR	FLEET		REVENUE				
			WEIGHT	FUEL	OTHER	TOTAL	% INCREASE
76-77	4890094.	987822.	$164,940,827.90	$425,950,748.30	$15,554,381.40	$606,445,957.59	0.00%
77-78	5126907.	1081990.	$174,361,567.56	$438,474,353.89	$17,409,791.00	$630,245,712.45	3.92%
78-79	5162138.	1122898.	$235,652,470.46	$503,404,363.86	$22,315,860.34	$761,372,694.66	20.81%
79-80	5220972.	1095634.	$236,391,482.52	$473,842,041.12	$28,852,639.66	$739,086,163.30	-2.93%
80-81	4848924.	1047504.	$210,619,599.11	$438,129,578.41	$33,992,580.56	$682,741,758.08	-7.62%
81-82	5000000.	1100000.	$211,736,397.60	$421,504,714.23	$29,432,988.00	$662,674,099.83	-2.94%
82-83	5200000.	1140000.	$218,514,213.22	$415,617,067.98	$28,280,637.00	$662,411,918.20	-0.04%
83-84	5400000.	1155000.	$220,685,970.96	$416,068,973.32	$29,386,191.00	$666,141,135.28	0.56%
84-85	5470000.	1170000.	$221,786,606.57	$409,296,379.67	$29,264,078.00	$660,347,064.25	-0.87%
85-86	5530000.	1170000.	$221,426,946.00	$403,698,934.84	$28,874,073.00	$653,999,953.84	-0.96%
86-87	5600000.	1190000.	$222,319,679.40	$397,807,677.90	$28,861,528.00	$648,988,885.30	-0.77%
87-88	5664500.	1200000.	$222,777,913.41	$383,467,454.58	$28,874,944.00	$635,120,311.99	-2.14%
88-89	5699750.	1210000.	$222,143,583.58	$370,408,947.41	$28,850,630.00	$621,443,160.99	-2.15%
89-90	5735000.	1220000.	$221,481,786.24	$358,656,407.55	$28,921,658.00	$609,059,851.79	-1.99%
90-91	5770250.	1250000.	$222,372,105.64	$347,226,567.91	$29,335,184.00	$598,933,857.55	-1.66%
91-92	5805500.	1220000.	$223,234,957.53	$338,958,695.91	$29,786,323.00	$591,979,966.44	-1.16%
92-93	5840750.	1310000.	$226,345,956.53	$330,958,395.12	$30,267,652.00	$587,572,003.64	-0.74%
93-94	5876000.	1340000.	$229,456,955.52	$322,945,710.53	$30,748,831.00	$583,151,497.05	-0.75%
94-95	5911250.	1380000.	$233,357,746.64	$316,545,237.59	$31,438,835.00	$581,341,819.23	-0.31%
95-96	5946500.	1410000.	$236,468,745.63	$315,241,449.22	$32,000,522.00	$583,710,716.85	0.41%

FIGURE 12

are various categories of revenue written to a computer file. Although the program goes on to allow on-line changes in the tax structure or selected variables for trying a variety of alternatives, we have usually found it best to isolate each alternative with its own set of input and output variables for later use.

The following shows how revenues are calculated:

Fuel Revenue is calculated according to: (see Figure 13)

Total Fuel Tax Revenue	=	Gas Tax Revenue	+	Diesel Tax Revenue	+	LPG Revenue

Where: Gas Tax Revenue = GFUEL * GTAX

Diesel Tax Revenue = D1FUEL * (DTAX - DTAXDIS) + D2FUEL * DTAX

LPG = Liquid Petroleum Gas

LPG Tax Revenue = LPG FACTOR * (GAS TAX REVENUE + DIESEL TAX REVENUE)

Where:

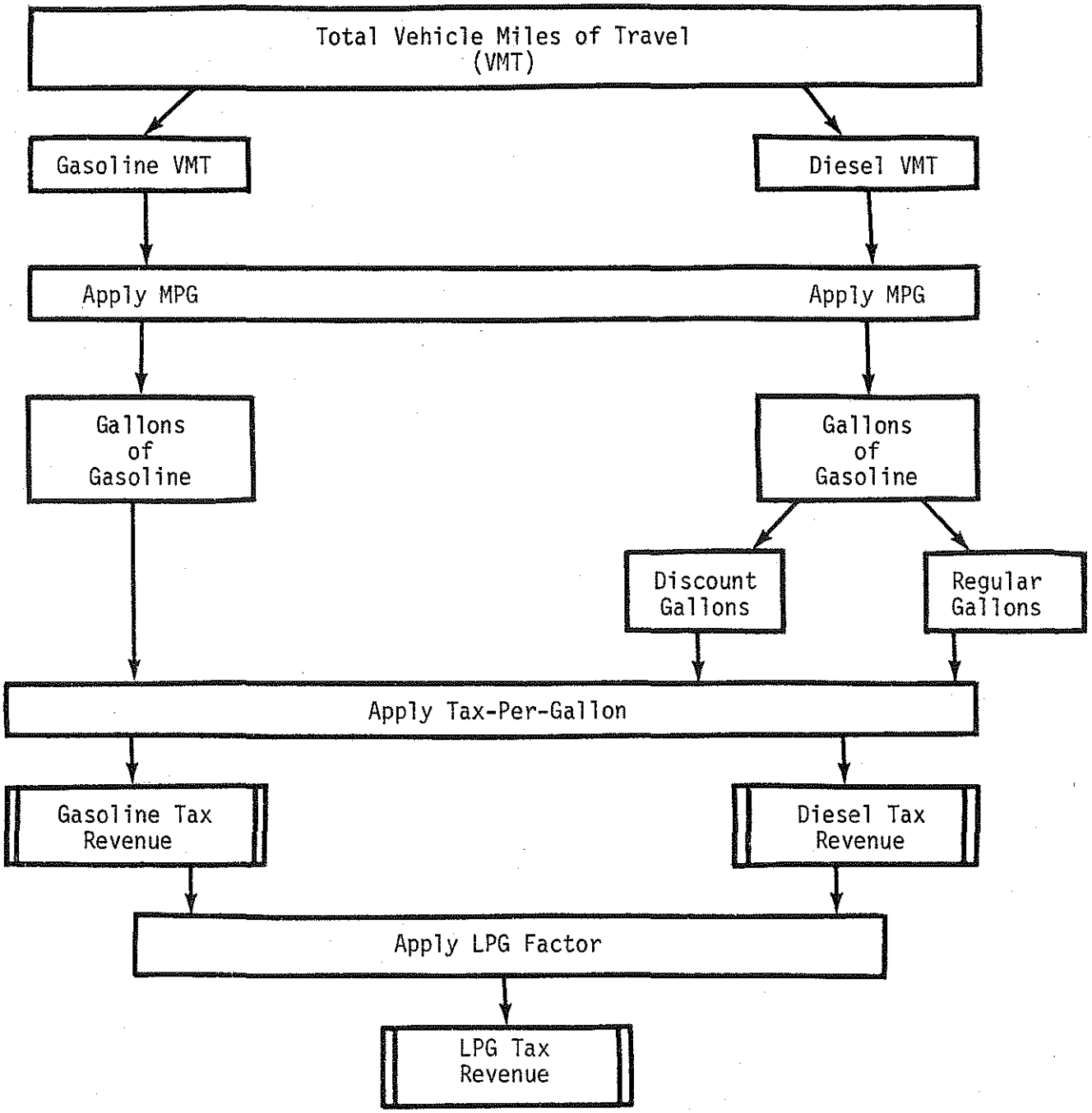
GFUEL	= gallons of gasoline
GTAX	= gasoline tax rate per gallon
DTAX	= diesel tax rate per gallon
DTAXDIS	= diesel tax discount per gallon
D1 FUEL	= gallons of diesel fuel by special permit holders
D2 FUEL	= gallons of diesel fuel by those without a special permit
LPG FACTOR	= historical relationship between LPG revenue and other fuel revenue which has been about .0006, but has been increased lately.

Where:

D1 FUEL	= [(VMT * PCTD)/DMPG] * PCT DISCOUNT
D2 FUEL	= [(VMT * PCTD)/DMPG] * [1 - PCT DISCOUNT]
GFUEL	= [(VMT * (1 - PCTD))/GMPG]

FIGURE 13

CALCULATION OF FUEL TAX REVENUE



Where: VMT = state total vehicle miles of travel

PCTD = percentage of vehicle miles traveled by heavy trucks

DMPG = diesel fleet miles per gallon

GMPG = gasoline fleet miles per gallon

PCT DISCOUNT = percent of heavy trucks with special permits for discounts

The future MPG's used for the Michigan model were based on, but not exactly equal to, the U. S. Department of Energy's values. See Figure 14 for a comparison. The D.O.E.'s national averages were adjusted to an average Michigan vehicle mix. For the known years of 1977 through 1981, the values of MPG's which worked well in our Michigan model were very close to D.O.E.'s adjusted estimates as can be seen in Figure 14.

The percentage of total vehicle miles which are due to diesel vehicles do not compare quite as well with D.O.E.'s national "heavy-heavy" trucks. See Figure 15. The difference may be the location of Michigan in the United States which would result in fewer through trips by trucks. Michigan's percentage increases faster since there is some accounting for increasing use of diesel fuel by automobiles.

Vehicle Revenue is calculated according to: (see Figure 16)

TOTAL VEHICLE TAX REVENUE = Passenger Weight Tax Revenue + Commercial Weight Tax Revenue + Miscellaneous

Where: Miscellaneous = (Passenger Weight Tax Revenue + Commercial Weight Tax Revenue) * .052

Passenger Weight Tax Revenue = Average tax per passenger vehicle * Passenger registrations

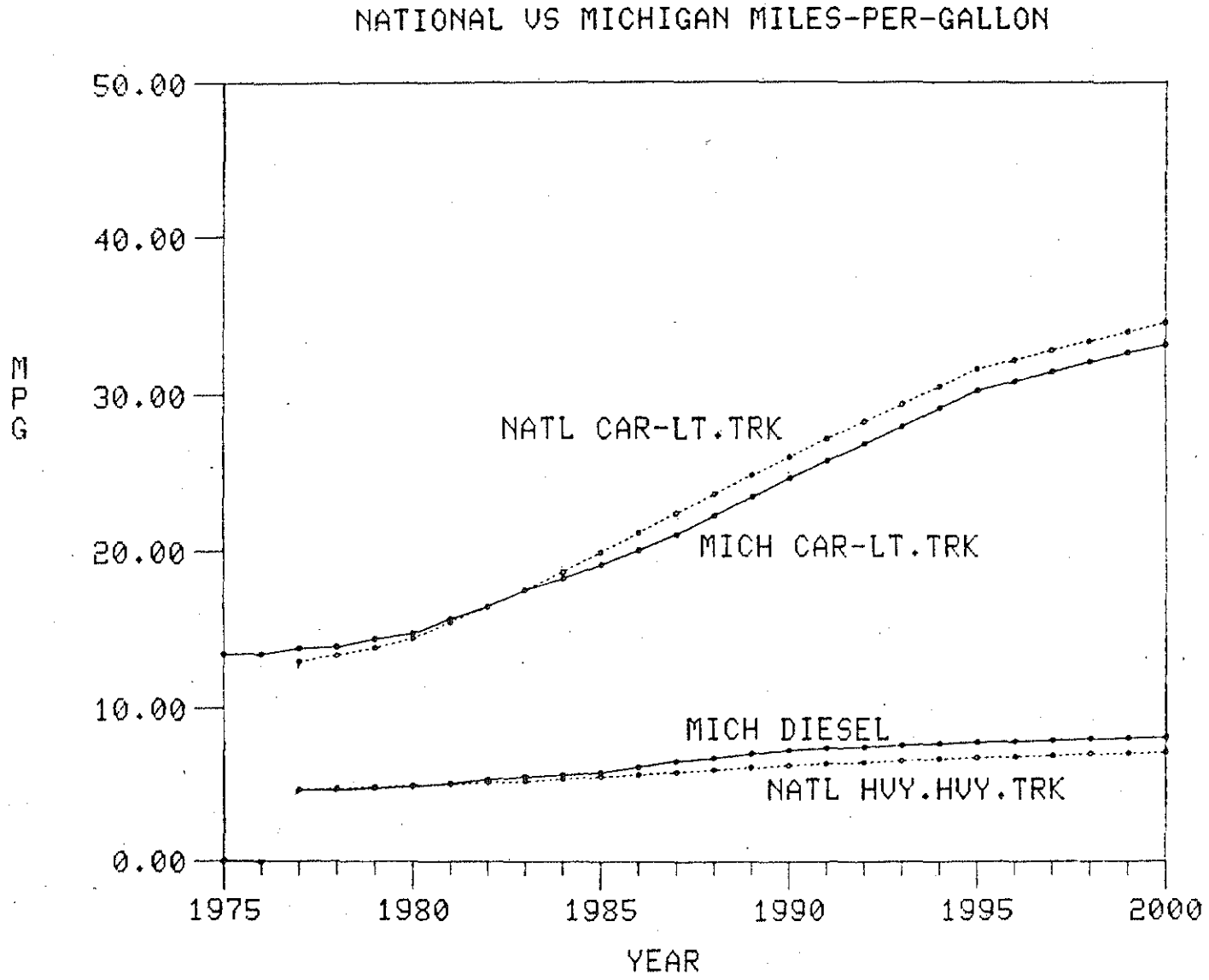
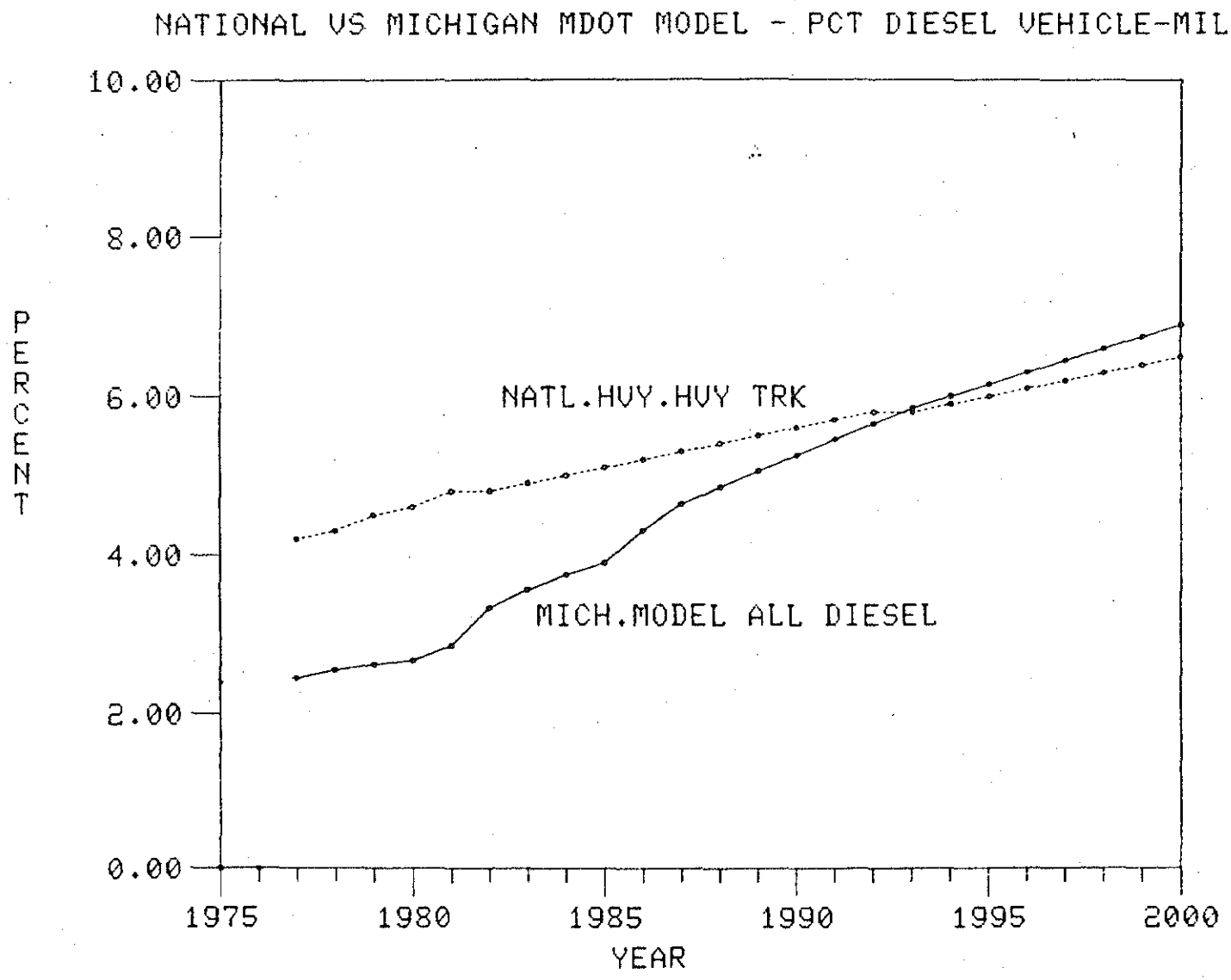


FIGURE 14

Source: U. S. Department of Energy, Michigan Department of Transportation, Transportation Planning Procedures, July 1982

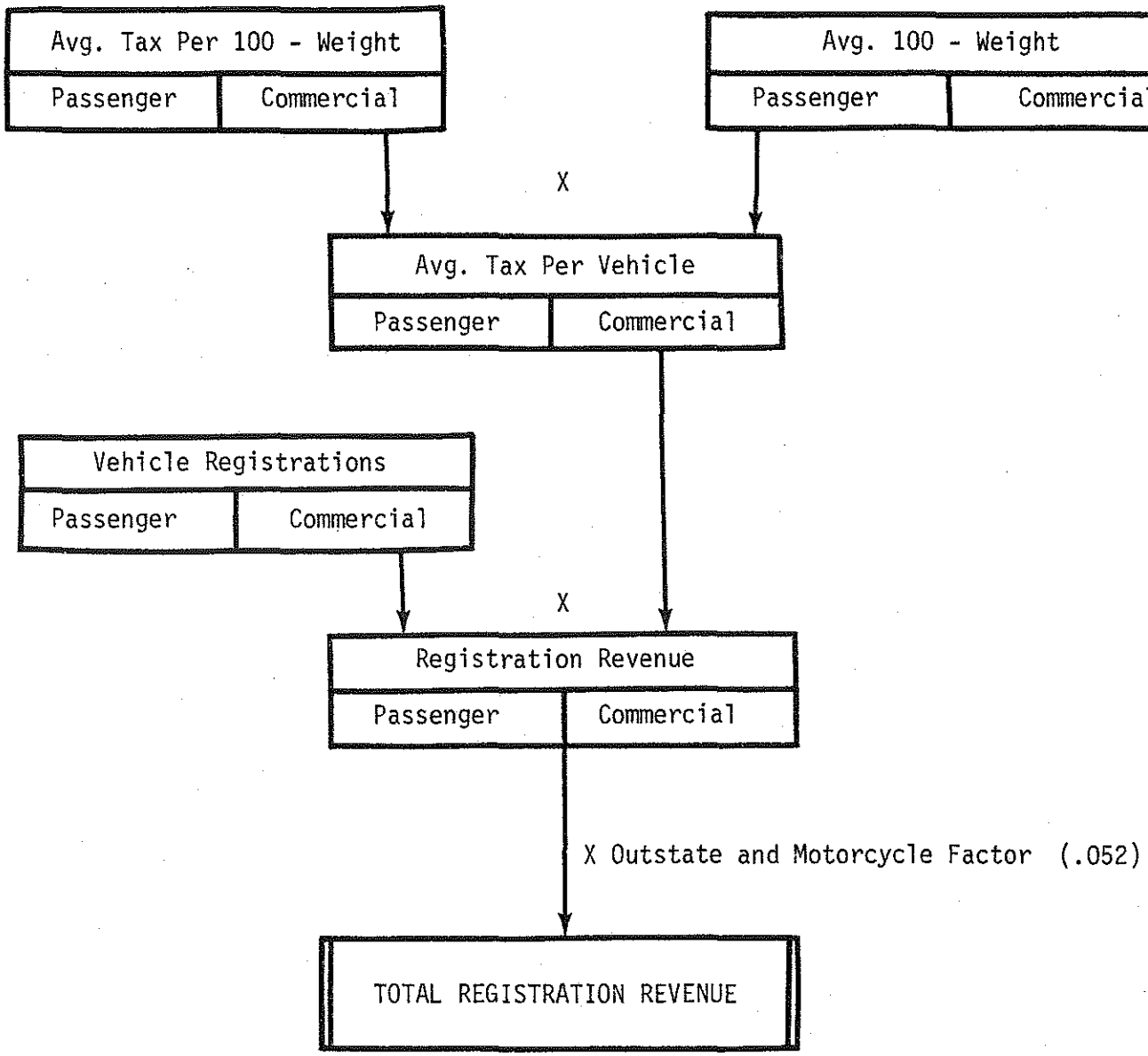


Source: U. S. Department of Energy, Michigan Department of Transportation, Transportation Planning Procedures Section, July 1982

FIGURE 15

FIGURE 16

CALCULATION OF VEHICLE REGISTRATION TAX REVENUE



Commercial Weight Tax Revenue	=	Average tax per commercial vehicle	*	Commercial registrations

The average tax per vehicle is estimated directly or by:

Average tax per vehicle = Average tax per 100 pounds * average vehicle weight in 100's

Other revenue is calculated according to: (see Figure 17)

OTHER REVENUE = Miscellaneous Fees and Permits + Interest + Special Diesel Permits

Where: Miscellaneous = a factor * commercial registrations.

This factor changes somewhat with time and seems to go up during good economic times and down in bad.

Interest Revenue = a factor * fuel and weight revenue.

This factor closely follows interest rates as expected. (For 1977 to 1981, the factor equals .144 times the yield on 90-day securities.)

Special Diesel Permits = a factor * commercial registrations.

These permits were not available until May 1980 and allow the purchaser of the permit a discount (presently 6¢ per gallon) on all diesel fuel purchased.

Phase II: Distribution of the Michigan Transportation Fund

This portion of the process estimates the deductions by four categories:

1) Waterways,

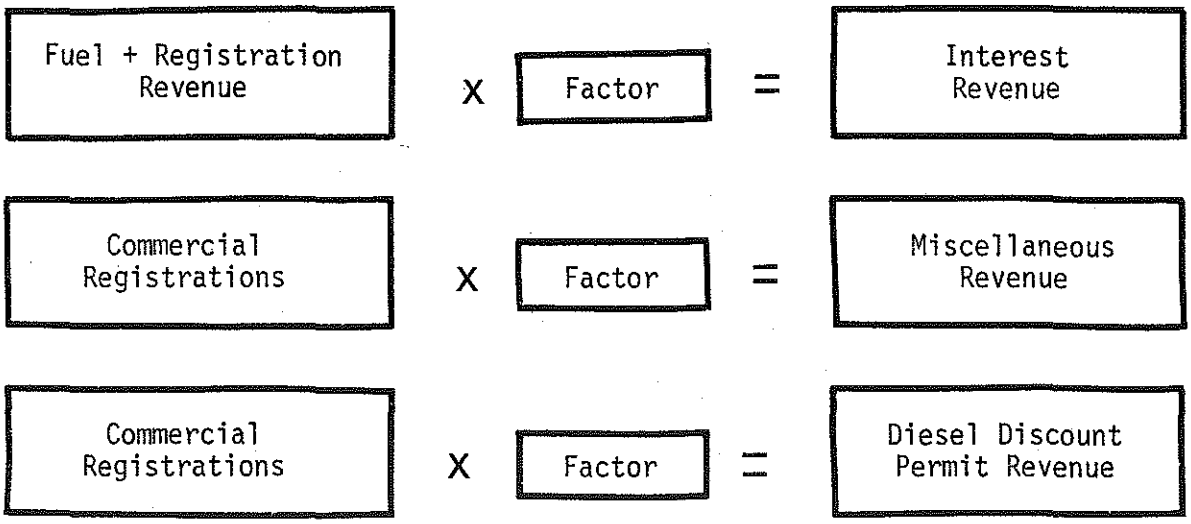
2) Mackinac Bridge Authority,

3) Critical Bridge Program, and

4) Administrative and other grants.

FIGURE 17

CALCULATION OF OTHER TAX REVENUE



The remaining amount is then divided into four amounts to be distributed to:

1) cities,

2) counties,

3) State Trunkline Fund, and

4) Comprehensive Transportation Fund.

The portion of each fund is governed by law at a fixed percent. The forecasting process allows changes in these percentages for future proposals as well as some changes in the amount of deductions. This breakdown of deductions and distributions is written for each year of the forecast to a computer file for later use.

For one specified year, an estimate is also made of how the total city and county money is split among the various counties. This future estimate is based on the actual process used each year to distribute the funds to counties and cities. Documentation of this process is available from the Annual Progress Report, Report No. 162, published by the Michigan Department of Transportation. It is a complex process involving population, miles of roadway, snowfall, and weight taxes collected. Our version of this process, adapted for estimating future distribution, uses population forecasts by county, weight taxes from Phase I, and values from a known year for snowfall and miles of roadway.

In summary, the major input requirements for each year are:

- Michigan Transportation Fund forecasts from Phase I;
- Deductions to:

1) Mackinac Bridge Authority

2) Critical Bridge Program

3) Waterways (actual amount or will be calculated as 1.023% of gasoline revenue less 1% for administration)

4) Administration and grants (actual amount or percent increase from previous year); and

- Percentage of fund to cities, counties, the State Trunkline Fund and the Comprehensive Transportation Fund.

For distribution among counties of the total county and city funds for one future year:

- year
- population forecasts
- snowfall data
- weight tax collections
- miles of roadway by city and county, major and local streets.

When all input files are ready, the program for Phase II is started at a computer terminal. The program is finished with less than 30 seconds elapsed time and about 10 seconds of computer processing.

The outputs are written to a computer file for later use in reports and graphs as well as input to Phase III programs. The major outputs for each year are:

Amount of deductions (four categories and total) from the Michigan Transportation Fund before distribution of funds.

- Amount of distribution to the two state funds: the State Trunkline Fund and the Comprehensive Transportation Fund.
- Amount of distribution to cities.
- Amount of distribution to counties.

For a selected year:

- The total probable distribution to each county for city and county roads.

The third phase involves further estimates of income to the State Trunkline Fund and the Comprehensive Transportation Fund.

Phase III: Further Estimates for Two State Funds

The gas and weight tax revenue from Phase II accounts for more than half of the income to both the State Trunkline Fund (STF) and the Comprehensive Transportation Fund (CTF). The figures in both the CTF and STF for federal aid, interest, and miscellaneous have been estimated so that they are in line with the Department's Financial Planning Section's short range budget projections and to give a more complete "ballpark" figure for the long range forecasts for these funds. The main emphasis of the long range forecasts is generally to evaluate gas and weight tax revenue for different economic, travel, or tax assumptions. The method for estimating the federal aid, interest, and miscellaneous income is less rigorous and involves using a percentage method based on historical patterns and the short range budget forecasts.

Additional revenue for the STF is divided into three categories:

1) federal aid,
2) miscellaneous, and
3) interest.

Two methods are available to forecast these items. One is by increasing (or decreasing) each amount from a known base year by a given percentage each year. The other is to assume that each portion will remain the same percentage of the total each year. The gas and weight revenue from the Michigan Transportation Fund from Phase II would determine the total by

being assumed to be a certain percentage of the total. We have generally used this method assuming the gas and weight total would be 58% of the total. During the past few years, this value has varied between 54% and 61%. Miscellaneous is assumed to be 5.5% of the total. Interest is 1.5%. Federal aid is 35%. This is not the best way to estimate federal aid since other considerations such as the ability to have matching funds is now an important consideration. Recent work with the State Transportation Plan, which used these revenue forecasts, did not make use of the federal aid estimate but used a more detailed method.

The input requirements by year are:

- Gas and weight tax revenue from Phase II:

Either:

- Percent of total income from gas and weight taxes.
- Percent of total income from miscellaneous.
- Percent of total income from interest.
- Percent of total income from federal aid.

Or:

- Income in a known year from the four categories: gas and weight tax, miscellaneous, interest, and federal aid.
- The percent increase (four values) to be applied each year to the four categories.

The output is a computer file containing one record for each year of the forecast with total STF income, gas and weight income, miscellaneous income, interest income, and federal aid income. There is also a total which does not include federal aid.

The approach for the CTF revenue is similar to the STF approach. Generally, over 50% of the CTF income comes from the gas and weight taxes. About 25% of the income comes from automobile-related sales tax. Sales tax forecasts are available from the Department of Management and Budget, which are based on a model using AAA Bond yields, wages and salaries, and automobile production. By law, 27.9% of 25% of the automobile-related sales tax goes to the CTF. The 27.9% is an input variable for each year and can be changed. The method for estimating miscellaneous, interest, and federal aid for the CTF is currently fixed in the program at:

$$\text{Miscellaneous Revenue} = .102 * \left[\begin{array}{c}\text{CTF}\\ \text{Sales Tax}\\ \text{Revenue}\end{array}\right] + \left[\begin{array}{c}\text{CTF}\\ \text{Gas \& Weight Tax}\\ \text{Revenue}\end{array}\right]$$

$$\text{Federal Aid Revenue} = .06 * \left[\begin{array}{c}\text{CTF}\\ \text{Sales Tax}\\ \text{Revenue}\end{array}\right] + \left[\begin{array}{c}\text{CTF}\\ \text{Gas \& Weight Tax}\\ \text{Revenue}\end{array}\right]$$

$$\text{Interest Revenue} = .03 * (\text{All CTF revenue other than interest})$$

Input requirements by year are:

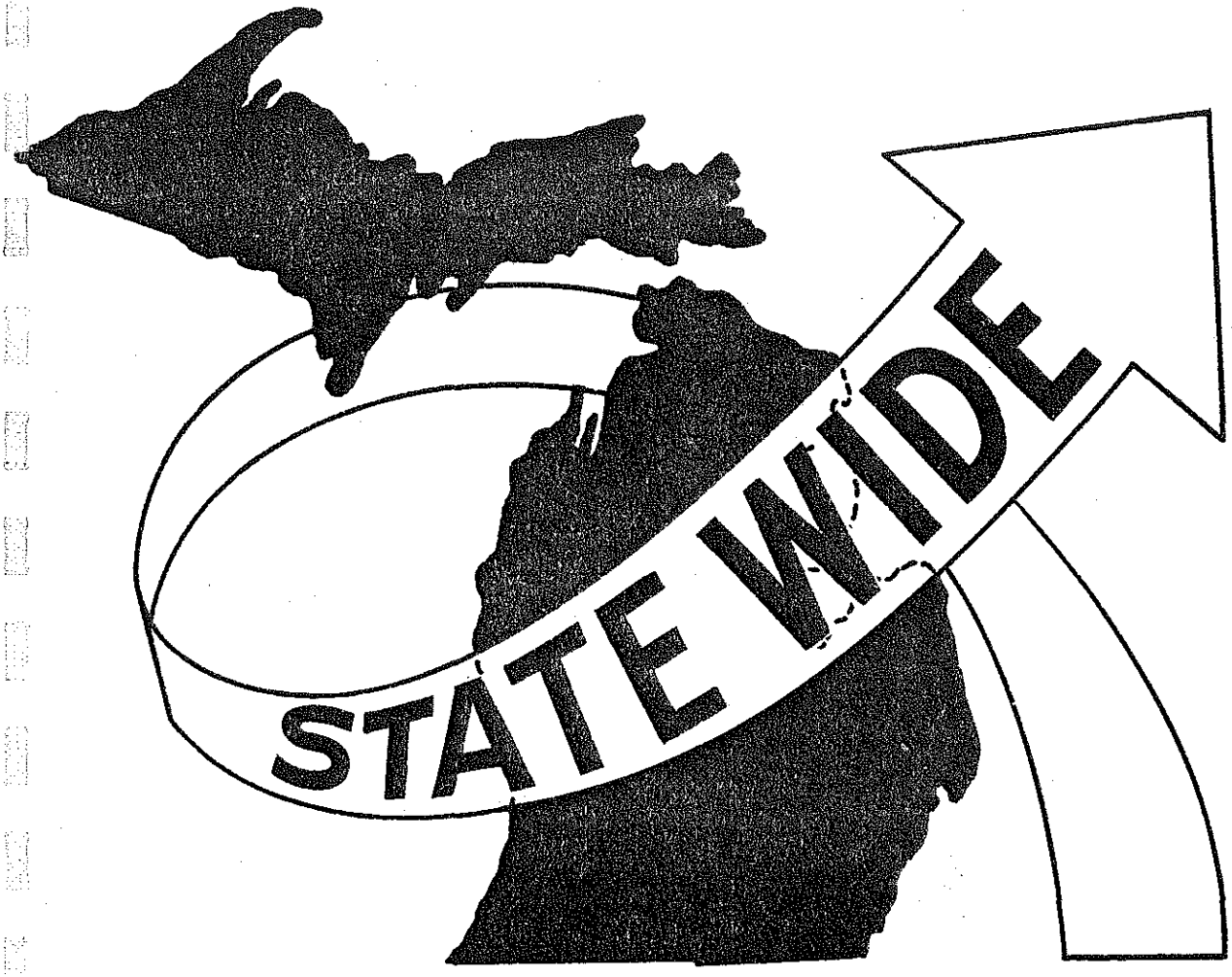
- Gas and weight tax revenue from Phase II,
- Total automobile-related sales tax, and
- That portion of the 25% of the automobile-related sales tax to go to the CTF.

Output results are written to a file containing one record for each year of the forecast with total CTF revenue, CTF sales tax revenue, interest, miscellaneous, and federal aid. A total is also included which does not include federal aid.

This last phase, which also includes producing a final summary report as previously noted in Figure 5, is completed with less than 30 seconds of

elapsed time and less than five seconds of computer process time. The graphs previously seen are produced by a general purpose graph program which uses as input the various files produced by the process. Graphs are not limited to those shown but can be produced for any of the output items mentioned.

APPLICATIONS



APPLICATIONS

To date, over 80 different alternatives have been examined for a variety of users. Most of the alternatives have been used to analyze proposed tax changes or prepare a proposal for tax changes. The most popular proposals have been:

Fuel Tax

1) increase the fixed tax per gallon by 1¢ to 3¢.

2) change the fixed tax per gallon to a percent of wholesale price.

3) a combination of 1) and 2).

4) index the tax per gallon to maintenance costs.

5) index the tax per gallon inversely to gallons of fuel consumed.

Vehicle Tax

1) increase the present average tax per vehicle by a given amount or by a percentage.

2) convert from a weight tax to a fixed rate per vehicle.

3) index the tax rate to Michigan Personal Income.

A detailed list of the tax alternatives is contained in Appendix A. Most of the alternatives are for the following users (in order of frequency of request):

1. MDOT, Bureau of Finance, Deputy Director - Analysis of tax proposals.

2. MDOT, Bureau of Finance, Financial Planning Section - Cash flow analysis.

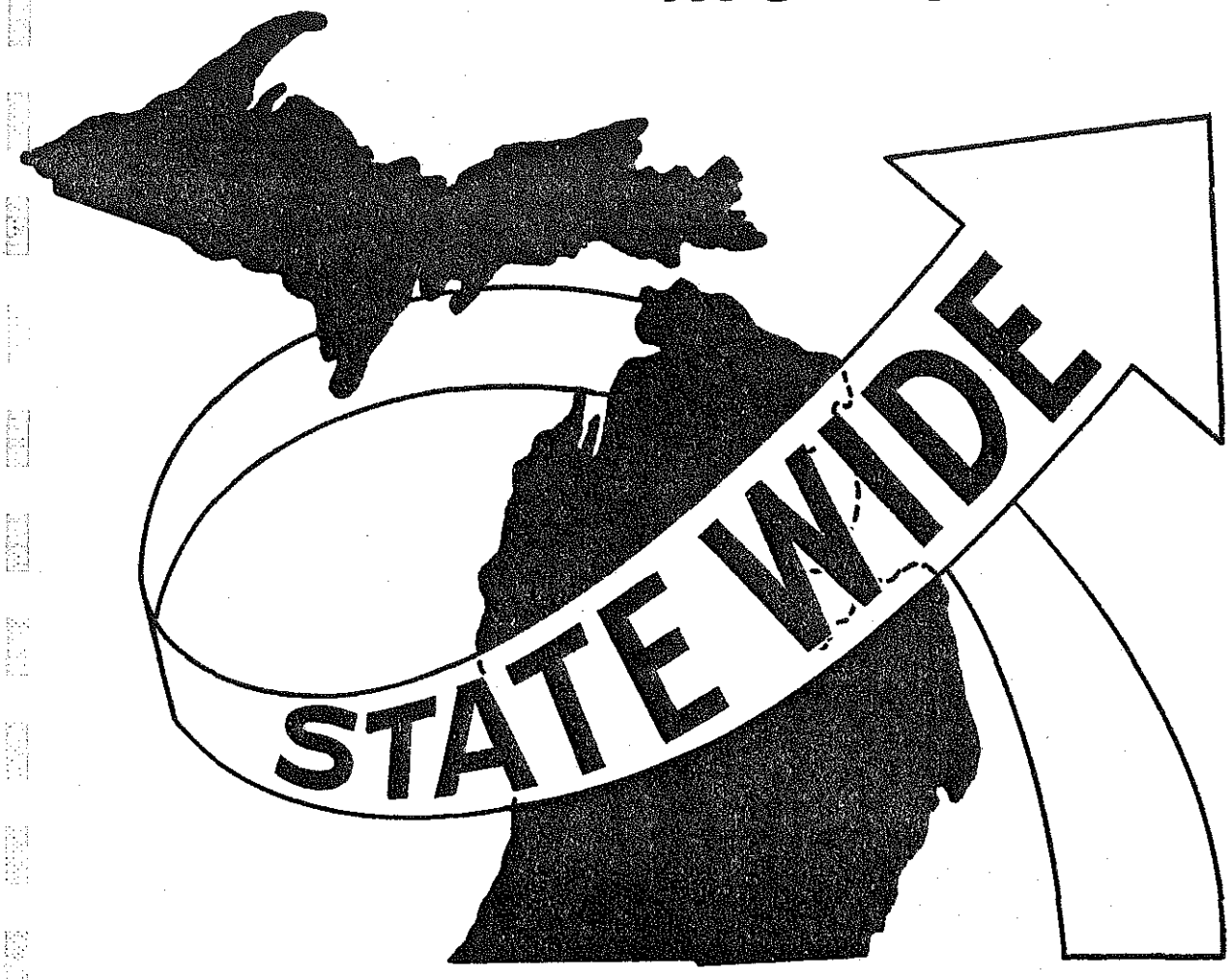
3. MDOT, Bureau of Transportation Planning, State Transportation Plan (STP) - Analysis of funds available vs. funds needed for prioritized needs.

4. MDOT, Director - Comparison of fixed fuel tax/gallon vs. percent of wholesale price.

5. Department of Management and Budget - Analysis of Governor's tax proposal.

The third application involving the State Transportation Plan deserves special note. It represents a continuing trend by the Bureau of Transportation Planning to integrate various planning functions into a more responsive and integrated system. Preparation of the STP brought together transportation demand forecasting, needs analysis, a prioritization process, and fiscal analysis. The cost of future needs are compared on a year-to-year basis with forecasted revenues from the long range revenue forecasting process. Analysis of shortfalls can be examined. Either tax proposals to generate more revenue can be examined or strategies to lessen deficiencies can be evaluated in order to bring income and costs more in line.

MODIFICATIONS



MODIFICATIONS

Proposed modifications center around either improvement in the forecasting ability or improvement in presentation of the results. Areas being considered are:

1). Use of a forecasted interest rate instead of a special interest factor when determining interest revenue.

2). Modifying the estimates of federal aid forecasts to use the process developed for the State Transportation Plan.

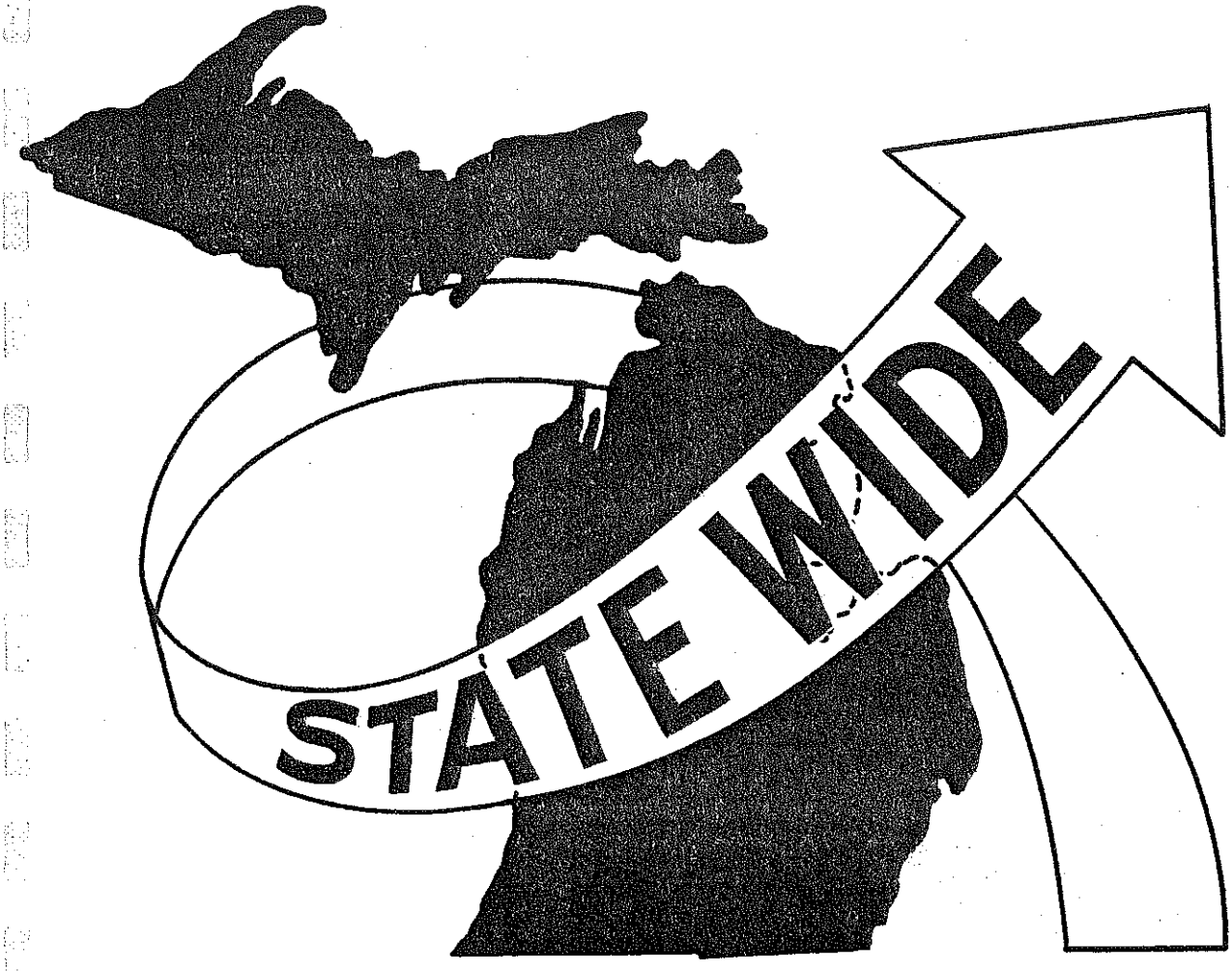
3). For the State Trunkline Fund and the Comprehensive Transportation Fund, allow the variables for miscellaneous interest and federal aid to be by year instead of constant for all years.

4). More development of simple summary reports.

5). Changes to better account for diesel automobiles.

The most important goal will be to keep the system useful and responsive to the user while maintaining a compatibility with other planning processes.

CONCLUSIONS



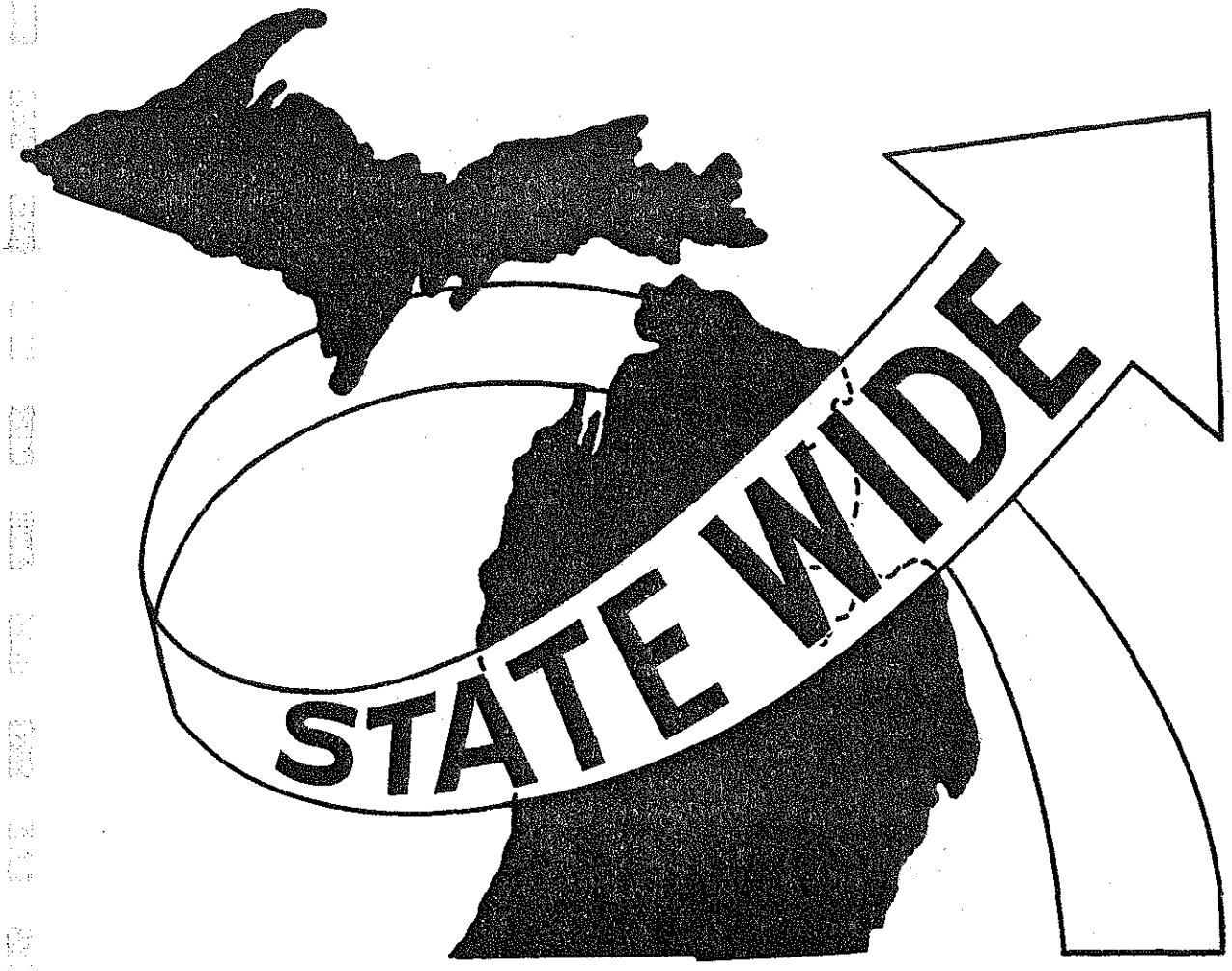
CONCLUSIONS

The long range transportation revenue forecasting model has become a useful tool for not only estimating future revenue based on the present situation, but also for testing tax structures or different types of future socio-economic schemes. Although there may be models which are technically more sophisticated, few will match the usefulness and flexibility to users of Michigan's model. There can be little claim to success unless a model is used. The over eighty tax alternatives attest to the usage of the systems.

Graphic display of the results or input assumptions is possible in black-and-white or color. These charts can be used for in-house, day-to-day applications or for publication in final documents.

Finally, the revenue forecasting process is not an isolated process. Input variables to the forecasting process come from other departmental products as well as using the revenue forecasting outputs as input to other departmental analysis.

APPENDIX A



APPENDIX A

REVENUE FORECASTING ALTERNATIVES

Alternative	Description
1	Present Tax Structure
2	$.02 per Gallon Fuel Tax Increase
3	$.04 per Gallon Fuel Tax Increase
4	$.06 Ad Valorem Assuming Fuel Price Increase
5	8% Ad Valorem Assuming Fuel Price Increase
6	6% Ad Valorem Assuming Fuel Price Fluctuation
7	4% Ad Valorem and $.05 per Gallon Assuming Price Fluctuation
8	Index Fuel Tax by Construction Price Index
9	Weight Tax Index: MPI; $.11 + 2% Ad Valorem Fuel Tax
10	Weight Tax Index: MPI (Maximum in 1985); $.11 + 2% Ad Valorem Fuel Tax
11	Vehicle Tax Index: MPI; $.11 + 2% Ad Valorem Fuel Tax
12	19 Equivalent Ad Valorem Fuel Tax (MDOT Prices)
13	19 Equivalent Ad Valorem Fuel Tax (Ernst & Whinney Prices)
14	Fuel Tax Index: CPI/MPI (Base Year 1978)

Alternative	Description
15	Bureau of Finance, except use new fuel prices (Ernst & Whinney, November 19) and weight tax beginning 82 of $28.00 and $91.00
	ALTS 16-32 are the same as ALT 11 except as noted.
	ALTS 16-23 are Bureau of Finance using MDOT Fuel Prices
	ALTS 24-32 are Bureau of Finance using Ernst & Whinney Fuel Prices
16	Weight Tax = $.00; Gas Tax = $.11 + 2%
17	Weight Tax = $35.00; Gas Tax = $.11 + 2%
18	Weight Tax = $28.00; Gas Taa = $.10 + 2%
19	Weight Tax = $.00; Gas Tax = $.10 + 2%
20	Weight Tax = $35.00; Gas Tax = $.10 + 2%
21	Weight Tax = $28.00; Gas Tax = $.09 + 2%
22	Weight Tax = $30.00; Gas Tax = $.09 + 2%
23	Weight Tax = $35.00; Gas Tax = $.09 + 2%
	ALTS 24-32 same as above except Ernts & Whinney November 19 Fuel Prices
	ALTS 33-41 are Department Director, best mix of fixed vs. Ad Valorem Tax. Modified ALT
33	Gas Tax = $.09 + 2%
34	Gas Tax = $.07 + 4.3%
34	Gas Tax = $.07 + 4.3%
35	Gas Tax = $.05 + 6.5%

Alternative	Description
36	Gas Tax = $.03 + 8.7%
	ALTS 37-40 are the same as ALTS 3336 ecept assume fuel price decline from 19 to 1985
41	Gas Tax = $.00 + 12%
42	Bureau of Finance, ALT 1 except flat MPG from 1980 on, New Vehicle Mile
43	Bureau of Finance, ALT 1 except flat vehicle mile from 1980 on
44	Bureau of Finance, ALT 1 standard vehicle mile
45	Same as ALT 32 except use 11% fuel tax
46	Same as ALT 45 except use double dip vehicle miles
47	Test Alternate
48	Bureau of Finance, Present Tax Structure
49	Test Alternate
50	11% Fuel Tax + Indexed Weight Tax, New Percent of Sales Tax
51	$10.00 Increase in Weight Tax + $.2 per Gallon Fuel Tax Increase
	ALTS 52-54, "Ohio type" Tax Structure
52	Fuel Tax Index to Federal Maintenance Cost Index
53	Fuel Tax Indexed to Ohio Type Formula which rises as maintenance costs rise or fuel use drops
54	Both Fuel and Weight Tax Index to Federal Maintenance Cost Index

Alternative	Description
55	Present Tax Structure with Modifications to Forecast Method
56	Present Tax Structure but Used DB Assumptions
57	Brown Bill Substitution using Ohio Type Index for Fuel Tax
58	Brown with 11% Fuel Gas Tax and Weight Tax Indexed by MPI
59	Brown as in ALT 58 except Fuel Ta uses Ohio Type from ALT 57
60	Same as ALT 59 except no sunset of fuel tax
61	Present Forecast using DMB 12/81 STP Assumption
62	Same as ALT 61 except Brown Package for Fuel Tax - index $.11 to Maintenance Cost and Fuel Consumed; Vehicle Tax Fee indexed to Michigan Personal Income
63	Same as ALT 62 except sunset after 1986 not allowed and fuel tax is continued using indexes
64	Same as ALT 61 but increase $.05 per gallon per year from 1988 - 1990 for federal turnback program
65	New Present Tax Structure
66	ALT 65 but Brown Tax Structure
67	Governor's Tax Package, with Income Tax (Not run)
68	ALT 65 + $.02 per Gallon
69	ALT 65 + $.03 per Gallon

Alternative	Description
70	May 1982, Present tax structure based on revised fuel tax method.
71	Present tax structure with revised fuel tax method
72	July 1982, Present tax structure with revised MPG figures
73	Start with ALT 72, then make Brown Package with 1980 base
74	Same as ALT 73, except use 1981 as base in calculating indexed taxes
	ALTS 75-81, Bureau of Finance, Modifications to ALT 72
75	Increase: Gas Tax by $.01, Passenger Weight Tax by $5.00, and Commercial Weight Tax by 30%
76	Increase: Gas Tax by $.02, Passenger Weight Tax by $5.00, and Commercial Weight Tax by 30%
77	Increase: Gas Tax by $.03, Passenger Weight Tax by $5.00, and Commercial Weight Tax by 30%
78	Increase: Gas Tax by $.01, Passenger Weight Tax by $5.00, and Commercial Weight Tax by 35%
79	Increase: Gas Tax by $.01, Passenger Weight Tax by $10.00, and Commercial Weight Tax by 30%
80	Increase: Gas Tax by $.02, Passenger Weight Tax by $10.00, and Commercial Weight Tax by 30%
81	Increase: Gas Tax by $.03, Passenger Weight Tax by $10.00, and Commercial Weight Tax by 30%