

Controlling Air Pollution in China

Risk Valuation and the Definition of
Environmental Policy

Therese Feng

*Research Fellow, Science, Technology, and Public Policy
Program, John F. Kennedy School of Government,
Harvard University, USA*

NEW HORIZONS IN ENVIRONMENTAL ECONOMICS

Edward Elgar

Cheltenham, UK • Northampton, MA, USA

Contents

<i>List of Illustrations</i>	<i>x</i>
<i>List of Tables</i>	<i>xi</i>
<i>List of Appendices</i>	<i>xiv</i>
<i>Glossary</i>	<i>xvi</i>
<i>Acknowledgments</i>	<i>xviii</i>
<i>Foreword</i>	<i>xix</i>
1 Introduction	1
1.1 The integrated assessment	3
1.2 Organization of the book	7
PART I THE INTEGRATED ASSESSMENT MODEL	
2 Power plant emissions and pollution control strategies	11
2.1 Emissions	13
2.2 Pollution control strategies: fuel modifications	17
2.3 Abatement technologies	22
2.3.1 Sulfur	22
2.3.2 Particulates	24
2.3.3 Nitrogen oxides	27
2.4 Alternative combustion and conversion technologies	30
2.5 Dispersion strategies	35
2.6 Fuel substitution: residual oil and natural gas	38
3 Transport and fate of coal-fired power plant emissions	42
3.1 Stack release and dispersion: the Gaussian plume model	43
3.2 Pollutant removal processes	48
3.2.1 Chemical transformation	48
3.2.2 Dry and wet deposition	- 53
3.3 Long-range transport	56

4	The nature and valuation of air pollutant effects	63
4.1	Human health effects	63
4.1.1	Measurement issues	63
4.1.2	Summary of effects by pollutant	67
4.1.2.1	Sulfur dioxide	68
4.1.2.2	Carbon monoxide	68
4.1.2.3	Nitrogen dioxide	68
4.1.2.4	Ozone	69
4.1.2.5	Particulates and secondary compounds	70
4.1.3	Estimating human health effects	74
4.1.3.1	The concentration-response function	74
4.1.3.2	Human mortality	77
4.1.3.3	Human morbidity	81
4.1.3.4	Valuation of human health effects	84
- 4.2	Non-health effects	89
4.2.1	Agriculture	89
4.2.1.1	Physical impacts of air pollutants	89
4.2.1.2	Valuation of agricultural impacts	93
4.2.2	Terrestrial ecosystems	97
4.2.2.1	Forests	97
4.2.2.2	Aquatic ecosystems	99
4.2.2.3	Valuation of damages to ecological services	100
4.2.3	Materials	101
4.2.3.1	Physical effects of air pollutants	101
4.2.3.2	Valuation of material damages	103
4.2.4	Atmospheric effects	105
4.2.4.1	Pollutant effects on local visibility	105
4.2.4.2	Global atmospheric effects: greenhouse gas warming	107
	Appendices 4.1 to 4.6	114

PART II APPLICATIONS OF THE INTEGRATED ASSESSMENT AND EFFICIENT POLICY DESIGN

5	Integrated assessment of an uncontrolled coal-fired plant in China and the choice of efficient pollution control techniques	133
5.1	Assumptions of the model application	134
5.2	Results of the base case: no pollution control measures	135
5.3	Efficient abatement control choice	144
5.4	Locally efficient control measures today	146
5.5	Locally efficient control measures over time	148

5.6	New technologies: locally efficient control measures overtime	152
5.7	Regionally and globally efficient policies	153
5.8	Conclusions and implications	156
	Appendices 5.1 to 5.7	159
6	Assessment of uncertainty in the integrated assessment and policy analysis	170
6.1	Sensitivity analysis	170
6.2	Uncertainty in the optimal choice of control technologies	177
6.3	Key parameters to resolve	179
	Appendices 6.1 to 6.4	181
7	Efficient pollution control over space	188
7.1	Theory and basic model	189
7.2	Empirical applications	192
	7.2.1 Pollutant classifications	192
	7.2.2 Human population density	195
	7.2.3 Regional meteorology	198
	7.2.4 Transboundary damages	200
7.3	Conclusions	202
	Appendices 7.1 to 7.3	204
8	Efficient pollution control over time	207
8.1	Model of efficient investment	208
8.2	Model investigations	211
	8.2.1 Forward-looking and myopic policies in the current period	212
	8.2.2 Empirical simulation of a single plant starting in the present	215
	8.2.3 An empirical investigation of the desirability of updating environmental policy over time	217
8.3	Conclusions	224
	Appendix 8.1	226
9	Conclusion	228
	<i>Bibliography</i>	232
	<i>Index</i>	262