

Table of contents

Executive summary	10
Scope and aims of the Energy Use Project	11
Objectives	12
Final report	13
Introduction	14
Project timeline and meetings	14
Project members	15
Geographical distribution of iron and steel production.....	16
Overview of the steelmaking process	17
Process routes and energy boundaries	18
Blast furnace process	18
Electric arc furnace/Mini mill	19
Direct reduced iron	19
DRI products.....	19
DRI reduction processes.....	20
Fire hazard risk of DRI.....	21
Smelting reduction technologies	21
Ore versus scrap steelmaking	21
Energy intensity: BF/BOF versus EAF.....	22
Raw materials availability.....	27
Influence of raw material quality on energy intensity	27
Utilisation of lower grade coal in metallurgical plants	27
Utilisation of low quality iron ore in metallurgical plants	28
Scrap types and quality	29
Power plants and auxiliary plants	31
Alternative ironmaking technologies	31
Direct reduced iron-ore technologies	33
Smelting reduction processes.....	37
Other alternative ironmaking technologies	43
Potential impact and timeline of alternative ironmaking technologies.....	52
Project methodology and benchmarking	54
Challenge	54
Reference value definitions	54
Energy survey.....	56
Technology survey	65
Roll-up methodology.....	66
Case studies	67

Economic aspects of energy investments	69
Policy limits for companies, countries or regions	71
Policies.....	71
Subsidies.....	72
Regulations.....	72
Assessment of energy technologies.....	72
Environmental protection	73
European Union emissions trading scheme.....	73
Twelfth Chinese five-year plan.....	74
General processes and techniques.....	76
Iron-ore based steelmaking	76
Coke oven plant.....	76
Pelletizing plant.....	78
Direct reduced iron plant (gas- and coal-based).....	78
Sinter plant	79
Blast furnace plant.....	81
BOF steelmaking	83
EAF steelmaking	84
Scrap-based EAF	84
Ore-based EAF	87
Hot rolling mill.....	87
Hot rolling mill – analyses of ore-based steel production results	87
Hot rolling mill – scrap-based steel production	89
Auxiliary equipment.....	89
Power plants	89
General technologies	90
Air separation units.....	91
Site energy intensity	96
Iron ore-based steel production – roll-up results	96
Scrap-based steel production – roll-up results	96
Industry-wide horizontal measures	97
Energy management systems.....	97
Energy source utilisation in metallurgical plant.....	100
Industrial gas input rate to metallurgical processes	100
Destination of industrial gases	100
Destination of coke oven gas	100
Destination of BF gas.....	101
Destination of BOF gas.....	102
Energy intensity indicators.....	103
Energy intensity indicator for BF/BOF process route	103
Energy intensity indicator for EAF process route	103

Conclusion	104
Project accomplishments	105
Recommendations for steel producers	106
List of appendices.....	108
List of abbreviations	109
List of figures.....	112
List of tables	114
References.....	115