Draft Final Report

SCARCITY, RECYCLING AND SUBSTITUTION OF POTENTIALLY CRITICAL MATERIALS USED FOR VEHICULAR EMISSIONS CONTROL

Subreport

Prepared for

U.S. Environmental Protection Agency
2565 Plymouth Road
Ann Arbor, Michigan 48105

CRA #501

Charles River Associates Incorporated

Charles
River
Associates

Draft Final Report EPA-420-D-81-101

SCARCITY, RECYCLING AND SUBSTITUTION OF POTENTIALLY CRITICAL MATERIALS USED FOR VEHICULAR EMISSIONS CONTROL

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Prepared for

U.S. Environmental Protection Agency
2565 Plymouth Road
Ann Arbor, Michigan 48105

CRA #501

Prepared by

Rath & Strong
21 Worthen Road
Lexington, Massachusetts 02173

This report is a separately bound appendix to the CRA Draft Final Report.

CRA

The following material was submitted by subcontractor Rath & Strong, in support of their projections of U.S. consumptions of platinum-group metals for vehicular emissions control, as discussed in Chapter 3 of the main project report prepared by Charles River Associates.

FINAL REPORT

CRITICAL MATERIALS SCARCITY RECYCLING AND SUBSTITUTION STUDY

SUBCONTRACT
BETWEEN
CHARLES RIVER ASSOCIATES INC.
BOSTON, MASSACHUSETTS 02116
AND
RATH & STRONG INC.
21 WORTHEN ROAD
LEXINGTON, MASSACHUSETTS 02173

SUBCONTRACT NUMBER 501-1
UNDER
PRIME CONTRACT EPA NUMBER 68-03-2910

Rath & Strong, Inc.
Management Consultants

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April 1981
LeRoy H. Lindgren,
Vice President
Rath & Strong, Inc.

RATH & STRONG
INCORPORATED

INDEX

ARTICLE I

STATEMENT OF WORK

As subcontractor to Charles River Associates, Rath & Strong will help investigate for the Environmental Protection Agency the potential of developing mobile source emission control technologies that are effective in meeting the most future emission standards, but which do not contain materials that: (1) are critical or strategic, (2) contribute to balance of payment difficulties, or (3) require undue reliance on potentially unpredictable foreign sources of supply.

The specific goals which will be met by this project are to (1) quantify the critical materials used in mobile source emission control systems, (2) investigate the feasibility of recycling those critical materials, and (3) study materials that might be used as replacements for certain specific critical materials.

In order to meet or exceed the goals of this contract, Rath & Strong shall provide all of the necessary personnel, facilities, and equipment to perform the following tasks.

Task 1 -- Critical Materials Study

Rath & Strong will quantify the amounts of potentially critical materials in current mobile source emission control systems for automobiles, light trucks, and heavy trucks, using prior work done by the firm for EPA, JPL, DOT, DOE and NAS. Rath & Strong will also estimate materials requirements at the component level for advanced emission systems for trucks, motorcycles, and diesels, focusing on those components which use significant amounts of potentially critical materials. This work will be similar to earlier work done for automobiles by Rath & Strong, but will be more narrowly focused on material requirements. Using the automotive market models of Data Resources, Inc., Rath & Strong will run future demand scenarios as a basis for projecting required quantities of materials.

Task 2 -- Recycling Study

Rath & Strong will provide limited general assistance to CRA in its study of recycling, such as providing any literature on the recycling of platinum which Rath & Strong already has on hand.

Task 3 -- Replacement Study

Rath & Strong will analyze replacement of one material for another in pollution control equipment to the extent such substitutions are revealed by and related to the analysis of material requirements for different emission control systems in Task 1. Rath & Strong will assist CRA engineers in assessing various further substitution possibilities, and will provide general assistance such as guiding CRA to knowledgeable industry sources of information.

ARTICLE II
DELIVERABLE ITEMS

1. Monthly Progress Reports

   During the period of performance of this subcontract, Rath & Strong will provide monthly progress reports within eight (8) days of the preceding month. If requested, this information will be in writing.

(a) A brief statement of work accomplished prior to the state of the current reporting period;

(b) A brief statement of work performed during the reporting period, regardless of results, including photographs, graphs, tables or charts as necessary;

(c) Any technical problems, schedule changes, etc., that will assist CRA's Project Officer in evaluating the subcontractor's progress;

(d) All experimental data collected during the reporting period;

(e) A statement of work to be accomplished in the next reporting period, and

(f) Status of funds expended for the month, the cumulative total, and a comparison of projected and actual costs.

2. Task 1 Subreport

Within 3 months after the effective date of the Subcontract, Rath & Strong will submit to CRA a detailed listing of the quantities of potentially critical materials required for emission control systems under various scenarios for the size and composition of future vehicular production. Preliminary results will be provided to CRA as they become available.

Within four months after the effective date of the subcontract, Rath & Strong will submit to CRA a finished draft chapter presenting the above listings of critical materials, explaining clearly the auto production scenarios upon which they are based and any other underlying assumptions.

3. Task 3 Draft Material

Analysis of replacement possibilities by Rath & Strong for Task 3, based on the Task 1 analysis, will be submitted to CRA within eight (8) months after the effective date of this subcontract. This discussion will be in draft form suitable for inclusion in a draft final report.

ARTICLE III

PERIOD OF PERFORMANCE

The period of performance of this contract shall be eight (8) months from the effective date of this Subcontract, which shall be concurrent with the effective state date of the Prime Contract.

ARTICLE IV

This is a cost plus fixed fee completion type contract as defined in FPR 1-3.405-5(e) (1).

The estimated allowable cost for this contract is $26,643 and the fixed fee is $2,131. The total estimated cost plus fixed fee for this contract is $28,774.

ARTICLE V

GENERAL PROVISIONS

R & S agrees that all work under this Subcontract is subject to the terms set forth in the document entitled "General Provisions" which is attached hereto and made a part hereof.

In the General Provisions, the terms "Seller" refers to General Research Corporation and "Buyer" refers to Charles River Associates Incorporated.

This Subcontract requires the written consent of the Prime Contract contracting officer prior to the placing of this Subcontract.

This Subcontract is entered into as of *December 10, 1979.*

CHARLES RIVER ASSOCIATES INCORPORATED	RATH & STRONG, INC.
By:	By:
Harrison S. Campbell	E. Robert Barlow
Typed Name	Typed Name
Assistant Treasurer	Vice President and Treasurer
Title	Title
December 27, 1979	December 10, 1979
Date	Date

Written approval of
U.S. Environmental Protection Agency
contracting officer:

12/17/79
Date

Task 1

Rath & Strong Inc. developed a set of scenarios for automobiles and light trucks that are included with this report. We also included a forecast of the econometric demand (consensus) and Rath & Strong's projection of the likely mix or share that was used to project the economic forecast. The first scenario is a technological projection of the changes in vehicles and emission systems by company and by year at a constant volume.

These two scenarios were used to generate the critical material demands using Rath & Strong's computer data base which resides on Data Resources Inc. computer in Lexington. Each emission system was defined for each vehicle configuration for several levels of emission standards. The diesel engines were assumed to be equipped with a monolithic substrate contained in a 409 steel clamshell particulate trap in which the particulate particles are burned off using exhaust gas temperatures. The scenarios define the introduction of the 4 - 6 and 8 engines starting in 1980.

The summary of the critical materials is included in this section. Also, we included the specifications of the emission system configurations used in the vehicles.

The platinum series summary indicates that a decline in usage is likely due to reduction in gasoline engine sizes and the introduction of diesel engines which reduce the use of gasoline engines. Also, it was assumed that noble metals would not be used on the particulate trap substrate.

The motorcycle usage of a catalytic device will not affect the usage significantly.

The heavy truck conversion to diesel engines will put a demand on particulate traps but it will have little or no effect on the critical materials demand. The gasoline engine will be replaced by diesel engines in all classes over Class 2 trucks.

Task 2
Recycling Study

Rath & Strong has some doubts that a cost effective recycling procedure can be developed. The current strategy of obtaining over 50,000 mile reliability in the emission systems is probably more cost effective. The replacement costs of a three-way catalyst will probably reach a $300 to $400 cost to customer.

Task 3
Replacement Study

Rath & Strong has worked on several emissions projects over the last 10 years and has concluded that a substitute catalyst such as nickel shims or other similar metal substrate will require a major redesign program in the automobile and light truck industry. If a platinum (OPEC type) situation shortage occurs, we will be faced with a major national environmental decision.

Company: Chrysler

3 WAY MONO - CLAM SHELL CONVERTER REDUCING OXIDATION (260) CLAMSHELL

Part	Description Material	MS	WT	
Converter Assembly	Assembly		26.17	
Outer Wrap	409SS	2792	8.00	
Shell	409SS	3920	4.00	
I/O Pipes	409SS	3920	2.50	
Bed Support	409SS	3920	3.77	
Insulation	Fiber glass	KZ1-6	1.50	
Substrates (Cordite O_2)	Ceramic	5747	3.10	
Washcoat	AL203	5835	.10	
			lbs.	grams
Platinum		5748		1.88
Palladium		5749		.59
Nox Substrate	Ceramic	5747	3.10	
Washcoat	AL_2O_3	5835	.10	
Rhodium (L4)		1936		.09
Ruthenium (L6-V8)		430		.17

Company: Ford

3 WAY MONOLITHIC CATALYST 63 CID

Part	Description Material	MS	WT	
Converter Assembly			20.61	
Shell	409SS	3920	6.47	
Rings (No.)	409SS	3920	2.70	
Inlet Cone	409SS	3920	1.35	
Outlet Cone	409SS	3920	1.35	
Inlet Pipe	409SS	3920	1.35	
Flanges	409SS	3920	.34	
Mesh	409SS	5789	.51	
Hardware	Steel	420	.14	
Substrates (2) - Ceramic	Ceramic	5747	3.10	
Washcoat	AL_2O_3	5835	.10	
O_2 Substrate			lbs.	grams
Platinum		5748		1.88
Palladium		5749		.59
Nox Substrate	Ceramic	5747	3.10	
Washcoat	AL_2O_3	5835	.10	
Rhodium (L6, V6 - V8)		1936		.17
Rhodium L4		1936		.09
Washcoat		5835		.10

Company: GM and AMC

REDUCING 3 WAY PELLETED OXIDATION CATALYST 260 CUBIC INCHES

Part	Description Material	MS	WT
Converter Assembly	Assembly		26.21
Outer Wrap	409SS	2792	8.00
Shell	409SS	3920	4.00
I/O Pipes	409SS	3920	2.50
Bed Support	409SS	3920	3.77
Insulation	Fiber glass	KZ1-6	1.50
Pellets (02)	Alumina	5835	3.22

			lbs.	grams
Platinum		5748		1.88
Palladium		5749		.59
Nox Pellets	Alumina	5835	3.22	
Rhodium L6-V6-V8		1936		.17
Rhodium L4		1936		.09

RATH & STRONG

INCORPORATED

Company: Chrysler, Ford, AMC, and GM

O_2 MONOLITHIC START CATALYST 43 CID

Part	Description Material	MS	WT
Converter Assembly	Assembly		4.880
Shell Rings	409SS	3920	2.000
Mesh	409SS	5789	.250
I/O Cones	409SS	3920	.750
Washcoat	AL_2O_3	5835	.10
Hardware	Steel	420	.250
Heat Shield	Aluminum	6202	1.000
Substrate	Ceramic	6077	.530
			grams
Platinum		5748	1.08
Palladium		5749	.47

Company: Chrysler

02 MONOLITH OXIDATION 63 CID

Part	Description Material	MS	WT
Converter Assembly	Assembly		22.97
Outer Wrap	409SS	2792	8.00
Shell	409SS	3920	4.00
I/O Pipes	409SS	3920	2.50
Bed Support	409SS	3920	3.77
Insulation	Fiber glass	KZ1-6	1.50
Substrate (Cordite 0_2)	Ceramic	5747	3.10
			grams
Wash Coat	AL_20_3	5835	.10 lbs.
Platinum		5748	1.74
Palladium		5749	.744

Company: Ford

MONOLITHIC OXIDIZING CATALYST

63 CUBIC INCH SUBSTRATE

Part	Description Material	MS	WT
Converter Assembly	Assembly		7.900
Shell	409SS	3920	2.000
Ring	409SS	3920	1.000
Inlet Cone	409SS	3920	1.000
Outlet Cone	409SS	3920	1.000
Inlet Pipe	409SS	3920	1.000
Flanges	409SS	3920	.250
Mesh	409SS	5789	.150
Hardware	Steel	420	.100
Substrate /Cordite O_2	Ceramic	5747	1.300
Washcoat	AL_2O_3	5835	.10

		Grams
Platinum	5748	1.74
Palladium	5749	.744

Company: GM and AMC

PELLETED OXIDATION 260 CUBIC INCHES

Part	Description Material	MS	WT
Converter Assembly	Assembly		26.20
Outer Wrap	409SS	2792	8.00
Shell	409SS	3920	4.00
I/O Pipes	409SS	3920	2.50
Bed Support	409SS	3920	3.77
Insulation	Fibre glass	KZ1-6	1.50
Pellets	Alumina	5835	6.43

		grams
Platinum	5748	1.74
Palladium	5749	.744

<u>CRA</u>

<u>CRITICAL MATERIALS</u>

<u>Company:</u> GM (in grams.) Est.

Vehicles	Mat'l	MS	1980	1981	1982	1983	1984	1985	1986	1987	1990
Cars - USA	PT	5748	11273400	10855800	8936400	8278200	7597800	7938000	9525600	8731800	
	PA	5749	4823400	4645800	3826800	2584200	2371800	2478000	2937600	2725800	
	RO	1936	-	-	-	586200	505800	522000	636000	564600	
	RU	430									
Constant Volume Total			5700000								
Consensus Forecast Total N.A.			4723000	4890000	5500000	5900000	6050000	6150000	6190000	7930000	
Light Trucks USA	PT	5748	2733305	2632055	2166685	2007100	1842133	1924617	2309540	2117079	
	PA	5749	1169463	1126403	927831	626555	575057	600806	720968	660887	
	RO	1936	-	-	-	142128	122634	126562	154202	136891	
	RU	430									
Constant Volume Total			1382000								
Consensus Forecast Total-N.A			904000	905000	1275000	1350000	1350000	1400000	1430000	* 1200000	
Total USA Cars & Light Trucks	PT	5748	14006705	13487855	11103085	10285300	9439933	9862617	11835140	10848879	
	PA	5749	5992863	5772203	4754631	3210755	2946857	3078806	3694568	3386687	
	RO	1936	-	-	-	728328	628434	648562	790202	701491	
	RU	430									
Total N.A. Cars & Light Trucks	PT	5748	11129021	11036729	10621773	10529288	9863810	10514368	12734222	13986199	
	PA	5749	4761627	4723230	4548521	3286921	3079178	3282263	3975234	4366062	
	RO	1936	-	-	-	745605	656652	691421	850231	904351	
	RU	430									

CRA
CRITICAL MATERIALS

Company: Ford (in grams.)

Vehicles	Mat'l	MS	1980	1981	1982	1983	1984	1985	1986	Est. 1987	1990
Cars - USA	PT	5748	5441920	5133040	4158000	4158000	4033260	3991680	3991680	3825360	
	PA	5749	2320780	2186360	1298000	1288000	1259060	1246080	1246080	1194160	
	RO	1936	0	0	286000	270160	251900	242880	242880	234960	
Constant Volume Total			2090000								
Consensus Forecast Total-N.A.			1536000	1705000	1875000	1975000	2025000	2075000	2195000	1690000 *	
Light Trucks USA	PT	5748	2385071	2249696	1822358	1822358	1767687	1749464	1749464	1676569	
	PA	5749	1017146	958232	568884	568884	551818	546129	546129	523373	
	RO	1936	0	0	125347	118405	110402	106449	106449	102978	
Constant Volume Total			916000								
Consensus Forecast Total-N.A.			715000	680000	900000	1000000	1000000	1030000	1040000	600000 *	
Total USA Cars & Light Trucks	PT	5748	7826991	7382736	5980358	5980358	5800747	5741144	5741144	5501929	
	PA	5749	3337926	3144592	1866884	1866884	1810878	1792209	1792209	1717533	
	RO	1936	0	0	411347	388565	362302	349329	349329	337938	
Total N.A. Cars & Light Trucks	PT	5748	5861130	587560	5520790	5918684	5837613	5930224	6178510	4191423	
	PA	5749	2499558	2494961	1723421	1847631	1822324	1851234	1928741	1308433	
	RO	1936	0	0	379737	384558	364596	360834	375941	257444	

*R & S Forecast

CRA
CRITICAL MATERIALS

Company: AMC (in grams.)

Vehicles	Mat'l	MS	1980	1981	1982	1983	1984	1985	1986	Est. 1987	1990
Cars - USA	PT	5748	846000	846000	846000	877920	883380	885060	799200	763680	
	PA	5749	363000	363000	363000	328800	322960	321160	286200	273480	
	RO	1936	-	-	-	20520	24020	25100	24300	23220	
	RU	430									
Constant Volume Total			285000								
Consensus Forecast Total-N.A.			185000	170000	190000	225000	250000	250000	260000	* 130000	
Light Trucks USA	PT	5748	457137	457137	457137	474385	477335	478243	431848	412655	
	PA	5749	196147	196147	196147	177667	174512	173539	154648	147775	
	RO	1936	-	-	-	11088	12979	13563	13131	12547	
	RU	430									
Constant Volume Total			154000								
Consensus Forecast Total N.A.			103000	85000	140000	150000	150000	155000	160000	* 50000	
Total USA Cars & Light Trucks	PT	5748	1303137	1303137	1303137	1352305	1360715	1363303	1231048	1176335	
	PA	5749	559147	559147	559147	506467	497472	494699	440848	421255	
	RO	1936	-	-	-	31608	36999	38663	37431	35767	
	RU	430									
Total N.A. Cars & Light Trucks	PT	5748	854905	756947	979579	1155158	1238251	1254239	1181806	482297	
	PA	5749	366821	324789	420316	432631	452700	455123	423214	172715	
	RO	1936	-			27000	33669	35570	35934	14664	
	RU	430									

* = R & S Forecast

<u>CRA</u>

<u>CRITICAL MATERIALS</u>

Company: Chrysler (in grams.)

Vehicles	Mat'l	MS	1980	1981	1982	1983	1984	1985	Est. 1986	1987	1990
Cars - USA	PT	5748	2535200	2225400	1710800	1466400	1466400	1428800	1278400	1146800	
	PA	5749	1027000	919600	536900	460200	460200	448400	401200	359900	
	RO	1936	25200	13500	53100	70200	70200	68400	61200	54900	
	RU	430	13420	-	60800	-	-	-	-	-	
Constant Volume Total			950000								
Consensus Forecast Total-N.A.			741000	930000	990000	1100000	1125000	1150000	1160000	* 910000	
Light Trucks USA	PT	5748	725868	637167	489829	419853	419853	409088	366026	328347	
	PA	5749	294046	263296	153723	131763	131763	128384	114870	103045	
	RO	1936	7215	3865	15203	20099	20099	19584	17523	15719	
	RU	430	3842	-	17408	-	-	-	-	-	
Constant Volume Total			272000								
Consensus Forecast Total-N.A.			222000	160000	200000	185000	185000	195000	195000	* 200000	
Total USA Cars & Light Trucks	PT	5748	3261068	2862567	2200629	1886253	1886253	1837888	1644426	1475147	
	PA	5749	1321046	1182896	690623	591963	591963	576784	516070	462945	
	RO	1936	32415	17365	68303	90299	90299	87984	78723	70619	
	RU	430	17262	-	78208		-	-	-	-	
Total N.A. Cars & Light Trucks	PT	5748	2569892	2553354	2143002	1983498	2022088	2022880	1823402	1339945	
	PA	5749	1041053	1055120	672538	622482	634592	634840	572238	420515	
	RO	1936	25545	15489	66514	94954	96802	96840	87291	64147	
	RU	430	13603	-	76160	-	-	-	-	-	

COMPARISON

	185 MPG Electric	1500 3 cyl G/D	2200 4 cyl G/D	2700 4 cyl V6 cyl G/D	3200 4 cyl V6 cyl G/D	3000 4 cyl V6 G/D	3500 V6 G/D	3700 V8/V6 G/D
		45/55	30/40	25/35	20/25	25/35	20/25	20/25
GM	EV	S FWD CVT T300	J FWD 125 X-Truck	X FWD 125/440 X-Truck	AX FWD 440	FX FWD 440	KX FWD 440	CX FWD 440
FORD	O	EXP FWD	ERICKA ESCORT Courier RWD	FX FWD ATO Topaz	Ltd RWD FIOD	Taurus FWD ATO	Versaille RWD FIOD	Contin. RWD FIOD
CHRYSLER	O	O	Omni	K K Truck FWD				
AMC	O	Mini LeCar	Maxi LeCar	4WD Jeep				
VW	O	O	Rabbit Pickup FWD	Jetta Van FWD				
TOYOTA	O	O	Tercel FWD	Corolla RWD				
HONDA		Civic	Accord					
NISSAN			310 FWD 210 RWD					

CODES

FWD – Front Wheel Drive
K or X – Design Designation for FWD Cars and Trucks
125/440 – FWD Transmission – GM

ATO – FWD Transmission – Ford
FIOD – RWD – Transmission – Ford

NORTH AMERICAN PASSENGER CAR MARKET FORECAST (X 1000)

CONSENSUS - SURVEY							RATH & STRONG		
Company	1980	% SOM	1983	% SOM	1985	% SOM	1987	% SOM	
Ford	1,536	15	1,975	16	2,075	17	1,690	13	Competitive Fleet not Available
GM	4,723	47	5,900	48	6,150	48	7,930	61	Full Fleet and Electric
Chrysler	741	8	1,100	9	1,150	9	910	7	Limited to 3 Car Lines
AMC	185	2	225	2	250	2	130	1	Selling Renaults
VW	197	2	425	3	550	4	520	4	Growing Fleet
Honda	—	—	125	1	250	2	130	1	Limited
Domestic Market	7,382	74	9,750	79	10,425	82	11,310	87	
Imports	2,549	26	2,600	21	2,275	18	1,690	13	Foreign Imports Lost
Total - NA Market	9,931		12,350		12,700		13,000		

Assuming the Conservation Policy and Price of Gasoline will continue to limit the imports from Europe and the USA small cars will reduce the Japanese imports.

NORTH AMERICAN LIGHT TRUCK MARKET FORECAST (X 1000)

CONSENSUS - SURVEY							RATH & STRONG		
Company	1980	% SOM	1983	% SOM	1985	% SOM	1987	% SOM	
FORD	715	29	1,000	30	1,030	32	600	25	RWD
GM	904	37	1,350	40	1,400	44	1,200	51	FWD X - J Trucks
CHRYSLER	222	9	185	6	195	6	200	8	FWD K - L Trucks
AMC	103	4	150	5	155	5	50	2	4-Wheel Only
IH (Scout)	10		0		0		0		
VW	22	1	35	1	35	1	50	2	FWD
NISSAN			105	3	110	3	110	3	RWD
Domestic Market	1,976	80	2,825	85	2,925	91	2,210	91	
Import Trucks	500	20	400	15	275	9	150	9	
Total Markets	2,476		3,225		3,200		2,360		

The light truck will lose volume to the cars.

FORD PASSENGER CAR

	ACTUAL 1980	1981	1982	1983	1984	1985	1986
FORD	135	130	135	125	-	-	-
T-BIRD —	141	97	110	170	190	185	180
GRANADA	89	151	170	160	260[4]	120/170[6]	320
FAIRMONT	305	235	190	95/140[3]	285	280	275
PINTO/ESCORT	179	297[1]	380	370	360	375	375
EXP ERICKA	-	71[1]	160	155	170	180	180
MUSTANG	253	205	140	135	130	125	120
MERCURY	53	61	55	50	-	-	-
XR7	51	41	45	80	90	90	85
MONARCH/COUGAR	32	68	75	70	95[4]	45/65[6]	130
ZEPHYR	113	76	65	30/50[3]	115*	110*	110*
BOBCAT/LYNX	39	103[1]	140	140	130	140	140
LN-7	-	25[1]	50	50	60	65	65
CAPRI	75	64	45	45	40	40	40
LINCOLN	27	38	35	35	40[5]	35	110[7]
MARK VI	39	43	40	40	60[5]	50	65[7]
VERSAILLES/CONTINENTAL	4	-	40[2]	35	-	-	-
TOTAL	1,535	1,705	1,875	1,975	2,025	2,075	2,195

1) ERIKA-FWD (Escort) PINTO/BOBCAT REPLACEMENT
2) TOWN CAR "FOX" VERSAILLES
3) TOPAZ-FWD FAIRMONT/ZEPHYR REPLACEMENT BY FORMAL ERIKA (Escort) 2-DR & 4-DR
4) FRESH "FOX" FORD/MERCURY REPLACEMENT
5) NEW "FOX" LINCOLN/MARK VI
6) TAURUS-FWD GRANADA/COUGAR MID-YEAR REPLACEMENT
7) TAURUS-FWD "FOX" LINCOLN/MARK REPLACEMENT

*INCLUDES LUXURY TOPAZ

11/18/80 REVISED PER 80E & PROGRAM 407
BFC SALES PLANNING 12/5/80

SUMMARY OF PRODUCTION

ASSUMING GENERAL MOTORS (ESTES FORECAST)

85 - 31.0 MPG   90 - 40 MPG   95 - 50 MPG

WITH ELECTRIC VEHICLE (185 MPG CREDIT)

Year	MPG	EV	S	TX	JX	X	FX	AX	BX	CX	EX	KX
1985	31.0	50	0	957	1163	1439	158	1152	325	200	64	154
1990	40.0	524	675	1757	941	824	–	749	50	50	55	75
1995	50.0	1078	1500	1507	655	430	–	530	–	–	–	–

AUTOMOTIVE SCENARIO 1980-1995

Introduction

Some of our clients in the tooling industry are confronted with unexpected windfall business that may create an overoptimistic forecast of their future capacity requirements.

To meet the need for valid consumption scenarios, we have developed a methodology to assess the impact of current economical trends, new technology, and current legislative action relating to the automotive industry. These data are "what if" scenarios, not necessarily predictions or forecasts.

A. Methodology

The methodology which we elected to follow, if straightforward at first sight, looks awesome:

1. These scenarios optimize diesel engines and full size cars to achieve maximum profits and machine tool investments.

2. We created a hypothetical fleet of cars for each manufacturer, year by year, for the 1980-1995 period which would meet a hypothetical CAFE standard (between 1985 and 1995), would comply with the 1985 emission standards, and still generate profits for the manufacturers.

   This first phase is referred to as the scenario.

3. For sake of simplicity and for lack of better knowledge, we kept the total production of cars to the 1979 level knowing that we could always modify the outputs by merely changing the production input in the revised scenario.

   We will now cover in detail the assumptions made for each company in preparing the scenario.

B. Scenario Assumptions

The scenarios for a passenger car fleet were based on the following technological assumptions:

1. Energy conservation would still be the driving force during the eighties and the nineties for lack of a well-defined energy production policy.

2. Long before the $2.50 per gallon price level, consumers' demands for economy cars will override the standards mandated by Congress.

3. EPA would maintain their 1985 standards on HC, CO, and NOx but might impose .2 gpm particulate regulations unless conclusive evidence would prove that particulates are not carcinogenous.

4. Technology would solve the emission and particulate standards and the diesel engine will be a significant percentage of the market.

5. Diesel fuel oil will be made available by the refineries from crude oil or synthetic process. The recent publications of both the American Petroleum Institute and the Society of Automotive Engineers support this assumption. Briefly stated, the present average production mix for U. S. refineries is referred to by the ratio of 2.1 parts gasoline to 1 part distillates. At this ratio, diesel fuel produced by U S. refineries equals 28,600,000 gallons a day. To make larger amounts of diesel fuel, it would be necessary to expand certain processing units. At a ratio of 0.7, these additions could theoretically require a total of plant investment $85 million. However, production of distillates would increase by 75%.

   Given the production mix of the scenario the U. S. car population of 1995 could consist of approximately 60% gasoline vehicles and 40% diesel vehicles. This car population could be fueled by U. S. crude oil refineries at an economically feasible production level of 0.7 parts gasoline to 1 part distillate referred to previously.

6. There would be no serious alternative for the internal combustion engine until 1990. The only serious alternate would be the birth of the electric or hybrid electric car for cummuting purposes.

Our fundamental assumptions applying to all scenarios were:

1. CAFE standard will increase by 1.5 mpg per year starting 1986 to reach 35 mpg in 1990 and 42 mpg in 1995.

2. Emission standards will be met by all engines in the scenario including diesel engines.

3. Reconfiguration to FWD with downsizing would lead to a 28% to 39% fuel economy improvement.

4. Diesel engines provide an increase of 15% to 20% in fuel economy over a comparable gas engine.

5. Turbocharging improves performance without improving or penalizing fuel economy.

6. GASAHOL will be used in limited applications--up to 10% by 1995.

C. Scenario Assumptions for Companies

1. Scenario Assumptions for AMC

   a. Renault cars will be weight reduced when U. S. production begins in 1983.

   b. Pacer dropped in 1980.

   c. 258 and 232 L-6 engines weight reduced in 1980.

d. Eagle downsized in 1981.

e. Produce own 4-cylinder engines in 1983.

f. Fleet sales in 1985 as follows:

(1) 50% FWD Renault
30% 4WD
20% RWD

(2) 10% 6-cylinder gas engines
90% 4-cylinder gas engines

(3) 15% Turbocharges engines

g. Fleet sales in 1990 as follows:

(1) 85% FWD
15% 4WD

(2) 35% 4-cylinder diesel engines (Purchased from Renault)
65% 4-cylinder gas engines

(3) 25% Turbocharged engines

h. Fleet sales in 1995 as follows:

(1) 95% FWD
5% 4WD

(2) 90% 4-cylinder diesel engines
10% 4-cylinder gas engines

(3) 45% Turbocharged engines

2. <u>Scenario Assumptions for Chrysler</u>

a. Stays in business.

b. Strategy parallels GM.

(1) All cars reconfigured to FWD on K line by 1983.

(2) Introduce commuter car in 1989.

First Year With FWD

	80	81	82	83	84	85
Body Type						
		FK		MK		LK*
						EK
						RK

* Omni will use K car components beginning in 1985.

c. Buy VW L-4 engines until 1981.

d. Import Mitsubishi cars and engines until 1984.

e. Produce own L-4 engine in 1982. (Mexico) (2.2)
Product L-4 engine. (Trenton, Michigan) (1.8)

f. Buy Peugeot L-4 diesel engine.

g. Produce own L-4 diesel engine in 1986 on a transfer line which will be capable of producing both gasoline and diesel engines.

h. All cars will be weight reduced when they go to FWD.

i. Fleet sales for 1985 as follows:

(1) 100% FWD

(2) 75% 4-cylinder gas engines
25% 4-cylinder diesel engines

(3) 20% Turbocharged engines

j. Fleet sales for 1990 as follows:

(1) 55% 4-cylinder gas engines
45% 4-cylinder diesel engines

(2) 20% Turbocharged engines

k. Fleet sales in 1995 as follows:

(1) 30% 4-cylinder gas engines
70% 4-cylinder diesel engines

(2) 20% Turbocharged engines

3. <u>Scenario Assumptions for Ford</u>

a. Improve CAFE by introducing and expanding the Escort to the car lines.

	First Year With FWD			
	1980	1981	1982	1983
Body Type		HE	F Fiesta*	Hsp

* Fiesta will be dropped as an import in 1981 and will begin production in the U. S. using Escort components.

b. Proco is cancelled.

c. Import Toyo Kogyo 4-cylinder diesel 2.0L engines, beginning in 1984.

d. Import TC 6-cylinder diesel BMW-STEYR in 1984.

e. Fleet sales in 1985 as follows:

(1) 75% FWD
25% RWD

(2) 65% 4-cylinder gas engines
5% 4-cylinder diesel engines
15% 6-cylinder gas engines
15% 8-cylinder gas engines

(3) 20% Turbocharged engines

f. Fleet sales in 1990 as follows:

(1) 95% FWD
5% RWD

(2) 40% 4-cylinder gas engines
30% 4-cylinder diesel engines
30% 6-cylinder gas engines

(3) 20% Turbocharged engines

g. Fleet sales in 1995 as follows:

(1) 100% FWD

(2) 50% 4-cylinder gas engines
45% 4-cylinder diesel engines
5% 6-cylinder gas engines

(3) 20% Turbocharged engines

4. <u>Scenario Assumptions for GM</u>

a. Improve CAFE by expanding the X line.

First Year With FWD

	80	81	82	83	84	85	86
Body Type	X	JX		AX	BX	TX	YX
					CX	AspX	FX
				P		EX	
						KX	

(1) Accelerate FWD program so that all cars are FWD by 1986.

(2) Reduce period between downsizing and FWD from seven to five years.

(3) Introduce a two-seat S Car (commuter) by 1983.

b. 1986 would be the first year with all front-wheel drives.

This, in our opinion, represented the greatest opportunity for GM to capitalize on engine, transmissions, and FWD commonality.

c. An electric vehicle will be introduced in 1985 with an MPG credit of 185 MPG. The GM forecast is to produce 200,000 EV by 1990.

d. 4-cylinder engines were optimized rather than diesels and 6-cylinder engines.

e. CAFE would be 27.5 MPG in 1985, 35.0 MPG in 1990, and 42.5 MPG in 1995.

f. Fleet sales in 1985 as follows:

(1) 50% 4-cylinder gas engine (1984-3-cylinder-1.5L-gas engine)
10% 4-cylinder diesel engine (1984-V5-2.7L-diesel engine)
15% 6-cylinder gas engine
20% 6-cylinder diesel engine
5% 8-cylinder diesel engine

(2) 17% Turbocharged engine

g. Fleet sales for 1990 as follows:

(1) 46% 4-cylinder gas engine - 3 cylinder gas engine
40% 4-cylinder diesel engine
10% V6-cylinder diesel engine - V5-cylinder diesel engine
4% Electric Vehicles

(2) 22% Turbocharged engines

h. Fleet sales in 1995 as follows:

(1) 37% 4-cylinder gas engine - 3-cylinder gas engine
50% 4-cylinder diesel engine
5% V6-cylinder diesel engine - V5-cylinder diesel engine
8% Electric Vehicles

(2) 15% Turbocharged engines

5. Scenario Assumptions for Honda

a. Cars will be built eventually in the U. S.

b. Produce or buy diesel engines.

c. Fleet sales for 1985 as follows:

(1) 100% FWD

(2) 100% 4-cylinder gas engines

(3) 15% Turbocharged engines

d. Fleet sales in 1990 as follows:

(1) 70% 4-cylinder gas engines
30% 4-cylinder diesel engines

(2) 20% Turbocharged engines

e. Fleet sales in 1995 as follows:

(1) 30% 4-cylinder gas engines
70% 4-cylinder diesel engines

(2) 20% Turbocharged engines

6. Scenario Assumptions for VW

a. Cars will eventually be U. S. built except engines will be imported.

b. Rabbit will be redesigned in 1984.

c. Bus get diesel engine in 1985.

d. Fleet sales in 1985 as follows:

(1) 95% FWD
5% RWD (Bus)

(2) 30% 4-cylinder gas engines
70% 4-cylinder diesel engines

(3) 20% Turbocharged engines

e. Fleet sales in 1990 as follows:

(1) 100% FWD

(2) 15% 4-cylinder gas engines
85% 4-cylinder diesel engines

(3) 20% Turbocharged engines

f. Fleet sales in 1995 as follows:

(1) 5% 4-cylinder gas engines
95% 4-cylinder diesel engines

(2) 20% Turbocharged engines

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
AMC

LAST UPDATE 12-18-80
(UNITS X1000)

								CAFE STANDARDS													CAFE PROJECTIONS			
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	70	1.1	R1	M	F	35	0	0	0	0	0	0	0	10	25	30	50	55	55	40	25	15	0
L-4	78	1.3	R2	A	F	31	20	30	40	50	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	78	1.3	R2	A	F	32	0	0	0	0	60	60	60	60	60	60	60	50	40	30	25	15	10
L-4	78	1.3	R3	A	F	32	0	0	0	0	60	60	60	60	60	60	60	50	40	30	25	15	10
L-4	115	1.8	R3	A	F	24	3	10	50	50	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	121	2.0	AX	A	R	26	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	121	2.0	H	A	R	25	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	151	2.5	E	A	4	24	0	0	10	27	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	151	2.5	H	A	R	25	0	51	51	58	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	140	2.3	E	A	4	25	0	0	0	0	27	37	47	27	17	10	0	0	0	0	0	0	0
L-4	140	2.3	H	A	R	26	0	0	0	0	58	58	58	48	18	5	0	0	0	0	0	0	0
L-4T	78	1.3	R2	A	F	32	0	0	0	0	0	10	10	10	15	15	15	15	0	0	0	0	0
L-4T	78	1.3	R3	A	F	32	0	0	0	0	0	10	10	10	20	20	20	20	0	0	0	0	0
L-4T	140	2.3	E	A	4	25	0	0	0	0	10	10	10	20	20	10	0	0	0	0	0	0	0
L-4T	140	2.3	H	A	R	26	0	0	0	0	0	10	10	10	10	5	0	0	0	0	0	0	0
L-4D	70	1.1	R1	M	F	44	0	0	0	0	0	0	0	0	0	15	20	30	55	80	95	110	127
L-4D	140	2.3	E	A	4	31	0	0	0	0	0	0	0	30	40	30	30	25	15	15	10	10	10
L-4TD	70	1.1	R1	M	F	44	0	0	0	0	0	0	0	0	0	15	20	30	65	80	95	110	128
L-4TD	140	2.3	E	A	4	31	0	0	0	0	0	0	0	0	0	10	10	10	15	10	10	10	0
L-6	232	3.8	AX	A	R	23	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6	232	3.8	E	A	4	21	0	0	33	25	20	15	10	0	0	0	0	0	0	0	0	0	0
L-6	232	3.8	H	A	R	23	97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6	232	3.8	H	A	R	24	0	0	30	25	15	0	0	0	0	0	0	0	0	0	0	0	0
L-6	232	3.8	P	A	R	22	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6	258	4.2	E	A	4	20	0	74	34	25	20	15	10	0	0	0	0	0	0	0	0	0	0
L-6	258	4.2	H	A	R	23	0	117	37	25	15	0	0	0	0	0	0	0	0	0	0	0	0
L-6	258	4.2	P	A	R	22	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	304	5.0	AX	A	R	16	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	304	5.0	P	A	R	16	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	285	285	285	285	285	285	285	285	285	285	285	285	285	285	285	285	285

AX-SPIRIT
E -EAGLE
H -CONCORD
P -PACER
R1-COMMUTER CAR
R2-LE CAR
R3-R18

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
CHRYSLER

LAST UPDATE 12-18-80
(UNITS X1000)

CAFE STANDARDS | CAFE PROJECTIONS

								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	86	1.4	LK	A	F	37	0	0	0	0	0	0	0	15	20	25	25	25	35	35	30	25	15
L-4	86	1.4	M1	M	F	37	28	28	28	28	28	28	0	0	0	0	0	0	0	0	0	0	0
L-4	86	1.4	S	A	F	40	0	0	0	0	0	0	0	0	0	0	15	20	40	50	55	55	40
L-4	98	1.6	M1	M	F	32	28	28	28	28	28	28	0	0	0	0	0	0	0	0	0	0	0
L-4	98	1.6	M2	M	R	31	8	8	8	8	8	8	0	0	0	0	0	0	0	0	0	0	0
L-4	98	1.6	M3	M	R	31	10	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0
L-4	104	1.7	L	A	F	27	186	186	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	110	1.8	L	A	F	31	0	0	0	70	70	70	0	0	0	0	0	0	0	0	0	0	0
L-4	110	1.8	LK	A	F	37	0	0	0	0	0	0	70	50	50	50	40	35	35	35	30	25	15
L-4	135	2.2	FK	A	F	31	0	0	180	200	200	200	150	100	80	75	60	50	50	50	45	40	30
L-4	135	2.2	LK	A	F	31	0	0	0	0	0	0	20	20	20	20	20	20	20	20	10	10	10
L-4	135	2.2	MK	A	F	31	0	0	0	0	40	40	50	50	40	30	25	25	20	20	10	10	10
L-4	135	2.2	RK	A	F	31	0	0	0	0	40	40	50	50	40	30	25	25	20	20	10	10	10
L-4	156	2.6	M2	A	R	25	8	8	8	8	8	8	0	0	0	0	0	0	0	0	0	0	0
L-4	156	2.6	M3	A	R	25	10	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0
L-4	156	2.6	FK	A	F	27	0	0	197	200	200	200	150	100	75	60	60	50	25	10	10	10	0
L-4	156	2.6	LK	A	F	27	0	0	0	0	0	0	20	20	20	20	20	20	10	0	0	0	0
L-4	156	2.6	MK	A	F	27	0	0	0	0	40	40	50	50	40	30	25	25	10	0	0	0	0
L-4	156	2.6	RK	A	F	27	0	0	0	0	40	40	50	50	40	30	25	25	10	0	0	0	0
L-4T	86	1.4	LK	A	F	37	0	0	0	0	0	0	0	0	0	0	10	15	25	25	25	20	10
L-4T	86	1.4	S	A	F	40	0	0	0	0	0	0	0	0	0	0	10	15	25	35	45	45	45
L-4T	110	1.8	FK	A	F	36	0	0	0	0	0	0	20	25	25	30	30	30	35	40	40	35	30
L-4T	110	1.8	LK	A	F	37	0	0	0	0	0	0	0	0	0	15	15	20	25	30	30	20	15
L-4T	110	1.8	MK	A	F	35	0	0	0	0	0	0	15	20	20	20	20	20	25	30	30	20	15
L-4T	110	1.8	RK	A	F	35	0	0	0	0	18	18	18	20	20	20	20	20	25	30	30	20	15
L-4T	135	2.2	FK	A	F	31	0	0	0	0	0	0	20	25	25	30	30	30	30	20	20	15	10
L-4T	135	2.2	LK	A	F	31	0	0	0	0	0	0	0	15	20	20	20	20	15	10	0	0	0
L-4T	135	2.2	MK	A	F	31	0	0	0	0	0	0	15	20	20	20	20	20	15	10	0	0	0
L-4T	135	2.2	RK	A	F	31	0	0	0	0	0	0	15	20	20	20	20	20	15	10	0	0	0
L-4D	86	1.4	LK	A	F	50	0	0	0	0	0	0	0	0	0	0	10	15	25	40	50	70	100
L-4D	86	1.4	S	A	F	52	0	0	0	0	0	0	0	0	0	0	0	15	25	40	50	70	100
L-4D	116	1.9	FK	A	F	41	0	0	0	89	150	150	125	75	75	75	65	45	35	20	20	20	20
L-4D	116	1.9	LK	A	F	41	0	0	0	0	0	0	0	15	20	25	25	20	10	0	0	0	0
L-4D	116	1.9	MK	A	F	41	0	0	0	0	0	0	15	25	30	30	25	20	10	0	0	0	0
L-4D	116	1.9	RK	A	F	41	0	0	0	0	0	0	15	25	30	30	25	20	10	0	0	0	0
L-4D	135	2.2	FK	A	F	40	0	0	0	0	0	0	0	25	30	40	40	45	55	55	55	50	50
L-4D	135	2.2	LK	A	F	40	0	0	0	0	0	0	0	10	20	25	25	30	40	40	45	40	30
L-4D	135	2.2	MK	A	F	40	0	0	0	0	0	0	0	10	20	20	25	30	40	40	45	40	30
L-4D	135	2.2	RK	A	F	40	0	0	0	0	0	0	0	10	20	20	25	30	40	40	45	40	30
L-4TD	86	1.4	LK	A	F	50	0	0	0	0	0	0	0	0	0	0	10	15	25	40	50	70	100
L-4TD	86	1.4	S	A	F	52	0	0	0	0	0	0	0	0	0	0	0	15	25	40	50	70	100
L-4TD	116	1.9	FK	A	F	41	0	0	0	0	60	60	60	40	40	40	40	20	10	0	0	0	0
L-4TD	116	1.9	LK	A	F	41	0	0	0	0	0	0	0	10	15	15	10	10	0	0	0	0	0
L-4TD	116	1.9	MK	A	F	41	0	0	0	0	0	0	0	10	15	15	10	10	0	0	0	0	0
L-4TD	116	1.9	RK	A	F	41	0	0	0	0	0	0	0	10	15	15	10	10	0	0	0	0	0

L-4TD	135	2.2	FK	A	F	36	0	0	0	0	0	0	12	15	15	20	20	20	25	30	30	30	30
L-4TD	135	2.2	LK	A	F	40	0	0	0	0	0	0	0	10	10	10	15	15	20	25	30	30	30
L-4TD	135	2.2	MK	A	F	36	0	0	0	0	0	0	10	10	10	15	20	20	25	30	30	30	30
L-4TD	135	2.2	RK	A	F	40	0	0	0	0	0	0	0	0	10	10	15	15	20	30	30	30	30
L-6	225	3.7	CR	A	R	20	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6	225	3.7	E	A	R	20	0	0	28	56	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6	225	3.7	F	A	R	20	191	191	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6	225	3.7	M	A	R	20	13	13	95	94	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	318	5.0	CR	A	R	18	125	125	65	45	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	318	5.0	E	A	R	18	58	58	58	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	318	5.0	F	A	R	18	62	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	318	5.0	M	A	R	18	165	165	145	84	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	318	5.0	Y	A	R	19	0	0	20	20	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	360	5.9	E	A	R	13	54	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950

C -NEWPORT
E -MAGNUM
F -ASPEN
L -OMNI
M -DIPLOMAT
M1-CHAMP
M2-ARROW
M3-SAPPARO
R -NEW YORKER
S -COMMUTER CAR
Y -IMPERIAL

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
FORD

LAST UPDATE 12-18-80
(UNITS X1000)

								CAFE STANDARDS										CAFE PROJECTIONS				
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	78	1.3	HE	M	F	32	0	0	29	34	161	185	215	205	195	155	140	100	100	100	100	100	100
L-4	98	1.6	FA	M	F	33	0	0	0	144	120	150	155	150	135	95	75	75	75	75	75	75	75
L-4	98	1.6	FA	M	F	32	58	86	144	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	98	1.6	HE	M	F	32	0	0	29	129	273	315	335	325	265	225	225	125	125	125	125	75	25
L-4	140	2.3	F	A	R	23	29	204	229	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	140	2.3	F	A	F	26	0	0	0	303	294	276	276	271	146	0	0	0	0	0	0	0	0
L-4	140	2.3	HE	A	F	25	0	0	144	144	68	0	0	0	0	0	0	0	0	0	0	0	0
L-4	140	2.3	H	M	R	24	109	109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	140	2.3	HS	M	R	24	118	173	173	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4T	78	1.3	HE	A	F	32	0	0	0	74	75	90	100	110	120	160	175	175	175	175	175	175	175
L-4T	98	1.6	FA	A	F	33	0	0	0	0	24	35	45	50	65	105	125	125	125	125	125	125	125
L-4T	98	1.6	HE	A	F	32	0	0	0	87	95	110	115	125	135	175	175	175	175	175	175	175	175
L-4T	98	1.6	HS	M	R	32	0	45	86	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4T	140	2.3	F	A	R	23	29	58	115	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4T	140	2.3	F	A	F	26	0	0	0	120	130	145	145	150	150	0	0	0	0	0	0	0	0
L-4D	70	1.2	FA	A	F	50	0	0	0	0	0	0	0	0	50	75	89	85	105	95	85	75	75
L-4D	70	1.2	F	A	F	50	0	0	0	0	0	0	0	0	75	75	80	70	50	90	80	70	70
L-4D	70	1.2	HE	A	F	50	0	0	0	0	0	70	55	50	40	25	25	69	69	69	69	69	69
L-4TD	70	1.2	FA	A	F	50	0	0	0	0	0	0	0	0	0	0	20	30	50	60	70	80	80
L-4TD	70	1.2	F	A	F	50	0	0	0	0	0	0	0	0	0	0	20	30	50	60	70	80	80
L-4TD	70	1.2	HE	A	F	50	0	0	0	0	0	0	15	20	30	50	50	65	65	65	65	65	65
L-4	45	0.8	S	A	F	48	0	0	0	0	0	0	0	0	50	75	75	100	180	230	230	280	330
L-4D	45	0.8	S	A	F	60	0	0	0	0	0	0	0	0	0	100	181	266	266	271	351	396	406
L-4TD	45	0.8	S	A	F	60	0	0	0	0	0	0	0	0	0	0	0	15	30	50	70	100	140
L-6	200	3.3	F	A	R	20	187	187	194	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6	250	4.1	B	A	R	19	4	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6	250	4.1	X	A	R	19	168	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6T	200	3.3	F	A	R	20	0	0	194	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	171	2.8	F	A	F	26	0	0	0	194	194	194	194	194	0	0	0	0	0	0	0	0	0
V-6	171	2.8	F	A	F	28	0	0	0	0	0	0	0	0	194	194	194	194	175	150	150	150	100
V-6	171	2.8	H	A	R	20	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	171	2.8	HS	A	R	20	122	0	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	171	2.8	X	A	R	28	0	0	0	0	0	0	0	0	0	91	91	91	75	50	50	0	0
V-6	171	2.8	XS	A	R	28	0	0	0	0	0	0	0	0	0	50	50	25	25	25	25	0	0
V-6	231	3.8	A	A	R	22	0	0	0	108	71	51	35	0	0	0	0	0	0	0	0	0	0
V-6	231	3.8	B	A	R	26	0	0	0	0	0	0	0	70	70	70	50	50	25	0	0	0	0
V-6	231	3.8	C	A	R	26	0	0	0	0	0	0	0	75	75	75	50	50	25	0	0	0	0
V-6	231	3.8	E	A	R	26	0	0	0	0	0	0	0	64	64	64	50	50	25	0	0	0	0
V-6	231	3.8	X	A	R	22	0	0	0	95	95	64	48	0	0	0	0	0	0	0	0	0	0
V-6	231	3.8	XS	A	R	22	0	0	0	14	14	14	0	0	0	0	0	0	0	0	0	0	0
V-6	231	3.8	XS	A	R	26	0	0	0	0	0	0	0	231	231	231	150	125	100	100	0	0	0
V-8	255	4.2	B	A	R	22	0	46	84	110	84	58	42	0	0	0	0	0	0	0	0	0	0
V-8	255	4.2	C	A	R	22	0	46	54	117	97	64	48	0	0	0	0	0	0	0	0	0	0
V-8	255	4.2	E	A	R	22	0	46	51	100	78	52	36	0	0	0	0	0	0	0	0	0	0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0

V-8	302	5.0	A	A	R	16	71	71	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	302	5.0	B	A	R	17	38	112	74	50	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	302	5.0	C	A	R	16	0	51	41	20	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	302	5.0	E	A	R	16	15	67	62	30	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	302	5.0	F	A	R	19	64	64	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	302	5.0	HS	A	R	18	35	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	302	5.0	X	A	R	18	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	302	5.0	XS	A	R	16	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	351	5.8	A	A	R	15	127	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	351	5.8	AS	A	R	15	288	115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	351	5.8	B	A	R	15	292	119	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	351	5.8	E	A	R	15	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	A	A	R	13	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	B	A	R	12	74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	C	A	R	13	57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	E	A	R	12	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	460	7.5	C	A	R	10	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090

A -LTD
AS-THUNDER BIRD
B -FORD
C -CONTINENTAL
E -MARK
F -FAIRMONT
FA-FIESTA
HE-ESCORT
H -PINTO
HS-MUSTANG
S -COMMUTER CAR
X -GRANADA
XS-VERSAILLE

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
GM-EV

LAST UPDATE 2-11-81
(UNITS X1000)

								CAFE STANDARDS						CAFE PROJECTIONS									
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
EV	-	-	EV	-	F	185	0	0	0	0	0	10	20	25	35	85	175	200	250	300	325	425	500
L-3	90	1.5	S	A	F	50	0	0	0	0	0	0	0	0	35	85	148	200	223	253	253	303	353
L-4	98	1.6	T	M	R	33	307	404	504	604	754	854	0	0	0	0	0	0	0	0	0	0	0
L-4	98	1.6	TX	A	F	36	0	0	0	0	0	0	854	854	804	804	804	704	704	704	704	604	541
L-4	110	1.8	OP	A	R	30	18	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	110	1.8	AX	A	F	31	0	0	0	0	0	0	0	0	0	25	50	100	100	50	50	25	25
L-4	110	1.8	JX	A	F	31	0	0	0	100	125	150	200	200	200	175	150	100	100	50	50	25	25
L-4	110	1.8	X	A	F	31	0	0	0	0	50	100	175	175	175	175	150	100	100	50	50	50	50
L-4	151	2.5	AX	A	F	28	0	0	0	150	200	200	200	254	200	0	0	0	0	0	0	0	0
L-4	151	2.5	ASX	A	F	28	0	0	0	0	0	0	0	0	54	154	104	79	79	54	0	0	0
L-4	151	2.5	H	A	R	25	145	145	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	151	2.5	JX	A	F	28	0	0	0	145	245	245	245	245	245	205	150	75	50	0	0	0	0
L-4	151	2.5	X	A	F	28	0	150	300	300	350	325	325	325	325	300	150	75	50	0	0	0	0
L-4T	98	1.6	TX	A	F	36	0	0	0	0	0	0	0	30	40	55	100	125	125	150	150	150	100
L-4T	151	2.5	AX	A	F	28	0	0	0	0	25	50	100	150	150	100	75	25	25	0	0	0	0
L-4T	151	2.5	ASX	A	F	28	0	0	0	0	0	0	0	100	100	80	60	20	20	0	0	0	0
L-4T	151	2.5	JX	A	F	28	0	0	0	0	0	0	0	100	100	80	60	20	20	0	0	0	0
L-4T	151	2.5	X	A	F	28	0	0	50	100	125	150	175	225	225	200	100	25	25	0	0	0	0
L-3D	90	1.5	S	A	F	65	0	0	0	0	0	0	0	0	0	0	100	200	200	300	400	500	650
L-4D	110	1.8	JX	A	F	40	0	0	0	25	50	50	70	70	85	115	145	200	220	240	270	320	370
L-4D	110	1.8	TX	A	F	42	0	0	0	0	0	0	0	30	55	148	198	258	298	348	348	388	478
L-4D	151	2.5	AX	A	F	37	0	0	0	0	0	25	40	50	70	100	150	200	200	250	250	250	200
L-4D	151	2.5	ASX	A	F	37	0	0	0	0	0	0	0	0	25	50	100	175	175	200	200	200	200
L-4D	151	2.5	X	A	F	37	0	0	0	0	0	25	40	50	80	100	150	200	200	225	225	225	200
L-4TD	110	1.8	TX	A	F	42	0	0	0	0	0	0	0	0	50	148	198	248	298	348	348	398	478
L-4TD	151	2.5	AX	A	F	37	0	0	0	0	0	0	0	0	30	50	100	120	120	180	180	180	150
L-4TD	151	2.5	ASX	A	F	37	0	0	0	0	0	0	0	0	20	50	120	150	150	200	200	200	175
L-4TD	151	2.5	X	A	F	37	0	0	0	0	0	0	0	25	30	50	100	130	130	180	180	180	150
V-6	173	2.8	AX	A	F	26	0	0	0	0	50	100	100	200	200	175	100	75	50	25	0	0	0
V-6	173	2.8	FX	A	F	26	0	0	0	0	50	150	150	200	200	175	100	75	50	25	0	0	0
V-6	173	2.8	H	A	R	22	76	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	173	2.8	JX	A	F	26	0	0	76	106	156	206	206	256	206	100	75	60	40	25	0	0	0
V-6	173	2.8	X	A	F	26	0	70	100	120	140	170	170	220	220	100	75	50	40	25	0	0	0
V-6	229	3.8	A	A	R	22	62	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	229	3.8	AX	A	F	26	0	0	0	100	100	155	155	185	185	155	55	50	30	25	0	0	0
V-6	229	3.8	AS	A	R	22	62	100	100	50	30	0	0	0	0	0	0	0	0	0	0	0	0
V-6	229	3.8	FX	A	F	26	0	0	0	30	30	90	90	120	120	100	40	0	0	0	0	0	0
V-6	229	3.8	X	A	R	22	142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	231	3.8	A	A	R	23	352	352	352	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	231	3.8	AX	A	F	28	0	0	0	352	352	352	352	352	167	167	100	88	80	50	0	0	0
V-6	231	3.8	F	A	R	23	13	88	138	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	231	3.8	FX	A	F	28	0	0	0	138	138	138	138	138	63	63	0	0	0	0	0	0	0
V-6	231	3.8	H	A	R	23	63	63	113	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	231	3.8	JX	A	F	28	0	0	0	113	113	113	113	113	63	63	30	0	0	0	0	0	0
V-6T	231	3.8	AX	A	F	28	0	0	0	0	50	100	100	160	160	100	50	50	50	50	0	0	0

V-6T	231	3.8	BX	A	F	29	0	0	0	0	50	100	100	160	160	100	50	50	50	50	0	0	0
V-6T	231	3.8	Y	A	R	23	0	0	38	38	38	38	38	38	38	38	0	0	0	0	0	0	0
V-6D	173	2.8	AX	A	F	34	0	0	0	25	50	75	75	100	125	175	293	261	261	239	239	192	185
V-6D	173	2.8	JX	A	F	34	0	0	0	25	50	75	75	100	125	175	293	261	261	239	239	192	185
V-6D	173	2.8	X	A	F	34	0	0	0	25	50	75	75	100	125	170	292	261	261	239	239	193	185
V-6D	250	4.1	BX	A	F	31	0	0	0	0	25	50	50	75	80	80	80	100	100	100	100	100	75
V-6D	250	4.1	CX	A	F	31	0	0	0	0	25	50	50	75	80	80	80	100	100	100	100	100	75
V-6D	250	4.1	EX	A	F	31	0	0	0	0	0	0	0	50	50	50	50	75	75	75	75	75	50
V-6D	250	4.1	KX	A	F	31	0	0	0	0	0	0	0	50	50	50	50	75	75	75	75	75	50
V-6TD	250	4.1	BX	A	F	31	0	0	0	0	0	20	50	50	50	75	75	100	100	100	100	100	75
V-6TD	250	4.1	CX	A	F	31	0	0	0	0	0	20	50	50	50	75	75	100	100	100	100	100	75
V-6TD	250	4.1	EX	A	F	31	0	0	0	0	0	0	0	0	30	50	50	70	70	75	75	75	50
V-6TD	250	4.1	KX	A	F	31	0	0	0	0	0	0	0	0	20	50	50	70	70	75	75	75	50
V-8	267	4.4	A	A	R	20	362	421	421	421	421	0	0	0	0	0	0	0	0	0	0	0	0
V-8	267	4.4	AS	A	R	20	429	429	429	429	429	0	0	0	0	0	0	0	0	0	0	0	0
V-8	267	4.4	B	A	R	19	131	131	131	131	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	301	4.9	AS	A	R	20	87	87	87	87	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	301	4.9	B	A	R	20	99	99	99	99	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	305	5.0	A	A	R	19	395	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	305	5.0	AS	A	R	19	484	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	305	5.0	B	A	R	19	67	67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	305	5.0	F	A	R	18	142	142	142	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	305	5.0	H	A	R	19	16	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	305	5.0	X	A	R	19	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	307	5.0	B	A	R	19	0	100	150	100	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	350	5.7	B	A	R	16	806	355	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	350	5.7	C	A	R	16	106	140	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	350	5.7	E	A	F	16	40	40	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	350	5.7	F	A	R	16	226	126	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	350	5.7	K	A	R	16	444	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	350	5.7	Y	A	R	14	28	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	368	6.0	C	A	R	19	0	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	368	6.0	K	A	F	19	0	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	403	6.6	C	A	R	15	134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	403	6.6	E	A	F	15	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	403	6.6	Y	A	R	14	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	425	7.0	C	A	R	13	217	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	425	7.0	E	A	F	13	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8T	301	5.0	F	A	R	20	0	226	200	150	100	0	0	0	0	0	0	0	0	0	0	0	0
V-8D	325	5.3	B	A	R	25	0	0	0	221	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8D	325	5.3	E	A	F	25	0	0	0	32	787	787	587	0	0	0	0	0	0	0	0	0	0
V-8D	325	5.3	K	A	F	25	0	0	0	252	552	652	532	0	0	0	0	0	0	0	0	0	0
V-8D	350	5.7	B	A	R	23	0	739	747	700	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8D	350	5.7	C	A	R	23	0	320	320	300	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8D	350	5.7	E	A	F	23	0	64	64	32	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8D	350	5.7	K	A	F	23	0	254	254	200	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700

A -MALIBU
AS-MONTE CARLO
B -IMPALA
C -NINETY EIGHT
D -FLEETWOOD
E -TORONADO
F -CAMARO
H -MONZA(RWD)
J -MONZA(FWD)
K,-SEVILLE
OP-OPEL
S -COMMUTER CAR
T -CHEVETTE
X -NOVA(RWD)
X -CITATION(FWD)
Y -CORVETTE

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
HONDA

LAST UPDATE 12-18-80
(UNITS X1000)

								CAFE STANDARDS						CAFE PROJECTIONS										
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	76	1.2	C	M	F	33	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	79	1.3	C	M	F	33	0	65	65	65	65	65	65	65	65	65	55	40	40	40	40	40	30
L-4	91	1.5	C	M	F	31	65	60	60	60	60	60	60	50	45	45	40	30	20	10	0	0	0
L-4	107	1.8	A	A	F	27	39	39	39	39	29	24	24	20	20	18	18	15	10	0	0	0	0
L-4	107	1.8	P	A	F	27	26	26	26	26	20	16	13	13	13	10	10	10	5	0	0	0	0
L-4T	79	1.3	A	A	F	32	0	0	0	0	10	15	15	19	19	21	21	24	19	19	19	19	19
L-4T	79	1.3	P	A	F	32	0	0	0	0	6	10	13	13	13	16	16	16	10	10	10	10	10
L-4D	91	1.5	C	M	F	49	0	0	0	0	0	0	0	10	15	15	30	55	65	75	85	85	95
L-4TD	91	1.5	A	A	F	49	0	0	0	0	0	0	0	0	0	0	0	0	10	20	20	20	20
L-4TD	91	1.5	P	A	F	49	0	0	0	0	0	0	0	0	0	0	0	0	11	16	16	16	16
						TOTAL:	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190

A-ACCORD
C-CIVIC
P-PRELUDE

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
VW

LAST UPDATE 12-18-80
(UNITS X1000)

								CAFE STANDARDS										CAFE PROJECTIONS					
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	89	1.5	R	A	F	28	75	50	50	30	30	50	50	50	40	30	25	25	20	15	10	5	0
L-4	97	1.6	C	A	F	27	0	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
L-4	97	1.6	D	A	F	27	10	10	10	10	10	10	5	5	5	5	5	5	5	5	5	5	5
L-4	97	1.6	J	A	F	28	0	16	16	8	6	6	5	5	5	5	5	5	5	5	5	5	5
L-4	97	1.6	R	A	F	27	91	50	50	50	50	0	0	0	0	0	0	0	0	0	0	0	0
L-4	97	1.6	S	A	F	27	20	20	20	20	10	10	10	5	5	5	0	0	0	0	0	0	0
L-4D	90	1.5	B	M	R	40	0	0	0	0	0	0	9	6	9	9	9	9	9	9	9	9	9
L-4D	90	1.5	D	M	F	46	10	10	10	10	10	5	5	5	5	5	5	5	5	5	5	5	5
L-4D	90	1.5	J	M	F	46	0	0	0	8	5	5	5	5	5	5	5	5	5	5	5	5	5
L-4D	90	1.5	R	M	F	46	50	100	75	95	85	85	75	75	80	85	85	85	90	95	95	100	100
L-4TD	90	1.5	B	M	R	40	0	0	0	0	0	0	0	6	9	9	9	9	9	9	9	9	9
L-4TD	90	1.5	D	M	F	46	0	0	0	0	0	5	10	10	10	10	10	10	10	10	10	10	10
L-4TD	90	1.5	J	M	F	46	0	0	0	0	5	5	6	6	6	6	6	6	6	6	6	6	6
L-4TD	90	1.5	R	M	F	46	0	0	25	25	35	65	75	75	80	85	90	90	90	90	95	95	100
L-4TD	90	1.5	S	M	F	46	0	0	0	0	10	10	10	15	15	15	20	20	20	20	20	20	20
HO-4	97	1.6	C	A	R	26	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HO-4	120	2.0	B	A	R	19	18	18	18	18	18	18	9	6	0	0	0	0	0	0	0	0	0
						TOTAL:	285	285	285	285	285	285	285	285	285	285	285	285	285	285	285	285	285

B-BUS
C-CONVERTIBLE
D-DASHER
J-JETTA
R-RABBIT
S-SCIROCCO

LIGHT TRUCK SCENARIOS

1. The methodology used in generating the light truck scenario is generally the same as was used in generating the automotive scenario except for the following changes:

   a. CAFE would be 22 mpg in 1985, 27 mpg in 1990, and 32 mpg in 1995.

   b. 8- and 6-cylinder engines were optimized.

2. Scenario Assumptions for Companies

   A. Scenario Assumptions for Chrysler

      (1) FWD K-pickup introduced in 1984
      FWD mini-pickup introduced in 1982 based on J-chassis

      (2) Fleet sales in 1985 as follows:

         (a) 22% FWD
         78% RWD

         (b) 69% gas engines
         31% diesel engines

      (3) Fleet sales in 1990 as follows:

         (a) 47% FWD
         53% RWD

         (b) 29% gas engines
         71% diesel engines

(4) Fleet sales in 1995 as follows:

(a) 93% FWD
7% RWD

(b) 4% gas engines
96% diesel engines

B. <u>Scenario Assumptions for Ford</u>

(1) RWD pickup in 1985 (Ranger)
FWD mini-pickup introduced in 1990

(2) Fleet sales in 1985 as follows:

(a) 100% RWD
(b) 100% gas engines

(3) Fleet sales in 1990 as follows:

(a) 100% FWD
(b) 100% gas engines

(4) Fleet sales in 1995 as follows:

(a) 100% FWD

(b) 11% gas engines
89% diesel engines

C. <u>Scenario Assumptions for General Motors</u>

(1) FWD mini-pickup introduced in 1988

(2) Fleet sales in 1985 as follows:

(a) 100% RWD

(b) 100% gas engines

(3) Fleet sales in 1990 as follows:

(a) 96% FWD
4% RWD

(b) 76% gas engines
24% diesel engines

(4) Fleet sales in 1995 as follows:

(a) 100% FWD

(b) 13% gas engines
87% diesel engines

D. <u>Scenario Assumptions for International Harvester</u>

(1) International will drop the light trucks to concentrate on heavier trucks.

(2) Fleet sales in 1985 as follows:

(a) 100% RWD

(b) 53% gas engines
47% diesel engines

(3) Fleet sales in 1990 as follows:

(a) 100% RWD

(b) 16% gas engines
84% diesel engines

MPG STANDARDS
CAFE
LIGHT TRUCK

	1983	1984	1985
Combined	19	20	21
2-Wheel Drive	19.5	20.3	21.6
4-Wheel Drive	17.5	18.5	19.0

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
CHRYSLER-2WD TRUCKS

LAST UPDATE 12-23-80
(UNITS X1000)

								CAFE STANDARDS													CAFE PROJECTIONS		
								16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	110	1.8	C	A	F	26	0	0	0	0	0	60	79	75	75	65	65	60	50	40	30	20	10
L-4	121	2.0	M4	M	R	25	0	0	20	24	30	0	0	0	0	0	0	0	0	C	0	0	0
L-4	156	2.6	M4	M	R	23	0	0	20	23	30	0	0	0	0	0	0	0	0	0	0	0	0
L-4D	110	1.8	C	A	F	33	0	0	0	0	0	0	0	10	10	20	47	67	100	130	172	202	242
L-6	225	3.7	C1	M	R	20	31	31	35	35	42	47	35	30	30	20	20	20	10	0	0	0	0
L-6	225	3.7	C2	M	R	20	3	3	5	10	10	15	5	5	5	5	0	0	0	0	0	0	0
L-6	225	3.7	C3	M	R	19	0	0	0	10	15	20	15	12	12	7	0	0	0	0	0	0	0
L-6	225	3.7	C4	M	R	19	0	0	0	10	15	20	15	10	10	8	0	0	0	0	0	0	0
L-6	225	3.7	C5	M	R	20	16	16	10	10	15	20	15	10	10	7	0	0	0	0	0	0	0
L-6D	243	4.0	C1	M	R	26	1	1	11	20	22	25	42	50	60	70	70	60	56	51	35	25	10
L-6D	243	4.0	C2	M	R	26	1	1	11	15	20	25	41	50	60	70	70	65	56	51	35	25	10
V-8	318	5.2	C1	A	R	16	45	45	40	35	18	15	5	5	0	0	0	0	0	0	0	0	0
V-8	318	5.2	C2	A	R	17	8	8	10	10	10	5	5	0	0	0	0	0	0	0	0	0	0
V-8	318	5.2	C3	A	R	16	2	2	10	10	10	5	5	5	0	0	0	0	0	0	0	0	0
V-8	318	5.2	C4	A	R	15	0	0	10	10	10	5	5	5	0	0	0	0	0	0	0	0	0
V-8	318	5.2	C5	A	R	16	67	67	50	50	25	10	5	5	0	0	0	0	0	0	0	0	0
V-8	360	5.9	C1	A	R	16	17	17	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	360	5.9	C2	A	R	16	12	12	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	360	5.9	C3	A	R	16	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	360	5.9	C4	A	R	16	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	360	5.9	C5	A	R	16	62	62	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272

C -MINI PICKUP
C1-D100
C2-D200
C3-D300
C4-RAMCHARGER
C5-TRADESMAN
M4-D50, ARROW PICKUP

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
FORD-2WD TRUCKS

LAST UPDATE 12-23-80
(UNITS X1000)

								CAFE STANDARDS										CAFE PROJECTIONS					
								16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	110	1.8	C	M	R	27	0	0	15	35	50	70	120	220	440	600	761	0	0	0	0	0	0
L-4	110	1.8	CX	M	F	27	0	0	0	0	0	0	0	0	0	0	0	916	700	550	400	250	100
L-4D	110	1.8	CX	M	F	33	0	0	0	0	0	0	0	0	0	0	0	0	216	366	516	666	816
L-6	300	5.0	F1	M	R	22	123	123	125	160	190	210	225	215	170	100	50	0	0	0	0	0	0
L-6	300	5.0	F2	M	R	22	10	10	25	55	85	105	120	110	70	55	25	0	0	0	0	0	0
L-6	300	5.0	F3	M	R	22	4	4	16	46	76	96	111	101	70	61	30	0	0	0	0	0	0
L-6	300	5.0	F4	M	R	22	83	83	95	150	170	190	205	200	145	100	50	0	0	0	0	0	0
V-8	302	5.0	F1	A	R	19	117	117	126	140	150	150	135	70	21	0	0	0	0	0	0	0	0
V-8	351	5.8	F1	A	R	16	177	177	177	120	70	35	0	0	0	0	0	0	0	0	0	0	0
V-8	351	5.8	F2	A	R	16	82	82	82	70	40	20	0	0	0	0	0	0	0	0	0	0	0
V-8	351	5.8	F3	A	R	16	45	45	45	30	20	10	0	0	0	0	0	0	0	0	0	0	0
V-8	351	5.8	F4	A	R	16	160	160	160	110	65	30	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	F1	A	R	15	44	44	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	F2	A	R	15	20	20	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	F3	A	R	15	11	11	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	F4	A	R	15	40	40	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	916	916	916	916	916	916	916	916	916	916	916	916	916	916	916	916	916

C -COURIER
F1-RANCHERO,F-150
F2-F-250
F3-F-350
F4-ECONOLINE,CLUBWAGON

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
GM-2WD TRUCKS

LAST UPDATE 12-23-80
(UNITS X1000)

								CAFE STANDARDS									CAFE PROJECTIONS						
								16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	110	1.8	LV	A	R	26	0	0	50	100	200	400	600	800	1000	0	0	0	0	0	0	0	0
L-4	110	1.8	LV	A	F	26	0	0	0	0	0	0	0	0	0	1200	1100	1000	850	700	525	350	175
L-4D	110	1.8	LV	A	F	33	0	0	0	0	0	0	0	0	0	0	192	327	522	682	857	1032	1207
L-6	250	4.1	G1	M	R	20	99	99	205	250	300	250	200	155	125	50	35	25	10	0	0	0	0
L-6	250	4.1	G2	M	R	20	12	12	75	100	125	110	100	75	50	25	15	10	0	0	0	0	0
L-6	250	4.1	G3	M	R	20	6	6	75	100	125	110	100	75	50	25	15	10	0	0	0	0	0
L-6	250	4.1	G4	M	R	20	1	1	75	100	125	110	100	65	50	25	15	10	0	0	0	0	0
L-6	250	4.1	G5	M	R	21	43	43	100	150	200	165	140	125	67	37	10	0	0	0	0	0	0
L-6	250	4.1	G6	M	R	21	7	7	27	62	62	52	42	27	20	10	0	0	0	0	0	0	0
V-8	305	5.1	G1	A	R	17	97	97	180	180	90	90	45	40	20	10	0	0	0	0	0	0	0
V-8	305	5.1	G4	A	R	17	7	7	30	30	15	15	10	10	0	0	0	0	0	0	0	0	0
V-8	305	5.1	G5	A	R	18	29	29	60	60	30	30	15	10	0	0	0	0	0	0	0	0	0
V-8	350	5.8	G1	A	R	16	288	288	170	85	40	20	10	0	0	0	0	0	0	0	0	0	0
V-8	350	5.8	G2	A	R	16	104	104	50	25	10	0	0	0	0	0	0	0	0	0	0	0	0
V-8	350	5.8	G3	A	R	16	62	62	30	15	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	350	5.8	G4	A	R	16	50	50	25	10	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	350	5.8	G5	A	R	16	169	169	110	55	30	15	10	0	0	0	0	0	0	0	0	0	0
V-8	350	5.8	G6	A	R	16	191	191	120	60	30	15	10	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	G1	A	R	14	72	72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	G2	A	R	14	26	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	G3	A	R	14	16	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	G4	A	R	14	13	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	G5	A	R	14	42	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	400	6.6	G6	A	R	14	48	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	1382	1382	1382	1382	1382	1382	1382	1382	1382	1382	1382	1382	1382	1382	1382	1382	1382

LV-LUV
G1-EL CAMINO,C10
G2-C20
G3-C30
G4-SUBURBAN,BLAZER
G5-SPORTVAN,CARAVAN
G6-P SERIES

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
INTERNATIONAL-2WD TRUCKS

LAST UPDATE 12-23-80
(UNITS X1)

								CAFE STANDARDS												CAFE PROJECTIONS			
								16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	196	3.2	I1	M	R	20	67	67	100	175	185	185	175	125	125	100	75	50	25	25	0	0	0
L-4	196	3.2	I2	M	R	20	76	76	100	175	185	185	175	125	125	100	75	50	25	25	0	0	0
L-6D	198	3.2	I1	M	R	30	25	25	115	163	215	240	291	366	366	391	416	441	466	481	516	0	0
L-6D	198	3.2	I2	M	R	30	41	41	116	163	216	316	360	435	500	585	655	720	775	920	860	0	0
V-8	304	5.0	I1	A	R	16	195	195	200	100	100	75	50	25	25	25	25	25	25	10	0	0	0
V-8	304	5.0	I2	A	R	16	739	739	745	600	475	375	325	300	235	175	130	90	60	15	0	0	0
V-8	345	5.7	I1	A	R	15	48	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	345	5.7	I2	A	R	15	185	185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	1376	1376	1376	1376	1376	1376	1376	1376	1376	1376	1376	1376	1376	1376	1376	0	0

I1-TERRA
I2-SCOUT II, TRAVELER

IMPORT CARS - LIGHT TRUCK

PROJECTION BASED ON

MEETING THE CAFE STANDARDS

AND THE PROJECTED STANDARDS

BY

COMPANY

AND

MODEL

ASSUMING NO NEW TECHNOLOGIES

OR CONFIGURATION CHANGES TO

MEET USA CAFE STANDARDS

RATH & STRONG

INCORPORATED

stributors Institute speaker

Many foreign car manufacturers can't meet U. S. CAFE averages

DRAKE HOTEL—Roy Lindgren, part- in the Boston-based automotive consult- firm of Rath & Strong, told members the Distributors Institute during the first sion of this organization's Spring meet- here, that many foreign car manufactur- do not have at this time a car fleet capable of meeting the U.S. Government Corporate Average Fuel Economy (CAFE) requirements that all U.S. car manufacturers have spent billions of dollars to meet.

Flatly predicting that the mighty General Motors "will eat the Japanese alive" a few years down the road with its brilliantly planned fleet of cars designed to average considerably more than 27.5 miles per gallon by 1985, Lindgren emphasized that development might have a profound effect upon the car buying public when the gas mileage truth becomes apparent.

U.S. CAFE requirements, noted Lindgren, progress from 20 miles per gallon on a fleet average basis in 1980 to 27.5 miles on the same average basis in 1985.

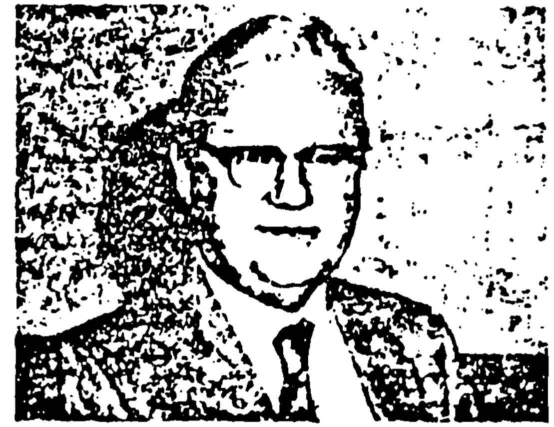
According to Lindgren, computer projections clearly show that few European and Japanese car manufacturers can meet that standard with present fleets.

Although conceding that foreign car manufacturers still have time to retool for a new line of cars that could meet such standards, Lindgren cited the tremendous tooling costs involved that have already dealt severe financial blows to every U.S. car manufacturer.

Using the G. M. car line as a comparison standard, Lindgren reviewed the various makes and models of both U.S. and foreign vehicles to prove his claim.

Conceding that the Japanese have had everything their way up to date, Lindgren pointed out some very difficult problems that car manufacturers in Japan will have to face once General Motors places all of its lines of fuel-efficient cars on the market.

When that finally happens, this consultant noted, we might see some very dramatic changes in car buying habits



Roy Lindgren

Ford Motor Company,said Lindgren, is one entire downsizing step behind General Motors. This will mean that they will suffer greatly before they catch up. From a product line standpoint, Lindgren said, Chrysler is actually in a better position because it has already completed its major downsizing step. All future Chrysler cars will be built on the K-car chassis utilizing engines and drivelines from these vehicles.

AMC, said Lindgren, is depending upon Renault, and will base all of its future vehicles on this company's lines.

According to Lindgren, the increased use of plastics in GM automobile bodies, the introduction of more four and three cylinder power plants, all designed with fuel injection, electronically controlled ignitions and fuel management systems, and installed in cars with total weights of around 2,000 pounds, will make General Motors cars the acknowledged winners of the mileage race.

The Japanese car manufacturers won't be in a position to compete with fleet averages that General Motors will be able to generate, says Lindgren, and we may see some real changes in the market place.

SCENARIO/ALFA (07/30/80) 3:32 PM TUESDAY AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
ALFA ROMEO

								CAFE STANDARDS										CAFE PROJECTIONS						
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	120	2.0	1	A	R	21	2700	2700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	120	2.0	2	M	R	21	650	650	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	120	2.0	3	M	R	20	650	650	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	4000	4000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 -SPORT SEDAN
2 -SPIDER VELOCE
3 -SPRINT VELOCE

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
AUDI

CAFE STANDARDS / CAFE PROJECTIONS

								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	97	1.6	1	M	F	23	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	97	1.6	2	M	F	23	0	25	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-5	131	2.1	3	A	F	20	23	18	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	43	43	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 -FOX
2 -4000
3 -5000

SCENARIO/AUSTIN (07/30/80)   3:33 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
AUSTIN (MG)

								CAFE STANDARDS										CAFE PROJECTIONS						
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	91	1.5	1	M	R	20	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	110	1.8	2	M	R	20	13	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	26	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 -MIDGET
2 -MGB

SCENARIO/BMW (07/30/80) 3:33 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
BMW

										CAFE STANDARDS									CAFE PROJECTIONS			
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	108	1.8	1	A	R	23	0	17	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	121	2.0	1	A	R	22	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6	170	2.8	2	A	R	20	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6	196	3.2	3	A	R	17	7	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-6	196	3.2	4	A	R	16	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	35	35	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 -320I
2 -528I
3 -636I
4 -733I

SCENARIO/FERRARI (07/30/80)

3:34 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
FERRARI

									CAFE STANDARDS											CAFE PROJECTIONS					
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
V-8	179	3.0	1	M	R	11	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	179	3.0	2	M	R	11	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	179	3.0	3	M	R	11	400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 -DINO 308 GT4
2 -308 GTB
3 -308 GTS

SCENARIO/FIAT (07/30/80) 3:34 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
FIAT

								CAFE STANDARDS											CAFE PROJECTIONS					
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	79	1.3	1	M	R	25	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	91	1.5	2	M	R	31	10	10	10	10	10	10	10	10	5	0	0	0	0	0	0	0	0
L-4	91	1.5	3	A	F	32	13	20	20	20	20	20	22	28	44	59	0	0	0	0	0	0	0
L-4	122	2.0	4	A	F	25	15	19	19	19	19	19	17	11	5	0	0	0	0	0	0	0	0
L-4	122	2.0	5	A	R	25	10	10	10	10	10	10	10	10	5	0	0	0	0	0	0	0	0
						TOTAL:	59	59	59	59	59	59	59	59	59	59	0	0	0	0	0	0	0

1 -128
2 -X1/9
3 -STRADA
4 -BRAVA
5 -SPIDER 2000

SCENARIO/FUJI (07/31/80) 3:35 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
FUJI (SUBARU)

								CAFE STANDARDS										CAFE PROJECTIONS					
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
HO-4	97	1.6	1	M	F	31	60	60	63	65	65	70	75	85	93	0	0	0	0	0	0	0	0
HO-4	97	1.6	2	A	F	30	30	33	35	38	40	40	38	30	23	0	0	0	0	0	0	0	0
HO-4	97	1.6	3	M	4	27	38	35	30	25	23	18	15	13	12	0	0	0	0	0	0	0	0
					TOTAL:		128	128	128	128	128	128	128	128	128	0	0	0	0	0	0	0	0

1 -DL
2 -GL
3 -BRAT

SCENARIO/JAGUAR (07/31/80) 3:36 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
JAGUAR

								CAFE STANDARDS									CAFE PROJECTIONS						
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-6	258	4.2	1	A	R	16	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-12	326	5.3	2	A	R	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-12	326	5.3	3	A	R	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 -XJ 6
2 -XJ 12
3 -XJ S

SCENARIO/LANCIA (07/30/80) 3:37 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
LANCIA

									CAFE STANDARDS												CAFE PROJECTIONS				
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	122	2.0	1	A	R	21	1000	900	800	700	600	400	300	200	0	0	0	0	0	0	0	0	0
L-4	122	2.0	2	A	R	31	500	600	700	800	900	1100	1200	1300	1500	0	0	0	0	0	0	0	0
					TOTAL:		1500	1500	1500	1500	1500	1500	1500	1500	1500	0	0	0	0	0	0	0	0

1 -BETA
2 -ZAGATO

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
MERCEDES-BENZ

								CAFE STANDARDS												CAFE PROJECTIONS				
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5	
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	
L-4D	147	2.4	1	A	R	30	10	10	12	12	17	22	27	43	0	0	0	0	0	0	0	0	0	
L-5D	183	3.0	2	A	R	25	4	5	6	8	8	7	6	2	0	0	0	0	0	0	0	0	0	
L-5D	183	3.0	3	A	R	25	4	5	6	8	8	7	6	2	0	0	0	0	0	0	0	0	0	
L-5D	183	3.0	4	A	R	25	4	5	6	8	8	8	6	2	0	0	0	0	0	0	0	0	0	
L-5TD	183	3.0	5	A	R	26	4	4	6	9	10	9	8	4	0	0	0	0	0	0	0	0	0	
L-6	168	2.7	6	A	R	16	5	5	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	
L-6	168	2.7	7	A	R	16	6	6	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	
L-6	168	2.7	8	A	R	16	6	6	6	4	2	0	0	0	0	0	0	0	0	0	0	0	0	
V-8	276	4.5	9	A	R	14	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
V-8	276	4.5	10	A	R	14	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
V-8	276	4.5	11	A	R	14	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
V-8	417	6.9	12	A	R	12	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
						TOTAL:	53	35	53	53	53	53	53	53	0	0	0	0	0	0	0	0	0	

1 -240 D
2 -300 D
3 -300 CD
4 -300 SD
5 -300 TD
6 -280 E
7 -280 CE
8 -280 SE
9 -450 SEL
10-450 SL
11-450 SLC
12-6.9 SEDAN

SCENARIO/NISSAN (07/30/80) 3:38 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
NISSAN (DATSUN)

								CAFE STANDARDS										CAFE PROJECTIONS					
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	76	1.2	1	M	R	33	0	25	45	60	75	100	100	125	200	300	472	0	0	0	0	0	0
L-4	85	1.4	1	M	R	32	70	70	70	65	65	60	55	55	50	50	0	0	0	0	0	0	0
L-4	85	1.4	2	M	R	30	70	70	70	85	87	87	97	97	87	62	0	0	0	0	0	0	0
L-4	91	1.5	1	A	R	30	77	77	77	82	85	85	95	95	85	60	0	0	0	0	0	0	0
L-4	119	2.0	3	A	R	26	50	50	50	45	35	30	25	25	25	0	0	0	0	0	0	0	0
L-4	119	2.0	4	A	R	25	80	70	60	45	45	35	25	25	25	0	0	0	0	0	0	0	0
L-6	146	2.4	5	A	R	23	50	50	50	40	30	25	25	25	0	0	0	0	0	0	0	0	0
L-6	168	2.8	6	A	R	21	40	30	25	25	25	25	25	25	0	0	0	0	0	0	0	0	0
L-6	168	2.8	7	A	R	18	35	30	25	25	25	25	25	0	0	0	0	0	0	0	0	0	0
						TOTAL:	472	472	472	472	472	472	472	472	472	472	472	0	0	0	0	0	0

1 -210
2 -310
3 -510
4 -200 SX
5 -810
6 -280 ZX
7 -280 ZX 2+2

SCENARIO/PEUGEOT (07/30/80) 3:39 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
PEUGEOT

								CAFE STANDARDS											CAFE PROJECTIONS					
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	120	2.0	1	A	R	19	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	120	2.0	2	A	R	18	0	5	4	4	2	1	1	0	0	0	0	0	0	0	0	0	9
L-4D	141	2.3	3	A	R	29	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4D	141	2.3	4	A	R	29	0	5	7	8	10	11	11	12	0	0	0	0	0	0	0	0	0
V-6	174	2.8	5	A	R	15	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					TOTAL:		12	12	12	12	12	12	12	12	0	0	0	0	0	0	0	0	0

1 -504
2 -505
3 -504D
4 -505D
5 -604

SCENARIO/ROLLS (07/30/80) 3:39 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
ROLLS ROYCE

								CAFE STANDARDS										CAFE PROJECTIONS					
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
V-8	412	6.8	1	A	R	11	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	412	6.8	2	A	R	11	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	412	6.8	3	A	R	11	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	412	6.8	4	A	R	11	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	412	6.8	5	A	R	11	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 -SILVER SHADOW II
2 -SILVER WRAITH II
3 -CORNICHE COUPE
4 -CORNICHE CONVERTIBLE
5 -CAMARGUE

SCENARIO/MAZDA (07/31/80) 3:41 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
TOYO KOGYO (MAZDA)

								CAFE STANDARDS											CAFE PROJECTIONS					
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
ROTARY	70	1.1	1	A	R	21	45	45	40	35	30	25	20	15	10	0	0	0	0	0	0	0	0
L-4	86	1.4	2	A	R	33	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	86	1.4	2	A	F	35	0	85	90	90	95	95	95	100	100	110	137	157	0	0	0	0	0
L-4	120	2.0	3	A	R	27	27	27	27	32	32	37	42	42	47	47	20	0	0	0	0	0	0
						TOTAL:	157	157	157	157	157	157	157	157	157	157	157	157	0	0	0	0	0

1 -RX 7
2 -GLC
3 -626

SCENARIO/TOYOTA (07/31/80) 3:41 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
. TOYOTA

								CAFE STANDARDS										CAFE PROJECTIONS						
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	71	1.2	1	A	R	27	130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	89	1.5	2	A	F	30	0	130	150	190	230	260	330	430	508	0	0	0	0	0	0	0	0
L-4	97	1.6	1	A	R	26	108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	108	1.8	1	A	R	27	0	108	128	158	158	158	128	78	0	0	0	0	0	0	0	0	0
L-4	134	2.2	3	A	R	20	60	60	40	20	20	0	0	0	0	0	0	0	0	0	0	0	0
L-4	134	2.2	4	A	R	22	60	60	40	20	10	0	0	0	0	0	0	0	0	0	0	0	0
L-6	156	2.6	5	A	R	21	75	75	75	60	40	40	0	0	0	0	0	0	0	0	0	0	0
L-6	156	2.6	6	A	R	21	75	75	75	60	50	50	50	0	0	0	0	0	0	0	0	0	0
						TOTAL:	508	508	508	508	508	508	508	508	508	0	0	0	0	0	0	0	0

1 -COROLLA
2 -TERCEL – FWD
3 -CORONA
4 -CELICA
5 -CRESSIDA
6 -SUPRA
7. STARLET · FWD

SCENARIO/TRIUMPH (07/31/80)   3:41 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
TRIUMPH

								CAFE STANDARDS										CAFE PROJECTIONS						
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	91	1.5	1	M	R	26	6	4	5	9	13	0	0	0	0	0	0	0	0	0	0	0	0
L-4	122	2.0	2	M	R	22	7	6	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	215	3.5	3	A	R	18	0	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	13	13	13	13	13	0	0	0	0	0	0	0	0	0	0	0	0

1 -SPITFIRE
2 -TR7
3 -TR8

SCENARIO/SAAB (07/31/80) 3:40 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
SAAB

								CAFE STANDARDS											CAFE PROJECTIONS					
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	121	2.0	1	A	R	23	3	5	5	15	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	121	2.0	2	A	R	21	10	8	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4T	121	2.0	3	A	R	22	2	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	15	15	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0

1 -99
2 -900
3 -900 TURBO

SCENARIO/VOLVO (07/31/80)   3:42 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
VOLVO

									CAFE STANDARDS									CAFE PROJECTIONS					
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	130	2.1	1	A	R	22	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4	130	2.1	2	A	R	22	0	20	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	163	2.7	3	A	R	19	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	163	2.7	4	A	R	19	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	174	2.8	5	A	R	19	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-6	174	2.8	6	A	R	19	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	56	56	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 -240
2 -DL SEDAN
3 -260 SEDAN
4 -626 C
5 -GLE COUPE
6 -COUPE

SCENARIO/PORSCHE (07/30/80) 3:42 PM TUESDAY, AUGUST 12, 1980

VEHICLE PRODUCTION SCENARIO
BY ENGINE SIZE
PORSCHE

								CAFE STANDARDS										CAFE PROJECTIONS					
								20	22	24	26	27	27.5	29	30.5	32	33.5	35	36.5	38	39.5	41	42.5
ENG	CID	L	BD	TR	DR	MPG	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L-4	121	2.0	1	A	R	20	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-4T	121	2.0	2	M	R	20	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HO-6	183	3.0	3	M	R	18	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HO-6T	201	3.3	4	M	R	16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V-8	273	4.5	5	A	R	14	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						TOTAL:	14	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 -924
2 -924T
3 -911
4 -TURBO
5 -928

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Plugging Into The Future: An Interview With Leroy H. Lindgren

"I try to put myself in the future and look backwards into the present," Leroy H. Lindgren, Vice President of Rath & Strong, management consultants, says. "This separates me from the econometrics school which can only think about the future in terms of the past."

Mr. Lindgren, who's in charge of new product development for Rath & Strong, aired his vision of the automobile's future in an exclusive EV Progress interview. He has developed a computer model of the American automobile industry which analyzes the impact of Government regulations and technical requirements on the industry. EVs, says Lindgren, enter the American auto industry's future largely by virtue of the CAFE inclusion credit. General Motors will be the only one of the big three mass producing EVs by 1990, he predicts. His Manufacturing Assessment Model and System breaks down the 1990 GM passenger car types as follows:

Projected General Motors 1990 Passenger Car Fleet

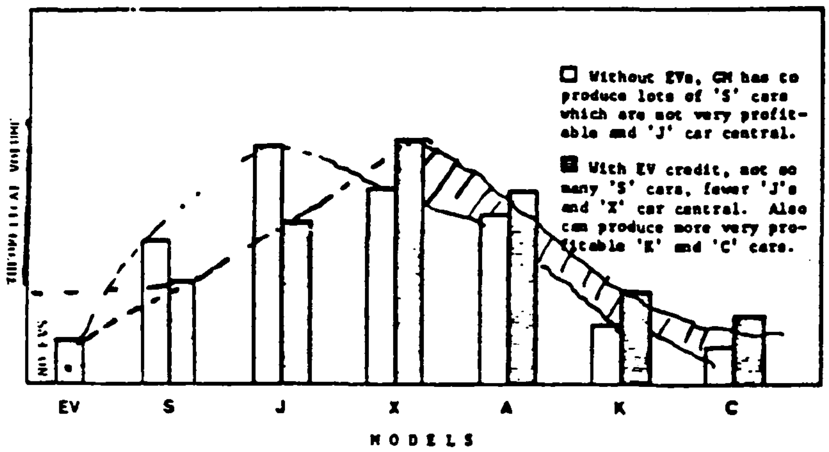
Model:	EV	'S'	'J'	'X'	'A'	'K'	'C'
Weight:	1,500 *	1,700	2,200	2,700	3,000	3,500	3,700
MPG:	85-185*	52	43/45	25/35	22/28	22/28	22/28

EV -- Two-passenger urban commuter car.
'S' -- Two-passenger urban car; possibly three-cylinder or diesel engine.
'J' -- Four-passenger family car; essentially chopped 'X'.
'X' -- Five-passenger family car; updated version of today's Citation, Skylark, etc.
'A' -- Six-passenger family car; tomorrow's Malibu.
'K' -- Five-passenger luxury car; tomorrow's Seville.
'C' -- Five-passenger personal car; tomorrow's Toronado, Eldorado, etc.
*MPG equivalency figure has not been finalized.

By 1990, the CAFE (Corporate Average Fuel Economy) standard will probably be pegged at 35 mpg. "At that CAFE level, GM's going to have problems," Lindgren began, "because the 'J' car will be the center of the car population, and they'll have to be producing a lot of 'S' cars to meet the requirement." The following graph was produced to illustrate his point.

"The lower mpg cars are much more profitable than those little 'S' cars. But if you want to optimize profits, then you have to make fewer of the 'S' cars and make the 'X' car the center of the car population, not the 'J'." The shaded bars of the graph show this method. How is General Motors going to accomplish this shift? "The electric car has the option of shifting this profile. It won't be built with

TWO METHODS FOR GENERAL MOTORS TO MEET 1990 CAFE



the idea of changing the entire country's whole vehicle population, or as a competitor to any of these cars -- because it's not -- but because of the CAFE inclusion. Through the CAFE inclusion and by building, say, 200,000 EVs a year, the curve shifts toward the additional profitability they're aiming for. That's their master plan, and it's an exquisite plan. General Motors is the only one of the big three that has in practice met the challenge of the CAFE standards. EVs, consequently, won't be built by either of the other two. GM is the only one that's going to benefit from the CAFE EV credit.

"So GM will be mass producing EVs by 1990. We have to decide first what configuration ought to be picked. It's got to be around 1,500 pounds, something like that. It can't be any more than that. It's got to be a two-passenger vehicle. If they try to make it any bigger, then it'll compete with the 'S' car, and you can put a diesel or a three-cylinder engine in the 'S'. Then there would be a head-on collision between the EV application and its benefit to the profile shift. If we knew exactly what the EV credit was going to be, then I'd be able to determine exactly what the profile shift would look like. Right now all this graph provides is illustration."

"Another reason why the EV looks so good to GM is to improve their economies of scale. All of the GM 1990 cars, except the 'S' will use, for example, the same transmission. And pushing that profile over even a little toward the 'X'...the difference in profitability is just staggering. They're not going to accept such a high proportion of small cars. They just aren't."

"Now, of course, the data is around to show that there is a place for the EV in the real world, if you're looking for urban-type travel. And you can't argue with these data: the 27 miles a day, the five trips, and so forth. But, I'm in favor of the hybrid concept because, remember, mobility is still the number one priority. [DOT defines the "reinvention" of the automobile in terms of these priorities: (1) Mobility; (2) Energy; (3) Emission; (4) Safety; (5) Noise; (6) Life Cycle Cost.] With a hybrid, you can get regenerative, you can use a little computer to optimize the energy use, and you can get DC to AC conversion, as in the Exxon hybrid."

And what about the Garrett Flywheel hybrid? "I don't see the flywheel concept at all. It's a technology that is rather crude -- crude in the sense that it harks back to the days when I was a mechanical engineer in school. And the only way that you got yourself any power in those days was to get yourself a big flywheel and spin the damn thing in order to get the inertial effect of the MV-squared. Well, so they decided that they'd get the effect of the MV-squared, but they'd have to go to very high speeds to get it because they didn't have a big enough space to put the flywheel. And because of the tremendously high RPMs, there's the safety question. Other than the flywheel design itself -- the fact that they made a flywheel out of that Kevlar composite and not out of the traditional cast iron or steel -- there's nothing significant about the Garrett vehicle."

And the Exxon hybrid? "They've got a heck of an idea there. Unfortunately their program was, in a sense, an attempt to save the full-sized car. So they put their DC to AC converter into a Cordoba, which weighed 4,200 pounds to begin with, and added another 200 pounds by hybriding it. Nevertheless, it did go from 17 mpg to 27.5 mpg, which was a big, quantum jump two or three years ago. But then they said, 'let's put a diesel in that Cordoba, a six-cylinder diesel, and see what happens.' The diesel came in at 25 mpg, so the $600 worth of electronic equipment doesn't really make much sense for two more mpg. Exxon has a whole lot of applications for the synthesizer which are non-automotive. I'm not sure whether they care all that much whether their hybrid flies or not."

Getting back to EVs. It is your view that EVs are being legislated into existence? "Yes, no question about it. If you'd wait for the 'real market' economies to take effect, they'd never be produced, but through the CAFE inclusion they will. There's an additional legislative mechanism which, to my mind, will have an impact on EVs. Large automobiles are going to be banned from all large center cities. The only kind of vehicles which will be allowed there are two-passenger models, such as the 'S' and electrics. There are a few reasons for this: air pollution considerations -- and the 'S' will be exquisitely clean, the present automobile fleet is an almost total misuse of urban space, and finally something has to be done about the 1.3 passenger problem -- 1.3 passengers being the average occupancy of an American automobile -- and the EV can and will make a significant contribution in this area."

CAPITAL EXPENDITURES BY AUTOMOTIVE INDUSTRIES

WORLDWIDE

	COMPANY	TIME PERIOD	$ BILLIONS
1.	G. M.	1980 - 1985	$38.0
2.	FORD	1980 - 1985	$20.0
3.	CHRYSLER	1980 - 1985	$13.6
4.	AMC	1980 - 1985	$ 3.0
	TOTAL ALL FOUR COMPANIES		$74.6

- -

RATH & STRONG ESTIMATE

(LESS INFLATION)

FOR 35 MPG	1985 - 1990	$55.0
FOR 42.5 MPG	1990 - 1995	$20.0
	TOTAL	$75.0

INCLUDES TOOLING AND FACILITIES INVESTMENTS

RATH & STRONG INC. GMC-A SCENARIO

INVESTMENT SUMMARY REPORT BY YEAR   SCALE = 1000

TOOLING & EQUIPMENT

YEARS	INVESTMENTS
1979	0
1980	356649
1981	2384450
1982	1872625
1983	413442
1984	719558
1985	896762
1986	796115
1987	374237
1988	777544
1989	562319
1990	698550
1991	375840
1992	52808
1993	0
1994	0

TOTAL INVESTMENTS   10280899

MPG.

85	90	95
27.5	35.0	42.5