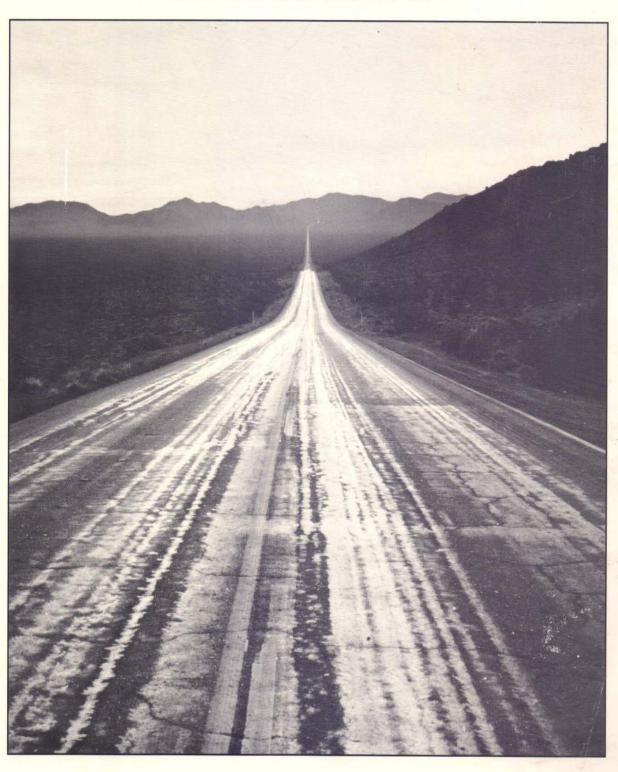
AUTOMOTIVE FUEL ECONOMY

How Far Should We Go?



NATIONAL RESEARCH COUNCIL

TABLE OF CONTENTS

PR	EFACE	vii		
EXECUTIVE SUMMARY				
1	INTRODUCTION	12		
	Fuel Economy Trends Since 1975	13		
	The Costs and Benefits of Reduced Automotive Fuel Consumption	23		
	Potential Benefits	23		
	Potential Costs	24		
	The Complexity of the Problem	26		
	Organization of Report	27		
	References	28		
2	FUEL USE IN AUTOMOBILES AND LIGHT TRUCKS	30		
	The Vehicle as a System	31		
	Engine Technology and Fuel Use	32		
	Standard Engine Technology	33		
	Performance/Fuel Economy Trade-Offs	37		
	Fuel Economy Technologies for the Next Decade	40		
	Proven Technologies	40		
	Emerging Technologies	43		
	Summary	45		
	References	46		
3	SAFETY IMPLICATIONS OF FUEL ECONOMY MEASURES	47		
	Background	47		
	Vehicle Characteristics and Fatality Risk	48		
	Risk of Crash Involvement	48		
	Risk of Injury	49		
	Design Compatibility	51		
	, , , , , , , , , , , , , , , , , , , ,	51		
	1	51		
		52		
		55		
		56		
		57		
		58		
	Strategies for Improving Safety and Fuel Economy Exposure Control	60		
	Crash Prevention	60		
	Behavior Modification	61		
	Safety as a Societal Value	61 61		
	Findings and Conclusions	62		
	References	64		
	1010101100	04		

4	ENVIRONMENTAL ISSUES	69
	The Nature of Automotive Emissions	69
	Automotive Emissions Control and Air Quality: A Brief History	71
	Standards in the 1990 Clean Air Act Amendments	72
	Federal Standards	72
	California Standards	73
	Emissions Standards and Technology Development	75
	Emissions Controls and Fuel Economy	75
	Control of Oxides of Nitrogen	76
	The Technical Challenge: Lean NO _x Catalyst	77
	Alternative NO _x Control Strategies	78
	Control of Hydrocarbons	79
	Heated Catalysts	79
	Gasoline Volatility	80
	Reformulated Gasolines	80
	Sulfur in Gasoline	81
	Alternative Fuels	81
	Control of Stationary Sources	82
	Impact of Emissions Standards on Light Trucks	82
	Surveillance of Existing Vehicles	83
	Indirect Impacts	84
	Conclusions	84
	References	86
5	IMPACTS ON THE AUTOMOTIVE INDUSTRY	90
	Financial Performance	91
	Effects of Competition	93
	Industry Trends	93
	Employment Trends	94
	Changing Market Share	98
	Product Development	98
	Manufacturing Productivity	100
	Capacity for Investment	100
	Structural Change in the Industry	102
	The International Automotive Market	102
	Impact of Fuel Prices	103
	Concerns over Greenhouse Gases	104
	Findings and Conclusions	104
	References	106

6	THE AUTOMOBILE, FUEL ECONOMY, AND THE CONSUMER	107
	The Auto Market Is a Replacement Market	107
	Balancing Fuel Cost, Purchase Price, and Vehicle Characteristics	111
	The Aging Population May Demand Fewer Small Cars	114
	Shifts in Aggregate Consumer Preference	117
	Impacts of Mandated Fuel Economy on the Consumer	117
	Findings and Conclusions	119
	References	121
7	FUEL ECONOMY PROJECTIONS	122
	Projecting Fuel Economy Levels	122
	Previous Efforts	122
	Overview of the Projection Methods	125
	Assumptions Common to All Projections	125
	Historical Trend Projections	126
	Best-In-Class (BIC) Projections	131
	Technology-Penetration or Shopping Cart Projections	133
	Method and Assumptions	133
	Data	137
	Results	139
	Conclusions	144
	References	147
8	ACHIEVABLE FUEL ECONOMY LEVELS	149
7	Technically Achievable Fuel Economy	150
	Method and Assumptions	150
	Results	151
	Practically Achievable Fuel Economy	154
	Cost-Benefit Considerations	154
	Costs and Benefits of Higher Fuel Economy to Consumers	156
	Costs and Benefits of Higher Fuel Economy to Manufacturers	159
	Sales	160
	Employment	161
	Competitiveness	162
	Costs and Benefits of Higher Fuel Economy to the Nation	163
	Petroleum Consumption	163
	Safety Emissions and the Environment	163
	Emissions and the Environment	164
	The Risk of Choosing Incorrectly	164
	Policy Coordination and Analysis	165
	References	167

9 POI	LICIES FOR IMPROVING FUEL ECONOMY	168	
	Comments on the Existing CAFE System	168	
	Market Approaches to Reduced Fuel Consumption	173	
	Increases in Fuel Price	173	
	Fees and Rebates for Fuel Economy	179	
	Improving the CAFE System	180	
	Timing	180	
	Alternatives to Uniform Fleet Targets	181	
	Light Trucks	183	
	Domestic Content	183	
	CAFE Credits	184	
	Unlawful Conduct	184	
	Other Policies for Reducing Fuel Consumption	185	
	Conclusions	186	
	References	188	
APPENDIXES			
A	Press Release Announcing Fuel Economy Study	191	
В	Proven Automotive Technologies: Fuel Economy and		
	Price Implications	196	
C	Emerging Engine Technologies and Concept and		
	Prototype Vehicles	217	
D	Vehicle Size and Occupant Safety: Private Versus		
	Societal Risks in Two-Car Collisions	227	
E	Shopping Cart Projection Method: An Illustration		
	for Subcompact Cars	232	
F	Committee Meetings and Activities	239	
G	Biographical Sketches of the Committee Members	251	
INDEX		257	
INDEV		201	