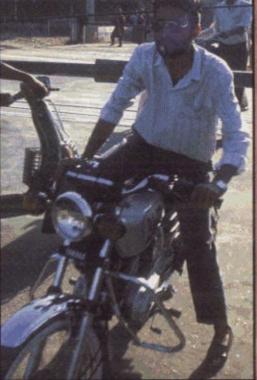
Improving Urban Air Quality in South Asia by Reducing Emissions from Two-Stroke Engine Vehicles

Masami Kojima, Carter Brandon, and Jitendra Shah







Contents

Foreword

Abstract

vii

ix

Acknowledgm	ents ix
Abbreviations	xi
Executive Sum	mary 1
	The Problem of Emissions from Two-Stroke Engine Vehicles 1 Emissions from two-stroke engines pose a danger to public health 1 Poor vehicle maintenance, misuse of lubricant, and adulteration of gasoline exacerbate emissions 2 Reducing Emissions from Two-Stroke Engines 2 Measures targeted at the existing fleet of two-stroke vehicles 2 Measures targeted at the environmental performance of new two-stroke vehicles 3 Replacing Two-Stroke Gasoline Engines 3 Four-stroke engines 3 Vehicles powered by liquefied petroleum gas 4 Vehicles powered by compressed natural gas 4 Electric vehicles 4 Standards and Enforcement 4
Chapter 1	Understanding the Problem of Two-Stroke Engine Emissions The Role of Two- and Three-Wheel Vehicles in South Asia 8 Types of Emissions 9 Factors Exacerbating Emission 10 Misuse of lubricant 10 Inadequate vehicle maintenance 11 Adulteration of gasoline 11 Lack of catalytic converters 11 Health Impact of Emissions 12 Effect of Emissions on Global Warming 12

in Delhi

30

Chapter	· ·
	Declines in Emissions 13
	Improving Gasoline Quality 15
	Improving Lubricant Use 15
	Standards for lubricants 15
	Using the correct concentration of lubricant 15
	Using low-smoke lubricant 16
	Metering lubricant 16
	Improving Vehicle Design 16
	Installing catalytic converters 17
	Reducing scavenging losses 18
	Improving Maintenance 18
Chapter 3	r 3 Alternatives to Two-Stroke Gasoline Engines 21
	Four-Stroke Gasoline Engines 21
	Vehicles Powered by Liquefied Petroleum Gas 22
	Vehicles Powered by Compressed Natural Gas 22
	Electric Vehicles 23
Chapter 4	r 4 Policy Options 25
	Emission-Based Policies 25
	Monitoring emissions 25
	Repairing vehicles that fail inspection 26
	Technology-Specific Policies 26
	Banning all two-stroke engines 27
	More selective bans 28
	Fiscal and Trade Policy Options 28
	Tax incentives for vehicle renewal 28
	Offering cash payments for older vehicles to remove them from the road 28
	Ensuring adequate credit 29
	Liberalizing trade in new vehicles 29
	Public Education 29
	Future Directions 29
Annex	
	ealth Impact of Air Pollution 31
	proving Particulate Sampling of Two-Stroke Engine Vehicles 35
C An	nalytical Tools for Cost-Benefit Analysis 39
D Re	ports Prepared under the South Asia Two-Stroke Engine Initiative 41
Notes	43
Referen	ices and Selected Bibliography 45
Boxes	
-	ducing pollution while caving manage 11
	ducing pollution while saving money 11 nission standards from around the world 17
	ducing scavenging losses in two-stroke engines 19

4 Converting diesel three-wheelers to electric Tempos in Kathmandu 24 The role of the supreme court in air quality management in Delhi 27 Reducing emissions and improving performance through free inspection and maintenance clinics

Figure

1 Number of vehicles in Delhi by type, 1971–96

Tables

- 1 Distribution of vehicles by type, selected South Asian countries 8
- 2 Emissions from uncontrolled motorcycles, 1970s (grams per kilometer except where otherwise indicated) 10
- 3 Emissions from selected Bangladeshi 2-stroke 3-wheelers (grams per kilometer) 10
- 4 Emission standards for gasoline-powered two-wheelers in Taiwan (China), 1988–2003 13
- 5 Emission standards for gasoline-powered two- and three-wheelers in India, 1991–2000 (grams per kilometer) 14
- 6 Particulate matter emission factors for two-wheelers in India 14
- 7 Relation between lubricant content and emissions by uncontrolled motorcycles 16
- 8 Retail prices of lubricants in India, March 2000 (Indian rupees) 16
- 9 Particulate matter emission factors for motorcycles in Bangkok (grams per kilometer, except where otherwise indicated) 17
- 10 Fuel economy of two-stroke and four-stroke engine vehicles 21
- A1 Experimental particulate emission results 36