Contents

| List of Tables, Figures and Maps Acknowledgements | | viii |
|--|---|------|
| | | xii |
| Al | Abbreviations | |
| Fu | uel Conversion Rates | xiv |
| Sı | ımmary of Major Conclusions | 1 |
| In | troduction | 15 |
| 1 | Alternative Scenarios for the FSU Reform Process | 19 |
| | 1.1 Introduction | 19 |
| | 1.2 Scenario 1: radical market reforms | 20 |
| | 1.3 Scenario 2: gradual market reforms | 25 |
| | 1.4 Scenario 3: extended period of reform impasse | 29 |
| | 1.5 Scenario 4: reform impasse and internal war | 33 |
| 2 | Production Constraints and Prospects | 35 |
| ~ | 2.1 Physical-technological constraints | 35 |
| | 2.1.1 Crude oil | 36 |
| | 2.1.2 Natural gas | 55 |
| | 2.1.2 Ivatural gas 2.1.3 Coal | 58 |
| | 2.1.4 Western technology and its expected impact | 60 |
| | 2.2 The economics of fuel supply in the FSU | 61 |
| | 2.2.1 Marginal costs and the range of uncertainty | 63 |
| | 2.2.2 Crude oil | 64 |
| | 2.2.3 Natural gas | 74 |
| | 2.2.4 Coal | 87 |
| | 2.2.5 Geographic breakdown of fuel production | 92 |
| | 2.3 Institutional and socio-political issues in energy | |
| | sector reform | 104 |
| | 2.3.1 The institutional structure of fuel production in | 104 |
| | 2.3.2 Institutional arrangements in the Russian fuel industries | 105 |

vi Contents

| | 2.3.3 Effects of Intra-FSU Political Tensions | 107 |
|---|---|------|
| | 2.3.4 Socio-economic constraints to fuel output in | |
| | Scenario 1 | 109 |
| | Appendix 2.1: Assessing the distribution and | |
| | recoverability of bypassed oil | 112 |
| | Appendix 2.2: Three methods to compute required | |
| | investment in the FSU's oil industry | 116 |
| | between 1993 and 2000 | 116 |
| | Appendix 2.3: Derivation of investment costs for a gas | 118 |
| | export pipeline. | 110 |
| 3 | Prospects for FSU Energy Consumption | 120 |
| | 3.1 Introduction | 120 |
| | 3.2 Energy use patterns in the FSU | 121 |
| | 3.2.1 Trends in energy efficiency | 123 |
| | 3.2.2 Behavioural factors behind inefficient energy use | |
| | and the magnitude of systemic wastage | 133 |
| | 3.3 Structure of energy prices at the beginning of market | |
| | reforms | 137 |
| | 3.3.1 State-controlled prices | 137 |
| | 3.3.2 Commodity-exchange prices | 141 |
| | 3.3.3 Contract prices | 142 |
| | 3.3.4 Barter prices | 143 |
| | 3.3.5 Interrepublican trade prices | 143 |
| | 3.3.6 Magnitude of distortions in current energy prices | 144 |
| | 3.3.7 Energy price outlook for the near future | 148 |
| | 3.4 Market reforms and future patterns of energy | 1.40 |
| | consumption | 149 |
| | 3.4.1 Methodology and main underlying assumptions | 149 |
| | for consumption projections | 149 |
| | 3.4.2 Projected trends in energy consumption under | 155 |
| | alternative scenarios | 133 |
| 4 | | |
| | Europe - | 168 |
| | 4.1 Introduction | 168 |
| | 4.2 The significance of the FSU as energy exporter prior | |
| | to the reforms | 168 |
| | 4.3 Projections of energy exports from the FSU | 171 |

| | Contents | vii |
|----------------------|--|-----|
| 4.4 FS | U export supply and world energy markets | 187 |
| 4.4.1 | International energy market reactions to changes | |
| | in supply | 189 |
| 4.4.2 | The price impact of shifting FSU exports | 190 |
| | plications for Eastern Europe | 205 |
| | Introduction | 205 |
| 4.5.2 | The impact of FSU export shortfalls | 206 |
| | Conclusions | 219 |
| Notes and References | | 220 |
| Bibliography | | 229 |
| Index | | 236 |

List of Tables, Figures and Maps

Tables

| Α | FSU energy: projections of production, consumption | 7 |
|--------------|--|----|
| | and exports under alternative scenarios | 7 |
| В | Energy in Russia: projections of production, | • |
| | consumption and exports under alternative scenarios | 8 |
| \mathbf{C} | Projected export revenue from fossil-fuel sales under | |
| | alternative scenarios | 12 |
| 1.1 | Anticipated impact on the energy sector of long-term | |
| | direction of policy and systemic change assumed in | |
| | Scenarios 1–3 | 34 |
| 2.1 | Proven plus probable reserves of oil in the FSU and | |
| | republics in 1991 | 38 |
| 2.2 | Proven plus probable oil reserves of Russia | 39 |
| 2.3 | Proven plus probable oil reserves of West Siberia | 40 |
| 2.4 | Reserves in producing oil fields in West Siberia and per | |
| | cent of initial reserves withdrawn, 1990 | 41 |
| 2.5 | Oil production according to well yields, percentage of | |
| | reserves produced, and dynamics of output, Russia and | |
| | West Siberia | 43 |
| 2.6 | Natural gas reserves in the FSU and republics in 1988 | 56 |
| 2.7 | FSU crude oil: prices, extraction costs and transport | |
| | costs to borders or major consumption centres | 73 |
| 2.8 | FSU natural gas: prices, extraction costs and transport | |
| | costs to borders or major consuming centres | 77 |
| 2.9 | Pipe requirement of the FSU gas industry | 83 |
| 2.10 | FSU natural gas: potential exports and estimated | |
| | investment requirements | 86 |
| 2.11 | Fuel production in the FSU, 1989–2005 | 93 |
| 2.12 | Fuel production in Russia, 1989–2005 | 94 |
| | Oil production in Russia, 1989–2005 | 95 |
| 2.14 | Natural gas production in Russia, 1989–2005 | 96 |
| 2.15 | | 97 |
| 2.16 | Fuel production in Ukraine, 1989–2005 | 99 |

| | List of Tables, Figures and Maps | ix |
|------|--|-----|
| 2.17 | Fuel production in Kazakhstan, 1989-2005 | 100 |
| 2.18 | Fuel production in Central Asia, 1989–2005 | 103 |
| 3.1 | Sectoral distribution of final energy consumption in the | |
| | FSU, the US and OECD Europe. | 128 |
| 3.2 | End-use energy intensity by sector in the FSU, the US, | |
| | Japan and Germany in 1980 and 1988 | 131 |
| 3.3 | Technological and vintage characteristics of equipment | |
| | in the former USSR | 132 |
| 3.4 | Magnitude of energy savings potential in the FSU by | |
| | sector, 1990 | 136 |
| 3.5 | Wholesale energy prices in Russia, June 1992 | 138 |
| 3.6 | State-set retail prices of energy in Russia, June 1992 | 140 |
| 3.7 | Volume of energy products traded on the Russian | |
| , | commodity exchanges | 142 |
| 3.8 | Degree of distortion in selected Russian wholesale | |
| 0.0 | energy prices, June 1992 | 145 |
| 3.9 | Degree of distortion in selected retail energy prices in | |
| J., | Russia, June 1992 | 147 |
| 3.10 | Fuel consumption in the FSU, 1989–2005. | 158 |
| 3.11 | Fuel consumption in Russia, 1989–2005. | 158 |
| 3.12 | Fuel consumption in Ukraine, 1989–2005. | 159 |
| 3.13 | Fuel consumption in Kazakhstan, 1989–2005 | 159 |
| 3.14 | Fuel consumption in Central Asia, 1989–2005 | 160 |
| 3.15 | Fuel consumption in Transcaucasia, 1989–2005 | 160 |
| 4.1 | Significance of net FSU exports in world fuel markets in | |
| | 1989 | 169 |
| 4.2 | Exports (gross) of fuels from leading supplying | |
| | countries in 1989 | 169 |
| 4.3 | The significance of imports from the FSU in the West | |
| | European fossil fuels markets in 1989 | 170 |
| 4.4 | FSU net exports of fossil fuels | 171 |
| 4.5 | FSU energy: projections of production, consumption | |
| •5 | and exports under alternative scenarios | 172 |
| 4.6 | FSU: projected export revenue from fossil fuel sales | |
| | under alternative scenarios. | 176 |
| 4.7 | Energy in Russia: projections of production, | |
| *., | consumption and exports under alternative scenarios | 178 |
| 4.8 | Russia: projected export revenue from fossil fuel sales | |
| 7.0 | under alternative scenarios | 180 |
| 4.9 | Energy in Kazakhstan: projections of production, | |
| 1.7 | consumption and exports under alternative scenarios | 182 |

| 4.10 | Energy in Central Asia: projections of production, consumption and exports under alternative scenarios | 183 |
|------|--|----------|
| 4 11 | Energy in Ukraine: projections of production, | |
| 4.11 | consumption and exports under alternative scenarios | 184 |
| 4.12 | Oil in the FSU: exportable surpluses by major republic | |
| 4.12 | or republican group, under alternative scenarios | 185 |
| 4.13 | Gas in the FSU: exportable surpluses by major republic | |
| 4.13 | or republican group, under alternative scenarios | 185 |
| 4.14 | Coal in the FSU: exportable surpluses by major republic | |
| 4.14 | or republican group, under alternative scenarios | 186 |
| 4.15 | FSU fuel export forecasts: scenario results compared | |
| 4.13 | with projected 1980-89 trends. | 188 |
| 4.16 | Measuring the international price impact of variations | |
| 4.10 | in the FSU's coal export performance | 193 |
| 4.17 | Measuring the international price impact of variations | |
| 4.17 | in the FSU's oil export performance | 195 |
| 4.18 | Measuring the impact on European price levels of | |
| 4.10 | variations in the FSU's natural gas export performance | 200 |
| 4.19 | Significance of imports from the FSU in the | |
| 4.17 | East-European energy markets in 1989 | 208 |
| 4.20 | Eastern Europe: an assessment of the economic impact | |
| 7.20 | of higher prices for fuels imported from the FSU | 211 |
| 4.21 | FSU gas export supply cost in the year 2000 | 215 |
| 4.22 | Costs of alternative sources of gas to Eastern Europe | 216 |
| 4.23 | Energy intensities in East and West Europe in 1989 | 218 |
| | | |
| Figu | res | |
| Α | FSU oil and gas: projections of production, | • |
| | consumption and exports under alternative scenarios | 9 |
| В | Russian oil and gas: projections of production, | |
| | consumption and exports under alternative scenarios | 10 |
| 1.1 | Growth Profiles of FSU GDP under Scenarios 1-3 | 20 |
| 2.1 | Percentage of 'active' reserves extracted in producing | |
| | fields, Russia and West Siberia | 44 |
| 2.2 | Production in Russia according to well yield | 49 |
| 2.3 | Production in West Siberia according to well yield | 49 50 |
| 2.4 | Sources of oil production for Scenario 2 | |
| 2.5 | West Siberia: extraction levels and marginal costs | 68 |
| 2.6 | Marginal cost of oil in Russia with a 10 per cent | /(|
| | discount rate (1993–2000) | 69 |

| 2.7 | Selected coal producers by volume and cost | 89 |
|------|--|-----|
| 2.8 | Institutional structure of the oil industry of the Russian | |
| | Federation, 1992 | 108 |
| 3.1 | Energy consumption in the FSU, 1971-91 | 122 |
| 3.2 | Total primary energy consumption in the FSU and the | |
| | OECD | 123 |
| 3.3 | Energy intensity of GDP in the FSU and the OECD | 124 |
| 3.4 | Energy intensity in the FSU | 125 |
| 3.5 | Primary energy consumption per capita | 126 |
| 3.6 | The FSU: energy intensity of end-use sectors | 129 |
| 3.7 | The FSU: projected energy use in Scenarios 1-3 | 156 |
| 3.8 | FSU natural gas consumption: magnitude of price effect | |
| | under Scenarios 1–2 | 163 |
| 3.9 | The FSU: fuel shares in total energy consumption | 164 |
| 3.10 | The FSU: energy efficiency paths under Scenarios 1-3 | 167 |
| 4.1 | FSU oil and gas: projections of production, | |
| | consumption and exports under alternative scenarios | 173 |
| 4.2 | Russian oil and gas: projections of production, | |
| | consumption and exports under alternative scenarios | 179 |
| 4.3 | Fuel exports from the FSU | 187 |
| 4.4 | Initial price adjustment to a fall in FSU supply | 192 |
| 4.5 | Gas import prices | 198 |
| 4.6 | Fossil fuels in Eastern Europe in 1989: shares of gross | |
| | availability by type and source | 210 |
| | | |
| Maps | | |
| 2.1 | Hydrocarbon basins of the FSU | 37 |
| 2.2 | The West-Siberian oil and gas province with subregions | 45 |
| 2.3 | Oilfields of the Middle Ob' petroleum region (after | |
| - | Maksimov) | 46 |
| 2.4 | Natural gas in West Siberia: deposits of the Nadym-Pur | |
| - | gas region | 57 |
| 2.5 | Main gas pipelines and volumes transmitted | 82 |
| | San bybannan and Angerine and A | |
| | | |

List of Tables, Figures and Maps

хi