

TABLE OF CONTENTS

Foreword	3
Acknowledgements	5
List of tables	8
List of figures	11
List of boxes	17
Executive summary	19
<i>Chapter 1 • Global and regional trends in residential electricity consumption</i>	<i>27</i>
<i>Chapter 2 • Effective policies for energy efficiency</i>	<i>39</i>
<i>Chapter 3 • Country and regional reviews</i>	<i>59</i>
Australasia	62
Canada	76
European Union	89
Japan	106
South Korea	125
United States	138
Brazil	161
China	172
India	189
Mexico	201
South Africa	210
<i>Chapter 4 • The case of electronic appliances</i>	<i>233</i>
<i>Chapter 5 • What's on TV?</i>	<i>251</i>
<i>Chapter 6 • Computers and monitors</i>	<i>275</i>
<i>Chapter 7 • Set-top boxes</i>	<i>305</i>
<i>Chapter 8 • Miscellaneous ICT and CE equipment</i>	<i>323</i>
<i>Chapter 9 • Cross-cutting issues</i>	<i>327</i>

<i>Chapter 10 • Summary of conclusions and recommendations</i>	361
<i>Annex I • Summary of estimated BAU, LLCC and BAT electricity consumption</i>	371
<i>Annex II • Evaluation metrics used in analysis</i>	373
<i>Abbreviations and acronyms</i>	375
<i>Glossary</i>	385
<i>References</i>	389

LIST OF TABLES

Table 1 • Rates of change of total and per capita electricity consumption	27
Table 2 • Energy and electricity as percentage of average household expenditure, selected countries	42
Table 3 • Summary of 16 energy efficiency programme case studies	50
Table 4 • Lifetime impact and cost effectiveness of eight evaluated energy efficiency programmes	55
Table 5 • National budget for electrical appliance energy efficiency programmes in Australia, AUD million, 2003-4 to 2006-7	64
Table 6 • Summary of major national policy measures for residential electrical appliances, Australasia	69
Table 7 • Coverage of sectoral energy use by NAEEEP (by % fossil fuel primary energy), Australia	69
Table 8 • Number of residential demand side NGACS created between 2003 and 2007	71
Table 9 • Record of check tests and the results undertaken between 2004 and 2007...	73
Table 10 • Australian financial support for Asia Pacific Partnership on Clean Development and Climate (APP) projects	75
Table 11 • Annual expenditure for energy efficiency programmes, CAD million, 2003-2007	79
Table 12 • Ontario Power Authority 'Every Kilowatt Counts' programme, 2008	82
Table 13 • Summary of major national policy measures for residential electrical appliances	84
Table 14 • Grants available under the EcoEnergy retrofit programme	85
Table 15 • Energy rating of household appliance, percentage of sales, EU 15, 2004-05	93
Table 16 • Summary of major national policy measures for residential electrical appliances	97
Table 17 • Survey of standby power levels from EICTA 2005 survey	99

Table 18 • Test results on sample of European air-conditioners	103
Table 19 • Extract of Japan's energy efficiency budget.....	109
Table 20 • ECCJ budget and staff allocations, 2001, 2003, 2005 and 2006	110
Table 21 • Implementation and revision dates of Top Runner residential electrical appliance categories	114
Table 22 • Standby power measurements by industry against self-declaration target, 2004.....	116
Table 23 • Summary of major national policy measures for residential electrical appliances.....	116
Table 24 • Expected energy reductions from Top Runner programme	118
Table 25 • Sample sizes for elements of standby power survey, 1999, 2002 and 2005 ..	121
Table 26 • Change in surveyed ownership and usage patterns for televisions and DVD players/recorders, 2002-2005	122
Table 27 • Long-term roadmap for energy labels and MEPS	126
Table 28 • KEMCO staff and budget allocation, USD, 2002-2007.....	127
Table 29 • Annual budget for appliance energy efficiency programmes, USD millions, 2003-2007	127
Table 30 • Implementation of standby power ≤ 1 W Standards.....	130
Table 31 • Summary of major national policy measures for residential electrical appliances.....	131
Table 32 • US federal government expenditure on major energy efficiency programmes (USD million).....	141
Table 33 • Energy Star qualified products	144
Table 34 • MEPS for residential electrical equipment in the United States.....	147
Table 35 • Summary of major national policy measures for residential electrical appliances.....	150
Table 36 • Investments in energy efficiency from wire charge	166
Table 37 • PROCEL budget, 1996-2003.....	166
Table 38 • Standby power levels for label rating	168
Table 39 • Summary of major national policy measures for residential electrical appliances.....	169
Table 40 • Allocation of GEF funding for capacity building in Brazil	170
Table 41 • Registered enterprises and products for energy information, October 2007 ...	177
Table 42 • Summary of major national policy measures for residential electrical appliances .	178
Table 43 • Progress with residential building codes.....	183
Table 44 • Estimated impacts of China's MEPS and labelling programmes for electric appliances and lighting in 2020	183
Table 45 • Estimated impacts of China's MEPS and labelling programmes for electric appliances and lighting in 2020	183
Table 46 • Initial recommendations for endorsement label	197

Table 47 • Summary of major national policy measures for residential electrical appliances . .	198
Table 48 • Ex-ante forecasts of savings from comparative labelling, 2007/08	198
Table 49 • Check tests undertaken on electric appliances in 2008	199
Table 50 • CONAE budget and staffing levels, 2001-2008.....	204
Table 51 • Summary of major national policy measures for residential electrical appliances . .	206
Table 52 • Availability of testing facilities for electrical appliances	208
Table 53 • Estimated energy savings from NOM electricity sector in 2007	209
Table 54 • Residential sector programme implementation and timeframes.....	213
Table 55 • CaBEERE funding for relevant energy efficiency projects.....	215
Table 56 • Summary of major electrical appliance energy efficiency programmes by appliance category, 2008	221
Table 57 • Examples of regional organisations involved in energy efficient ITC and CE equipment	249
Table 58 • Power consumption of televisions receiving digital radio	267
Table 59 • Summary of current national policies for televisions	270
Table 60 • Power consumption of PC monitors by technology	289
Table 61 • Estimated energy consumption of ICT services, France, 2006.....	296
Table 62 • Summary of energy efficiency policies for personal computers	299
Table 63 • Summary of energy efficiency policies for computer monitors.....	300
Table 64 • Typical annual energy consumption values for common STB types and features	311
Table 65 • Summary of current policies for set-top boxes.....	316
Table 66 • Allocation of hours in Energy Star duty cycle.....	317
Table 67 • Assumed daily operating times used in Top Runner programme for DVD recorders	317
Table 68 • Average EPS efficiency data from studies 2003 to 2007	333
Table 69 • Development cycle for new EPS product	337
Table 70 • Summary of major policy measures for EPS (excluding ELV halogen lighting transformers).....	339
Table 71 • Proposed MEPS for halogen lighting transformers in Australia and New Zealand	340
Table 72 • Comparison between standby power surveys in Japan and Australia	346
Table 73 • Table of major existing national energy efficiency policies targeting standby power in place	351
Table 74 • EU Ecodesign requirements for standby and off mode contained in implementing directive.	353
Table 75 • Example of functional adder approach for two devices	355
Table 76 • Estimated global residential electricity consumption by ICT and CE equipment (TWh), 1990-2030	371

LIST OF FIGURES

Figure 1	• Recorded fall in average electricity consumption and prices for several major appliance types in selected countries	20
Figure 2	• Residential electricity consumption by region, 1990-2006.....	20
Figure 3	• Estimated electricity consumption by ICT and CE equipment in the residential sector, by region, 1990-2030	21
Figure 4	• Estimated electricity savings from adoption of least life-cycle cost (LLCC) and best available technologies (BAT).....	22
Figure 5	• Rates of change of total residential electricity consumption, 1990-2006	27
Figure 6	• Average annual change in electricity consumption amongst OECD countries, 1996-2006	28
Figure 7	• Residential electricity consumption per capita, 1996-2006	29
Figure 8	• Shares of space heating demand supplied by electrical appliances, IEA19, 1990 and 2005	29
Figure 9	• Rates of change of electricity consumption and GDP for OECD countries, 1996-2006	30
Figure 10	• Rates of change of electricity consumption and GDP for OECD regions and non-OECD, 1996-2006	31
Figure 11	• Comparison between Cool Appliance projection and actual residential electricity consumption, 2000-2006.....	31
Figure 12	• Change in electricity consumption and % change by end-use category, United States, 1998-2008.....	33
Figure 13	• Change in electricity consumption and % change by end-use category, Canada, 1995-2005.....	34
Figure 14	• Change in electricity consumption by end-use category, United Kingdom, 1998-2006	34
Figure 15	• Change in electricity consumption and % change by end-use category, Japan, 1995-2005	35
Figure 16	• Change in electricity consumption and % change by end-use category, Australia, 1998-2008.....	36
Figure 17	• Change in electricity consumption by appliances, Australia, 1998-2008	36
Figure 18	• Long-term energy savings from improvements in energy efficiency, all sectors, IEA11, 1973-2005.....	39
Figure 19	• Consumer payback requirements for energy efficiency improvements vs. achieved payback periods.....	43
Figure 20	• Recorded fall in average electricity consumption and prices for several major appliance types in selected countries	49
Figure 21	• Summary of energy savings versus cost effectiveness for eight evaluated energy efficiency programmes	55

Figure 22 • Total residential electricity consumption, 1995-2006	59
Figure 23 • Total residential and per capita electricity consumption, Australasia, 1995-2006	62
Figure 24 • Distribution of electricity consumption in Australia by end-use in 2005.....	63
Figure 25 • Change in electricity use in Australia, 1990-2005 by major end-use.....	63
Figure 26 • Progress in share of sales for Energy Star registered products in New Zealand, 2006-2007	67
Figure 27 • Source of New South Wales greenhouse abatement certificates (NGACS) created between 2003 and 2007	71
Figure 28 • Total residential and per capita electricity consumption, 1995-2006	76
Figure 29 • Residential electricity consumption by major end-use equipment, 1995-2005 ..	76
Figure 30 • Energy use by type of heating appliances and by fuel, 2002	77
Figure 31 • Heating and cooling degree days, 1998-2005.....	77
Figure 32 • Consumer awareness of EnerGuide label, 2001-2007.....	80
Figure 33 • Consumer awareness of Energy Star label, 2001-2007	82
Figure 34 • Total residential and per capita electricity consumption, OECD Europe, 1995-2006	89
Figure 35 • Change in residential electricity consumption, OECD Europe, 1996-2006...	90
Figure 36 • Distribution of residential electricity by end-use, EU-15, 2004	90
Figure 37 • Sales of cold appliances in Denmark, 1995-2005 by energy rating.....	93
Figure 38 • Total and per capita residential electricity consumption in Japan, 1990-2006..	106
Figure 39 • Distribution of residential electricity consumption by end-use category, 2005 .	107
Figure 40 • Household appliance ownership trends, 1990-2006.....	107
Figure 41 • Shipments of VCRs, DVD players and recorders in Japan	114
Figure 42 • Comparison of energy consumption values based on original and new version of JIS 9801.....	120
Figure 43 • Trends in electricity consumed by refrigerators in Japan, 1990-2006	120
Figure 44 • Average electricity consumed per household by major appliance categories in standby mode, 1999, 2002 and 2005.....	122
Figure 45 • Total residential and per capita electricity consumption, South Korea, 1995-2006	125
Figure 46 • Uptake of energy efficiency products through public procurement system, 2004-2007	133
Figure 47 • Estimated energy savings from three energy efficiency programmes, Korea, 2002-2006	135
Figure 48 • Total residential and per capita electricity consumption, United States, 1995-2006	138
Figure 49 • Change in United States residential electricity consumption, 1998-2005.....	138
Figure 50 • Distribution of residential electricity consumption by end-use, United States, 2005.....	139

Figure 51 • Households with access to electricity (%)	161
Figure 52 • Total and per capita residential electricity consumption, 1990-2005	162
Figure 53 • Growth in ownership levels of household appliances, 1995-2005.....	162
Figure 54 • Residential end-use electricity consumption, 2005.....	163
Figure 55 • Progress with MEPS and labels for all products in Brazil	164
Figure 56 • Allocation of investments from Wire Charge by sector	166
Figure 57 • Estimated savings and cost effectiveness of wire charge expenditure on energy efficiency.....	171
Figure 58 • Potential energy saving under three scenarios to 2020	171
Figure 59 • Total residential and per capita electricity consumption, 1990-2005	172
Figure 60 • Number of Chinese households in urban and rural locations	172
Figure 61 • Progress with electrification in China, 1993-2002.....	173
Figure 62 • Villages and households without access to electricity, 1993-2002.....	173
Figure 63 • Results of product performance testing, 2001-2006	184
Figure 64 • Results of product performance testing by CNIS, 2006.....	185
Figure 65 • Results of NSI testing on CFLs, 1998-2006	185
Figure 66 • Total residential and per capita electricity consumption, 1990-2006	189
Figure 67 • Proportion of Indian households with access to electricity.....	190
Figure 68 • Status of rural electrification in States and Union Territories, April 2008.....	190
Figure 69 • Retail power tariffs per sector, 2002	191
Figure 70 • Estimated residential end-use electricity consumption, 2007	191
Figure 71 • Historical and forecast information on consumer electronics and whitegoods market	192
Figure 72 • Number labelled linear fluorescent lamps by supplier, February 2008.....	196
Figure 73 • Number labelled refrigerators by supplier, February 2008.....	196
Figure 74 • Number labelled air conditioners by supplier, February 2008	196
Figure 75 • Total residential and per capita electricity consumption, 1990-2005	201
Figure 76 • Estimated electricity consumption per household by major end-use application, 2008	202
Figure 77 • Annual new household electricity connections, 1995-2005	210
Figure 78 • Total residential and per capita electricity consumption, 1990-2005	210
Figure 79 • Household electricity prices, 1996-2006	211
Figure 80 • Example of estimated savings from policy measure	223
Figure 81 • Estimated impact of implementation failures on energy efficiency programme savings.....	224
Figure 82 • Estimated impact of implementation failures on cumulative energy efficiency programme savings.....	224
Figure 83 • Typical OECD household electricity consumption of major traditional and digital appliances	235

Figure 84	• Growth in transistors per chip, 1950s-2000s (Moore, 1965)	236
Figure 85	• Estimated global electricity consumption from ICT and CE equipment, 1990-2030	238
Figure 86	• Estimated change in stocks and average unit energy consumption (UEC) of residential ICT and CE appliances in OECD, 1990-2030	239
Figure 87	• Estimated change in stocks and average unit energy consumption (UEC) of residential ICT and CE appliances in non-OECD countries, 1990-2030	239
Figure 88	• Estimated global electricity consumption from ICT and CE equipment by region, 1990-2030	240
Figure 89	• Estimated impact on global electricity consumption by ITC and CE equipment by energy efficiency policies based on least life-cycle cost (LLCC) and best available technology (BAT), 1990-2030	241
Figure 90	• Estimated impact on global CO ₂ emissions by ITC and CE equipment by energy efficiency policies based on least life-cycle cost (LLCC) and best available technology (BAT), 1990-2030	241
Figure 91	• Value of trade in major household appliances, 2001-2006	248
Figure 92	• Cathode ray tube television	252
Figure 93	• Plasma television	253
Figure 94	• LCD television	253
Figure 95	• DLP projection television	254
Figure 96	• Approximate range of currently available screen sizes by technology	255
Figure 97	• Share of global TV sales by technology type, 1990-2008	256
Figure 98	• Number of global TV sales by region, 1991-2008	256
Figure 99	• Examples of national TV ownership rates, 1990-2006	257
Figure 100	• Average prices of televisions in U.S., 2004-2007	258
Figure 101	• Date for switching-off analogue TV broadcast services	258
Figure 102	• Television viewing hours, by time and country	259
Figure 103	• Estimated electricity consumption by televisions by region, 1990-2008	260
Figure 104	• Estimated electricity consumption by televisions by technology, 1990-2008	261
Figure 105	• Variation of on mode consumption with screen size for a sample of televisions from Australia, United Kingdom and United States, 2007	261
Figure 106	• Estimated electricity consumption by televisions, 1990-2030	262
Figure 107	• Sample of on mode consumption of DLP televisions in U.S., 2007	264
Figure 108	• OLED sales forecast, 2006-2013	265
Figure 109	• Example of variation in standby power measurements by size	266
Figure 110	• Distribution of standby power measurements	267
Figure 111	• Potential lifecycle cost and energy efficiency improvements for LCD televisions	268
Figure 112	• Potential lifecycle cost and energy efficiency improvements for plasma televisions	269

Figure 113 • Estimated electricity savings from implementation of LLCC and BAT policies	272
Figure 114 • Global PC shipments, actual and estimated, 2004-2010	275
Figure 115 • Household penetration of PCs, 2005	276
Figure 116 • Estimated share of global PC stock by technology, 1990-2008	277
Figure 117 • Growth in stocks of PCs in BRICS, 1994-2004	277
Figure 118 • Typical LCD PC monitor costs, 2000-2008	278
Figure 119 • Estimated share of global PC monitor stock, 1990-2008	279
Figure 120 • PC penetration and Internet access, selected countries, 2005	279
Figure 121 • Households use of broadband in selected OECD countries, 2003 and 2006 (or available years)	280
Figure 122 • Estimated distribution of power amongst components in a typical desktop PC with LCD monitor	282
Figure 123 • Typical estimated desktop PC energy consumption in different modes ...	283
Figure 124 • Estimated annual electricity consumption of desktop PC and monitor with and without power management	284
Figure 125 • Range of power drawn by PCs in idle mode	285
Figure 126 • Distribution of electricity consumption in a typical portable PC	286
Figure 127 • Maximum power draw of Intel microprocessors	287
Figure 128 • Power draw of Intel microprocessors vs. normalised performance	287
Figure 129 • Average retail price of PCs in United States, 2006-2008	288
Figure 130 • Power draw by PC monitors vs. screen size	289
Figure 131 • Estimated electricity consumption by all PCs and monitors, 1990-2008, by technology	290
Figure 132 • Estimated electricity consumption by all PCs and monitors, 1990-2008, by region	291
Figure 133 • Estimated growth in Internet users by region, 2000-2008	292
Figure 134 • Estimated electricity consumption from PCs and monitors, 1990-2030 ...	294
Figure 135 • Estimated electricity consumption from PCs and monitors by region, 1990-2030	294
Figure 136 • Estimated share of energy consumed by office computers and related infrastructure in United States, 2002	295
Figure 137 • Estimated share of energy consumed by computers and related infrastructure in Germany, 2001-2010	296
Figure 138 • Estimated electricity savings from implementation of LLCC and BAT policies ..	303
Figure 139 • Estimated digital TV share of total TV stock, 2000-2030	306
Figure 140 • Estimated stock of set-top boxes by region, 1990-2030	308
Figure 141 • Estimated stock of set-top boxes by type, 1995-2030	308
Figure 142 • Combined results from the measurement of 87 STBs in Europe and United States	312

Figure 143 • Impact of effective power management on the energy consumed by two types of STBs	312
Figure 144 • Estimated electricity consumption by STBs by region, and average unit energy consumption, 1990-2030	313
Figure 145 • Estimated electricity consumption by STBs type, 1990-2030	313
Figure 146 • Standby power measurements, 87 samples from the United States and Europe	314
Figure 147 • On mode power measurements consumption 87 samples from the United States and Europe	314
Figure 148 • Number of USD 40 coupons for set-top boxes claimed by U.S. consumers in 2008	319
Figure 149 • Estimated impact on electricity consumption of energy efficiency policies based on least life-cycle cost (LLCC) and best available technology (BAT), 1990-2030	320
Figure 150 • Estimated stock of selected miscellaneous ICT and CE equipment, 1990-2030	323
Figure 151 • Estimated change in unit energy consumption (UEC) and stock of miscellaneous ICT and CE equipment, 1990-2008	324
Figure 152 • Estimated electricity consumption by miscellaneous ICT and CE equipment, 1990-2030	324
Figure 153 • Estimated impact on electricity consumption of energy efficiency policies in miscellaneous ICT and CE equipment, based on least life-cycle cost (LLCC) and best available technology (BAT), 1990-2030	325
Figure 154 • Mobile phone subscribers, annual growth and penetration rates in selected economies, 2007	329
Figure 155 • Estimated stock of EPS by major market sector, 2008	330
Figure 156 • Estimated distribution of EPS stock by region, 2008	330
Figure 157 • Variation in power supply load in sample laptop computer	331
Figure 158 • Variation in power supply efficiency with load	331
Figure 159 • Measured no-load losses for 650 sample external power supplies	332
Figure 160 • Average EPS efficiency data from studies 2003 to 2007	333
Figure 161 • Estimated electricity consumption from external power supplies, 1990-2008	334
Figure 162 • Estimated distribution of electricity consumption by end-use sector, 2008	335
Figure 163 • Least life-cycle analysis of alternative ELV transformer technologies	337
Figure 164 • Estimated electricity consumption from external power supplies, 1990-2030	338
Figure 165 • Illustration of energy performance mark	341
Figure 166 • Estimated impact on electricity consumption of energy efficiency policies in external power supplies, based on least life-cycle cost (LLCC) and best available technology (BAT), 1990-2030	343

Figure 167 • Time series, passive standby demand in selected home appliances in Australia, 2003/4-2007/8	348
Figure 168 • Average and best available (BAT) standby power values for European devices, 2007	349
Figure 169 • Power draw by network interface components	357

LIST OF BOXES

Box 1 • The Sky's the limit	310
Box 2 • Efficient boxes made in China	315
Box 3 • Subsidies for efficient STBs in the United States	319
Box 4 • APP standby measurement project	348