Index

abandonment, oil industry phase 403
abatement opportunities 687
access 76, 671–2, 673, 674, 740, 752, 761
see also access pricing problem; open access transmission; open access transmission tariff (OATT); open access transportation; retail access; third party access (TPA)
access pricing problem 45‒8
acid rain 14, 81–2
actual price indexes (APIs) 518
ad valorem tax 348‒50, 351, 354‒5, 357‒8, 359, 360, 361, 413
Adams, F.G. 747‒8
Adelman, M.A. 75, 76‒7, 79, 86, 384, 443
Ademiyi, O.I. 136
administrative and general costs 504, 513
advanced capacity electricity markets 643‒4
adverse selection see hidden action
Africa 741, 742, 747
see also North Africa; South Africa
agency problems see hidden information
aggregate benefit, and spot pricing, simplified model 34, 35
aggregate consumer surplus, cost–benefit analysis and market structure 21, 22, 23, 24
aggregate consumer welfare, cost–benefit analysis and market structure 22
aggregate demand curve, and theoretical foundations of the rebound effect 183, 184, 185
aggregate energy demand, and empirical modelling of consumer energy demand 120–21
aggregate energy efficiency, and rebound effect 205
aggregate energy savings 239–40, 248–52, 253
aggregate market demand curve, cost–benefit analysis and market structure 22, 23
aggregate prices 32, 33–4, 44, 45, 46, 47–8
aggregate producer surplus, cost–benefit analysis and market structure 22, 23, 24
aggregate supply curve, and theoretical foundations of the rebound effect 183, 184–5
agriculture 1–4, 14, 16, 765–6
air pollution 14, 17, 81, 82, 374, 763–4, 767
airline industry 710–11
Al-Rabbae, A. 130
Allan, G.J. 221–4, 225, 229, 373
allocative efficiency 584, 598
allocative inefficiency 604
almost ideal demand system (AIDS) 122
alternative energy technologies 80
Amaranth Hedge Fund 429, 431
American options 708
Anand, S. 748
anchoring, floor traders' behaviour 427
ancillary services, and wholesale electricity markets 627–8, 632, 678
Andersson, B. 671, 678
animal effort 3
appliance prices 247, 254–5
appliance retirement rates 243
applied energy–economy–environment modelling 369‒71
appraisal, oil industry phase 402–3
Apt, J. 626, 660, 670, 674, 675, 677, 678, 681
arbitrage opportunities, and wholesale electricity markets 629, 630
ARDL (autoregressive distributed lag), and non-stationarity in modelling energy demand 129–30
Argentina 456, 489, 583, 640, 641, 642, 746
Arizona 674
Armstrong, M. 44–5, 476, 480–82, 497
Arrow, K.J. 61, 192, 193, 332, 375, 773
Asafu-Adjaye, J. 743, 745–6, 747
Asia 3, 448, 712, 713
see also Asia Pacific; China; Eurasia; India; Indonesia; Japan; Philippines; South Korea; Thailand
Asia Pacific 15, 741
asymmetric demand, and price changes in empirical modelling of energy demand 131–7
asymmetric energy–income relationship 96–7
auctions 655, 659–60, 670, 673, 674
see also merchant transmission investment of electricity transmission expansion
Australia
col industry 445, 446, 447
col international trade 448
competitive electricity retail pricing 667
derivatives markets 715
electricity distribution regulation 533, 535, 583

791
electricity transmission regulation 527–8, 530, 583
market structure of electricity distribution industry 570–71, 573
market structure of electricity transmission industry 559, 561–2, 564
merchant transmission investment of electricity transmission expansion 588
petroleum tax 411
wholesale electricity markets 627, 628, 637, 639, 645
see also carbon dioxide emissions trading and convergence of electricity and transport markets in Australia; SFE (Sydney Futures Exchange)

Austria 523–4, 529, 531–2, 535, 549–50, 560, 566–7, 572
autocorrelation, and empirical modelling energy demand 127
automobile demand 9
automobile prices 9
automobiles
and CO₂ emissions trading and convergence of electricity and transport markets in Australia 688, 693–4, 700, 701
and elasticities of energy demand 105, 107, 108
energy-efficiency 80, 84, 200, 201, 207, 212
and energy policy 80, 84, 212
and rebound effect 211–13, 214, 215
autonomous energy efficiency index (AEEI) 272, 273, 276, 277, 313, 314, 316, 327–8, 358
average cost pricing 24, 665–6, 682
average costs 44, 45, 407, 474, 509, 511, 515, 518
average revenue, and price-capping regulation 482–3
Aversch–Johnson effect 663, 664
Azary Lee, I.G. 215, 218–19

backfire
defined 199, 200
and energy–economy–environment modelling 373
and energy efficiency in a stylised small open economy 149, 153, 154–5, 159, 161
and rebound effect estimation 222, 223, 224
and theoretical foundations of the rebound effect 172, 173, 178, 195, 196
backstop energy resources 54, 55, 58, 62, 65, 66, 70, 71
backstop prices 54, 55, 65, 66
backwardation, and valuing derivative instruments 709
Bahá’í school 368, 369
bankruptcy, and natural gas industry 457
Barker, T. 210, 221, 224, 226
Barnett, A. 744
Baselice, R. 635, 637, 638
basin competitiveness 401–2
Bataille, C. 258, 269, 273, 274, 276, 316, 317, 327
Baumol, W.J. 45, 453, 603–4
bear markets 433, 435, 437
Beato, P. 667, 678, 680
Beccue, P. 388–94
BEEAM (Brookhaven Energy Economic Assessment Model) 754
behaviour
and CIMS 269, 320–26, 328
and ITC (induced technological change) policy models 311–12, 315, 316
and MARKAL model 261, 288
and market power in wholesale electricity markets 636–7
and modelling energy savings and environmental benefits of new technologies 236, 241, 242–9, 250, 251–2, 253, 254
see also behaviour of crude oil futures markets; behavioural change
behaviour of crude oil futures markets
benchmark crude oils and their pricing 420–24
crude oil markets 421
dominance of behavioural analysis in market pricing 438–9
fear-and-greed analysis 430, 435–6
fundamental analysis of oil supply and demand 436–7
futures markets 424–6
market participants 428–9
price behaviour in futures markets 429–34
traders’ attributes, effect on crude oil prices 426–8, 433
behavioural change 208–9, 293
Belgium
coal industry 84, 85
coal production 445
competitive electricity retail pricing 667
electricity distribution regulation 535
electricity transmission regulation 524, 529
market structure of electricity distribution industry 567, 572
market structure of electricity transmission industry 550, 560
benchmark equilibrium 343, 357
benchmark prices 343, 420–24, 435–6
benchmarking
and cost efficiency 599
and economic rent 482
and energy network regulation 476, 486, 487
Europe 526–7
incentive regulation in electricity
transmission and distribution 519
New Zealand 529, 533–4, 535
regulation and efficiency measurement
in electricity and gas distribution
industries 607, 615–19
Bentzen, J. 115, 128, 129
Bernstein, J.I. 494, 495
best available control technology (BACT) 81, 82
bilateral agreements, and forward contracts
706
bilateral electricity markets 626–7, 629, 655, 674, 678, 680
Bio Society 763, 764, 765–6, 767, 768
biofuels 694, 744, 764, 765–6, 767, 768
biomass 2, 6, 13, 689, 694
biomass consumption 12, 90–91, 298, 299, 300, 306, 740, 751
Birol, F. 740, 751
Black–Scholes model, and valuing derivative
instruments 709–10
Blumsack, S. 633, 670
Bohi, D.R. 78, 383, 386, 387, 388, 771–2
bonuses 413–14, 415–16
Bremerius, S. 624, 632, 634, 635, 636, 638, 666, 680
bottom-up energy models
applications 258
background to 257–8
and energy–economy–environment
modelling 370, 376, 377
future developments 279–80
and induced technological change (ITC)
policies 312–13, 314, 315
and macroeconomic hybridization 271–6, 279
and macroeconomic hybridization of
top-down models see top-down and
bottom-up hybrid energy–economy
models
optimization models 259–64, 279
see also MARKAL models; UK
MARKAL model
simulation models 264–71, 279
see also carbon dioxide emissions trading
and convergence of electricity and
transport markets in Australia
Bowman, D. 388
Brännlund, R. 220–21, 229
Brazil 744
see also electricity security in large
hydropower systems in Brazil
Brent crude oil derivatives 421, 423, 718–19,
720–21, 722, 723, 727, 728, 730, 733
Broadstock, D.C. 119, 120, 155, 174, 225
brokers 461
Brown, M. 314
Brown tax 410, 417
Brunekreeft, G. 553, 590
budget constraints 100, 101, 186, 187, 189, 192,
259, 591
budgeting, and empirical modelling of
consumer energy demand 120–21
buildings, energy efficiency 220, 234
bull markets 433, 435, 437
Bundesnetzagentur 486–7, 489
Bureau of Economic Analysis (BEA) 504, 506, 512
Burns, Philip 476, 489, 492–3
CAFE 80, 84, 212
California 627, 628, 630, 631, 632, 635–6, 637,
638, 639, 663, 673, 674, 675, 678
Californian energy crisis 630, 638, 663, 675
call option prices 709, 710
call options 707
Canada
CIMS 269–71, 274–6, 323–5, 328, 329
coil international trade 447, 448
coil production 445–6
electricity distribution regulation 531, 535
electricity transmission regulation 521–3, 529
electricity demand 137
environmental policy 81–2
market structure of electricity distribution
industry 565–6, 572
market structure of electricity transmission
industry 545–7, 548
modelling energy savings and environmental
benefits of new technologies 236–7,
238–9, 244–5, 249–52
oil consumption 131, 133
oil prices 131, 132
petroleum tax 411
wholesale electricity markets 645
Cao, X. 749
capacity
and energy in Brazil 653, 654
and energy insecurity 650, 651
and marginal cost and investment decisions
in energy supply 29–31
and peak-load pricing 33, 34
and spot pricing, simplified model 35, 36, 37, 38, 39
and wholesale electricity markets 633, 639–42, 643
see also electricity security in large hydropower systems in Brazil
capacity cost functions, and electricity transmission expansion mechanisms 591
capacity payments 640–42, 643, 650, 660
capacity utilization, and modelling energy demand 100, 101, 106
capacity wholesale electricity markets 642–5
capital
and bottom-up energy models and macroeconomic hybridization 272, 273, 276
and CGE models 344, 345, 354, 355, 362, 369
and electricity ratemaking regulation 644
and energy efficiency in a stylised small open economy 157, 158
and general equilibrium theory 192
and macroeconomic hybridization of top-down models with bottom-up characteristics 276
and modelling energy demand 98–9, 100, 101
and neoclassical growth theory 174, 175
and oil industry 403
and rebound effect 192, 193, 215, 216, 219
capital costs
and capacity 650
and CIMS 318, 319, 320, 322, 323
and CO₂ emissions abatement costs in electricity and transport markets in Australia 686, 689
and efficiency measurement in electricity and gas distribution industries 613, 616
and electricity distribution costs 512, 513–14, 515, 516, 517
and electricity transmission costs 501, 504, 505–6, 508, 509, 510
and electricity transmission expansion mechanisms 584, 587
and life-cycle costs approach (LCC) to modelling energy savings 236, 237, 240
and modelling energy savings and environmental benefits of new technologies 242
capital–energy substitution elasticity 372–4, 377
capital equipment 132–4
capital expenditure flow (CAPEX), and CPI-X incentive regulation 493–4
capital intensity, and GDP elasticity of energy consumption in developing countries 747–8
capital investment 63–5, 66, 82–3
capital markets 368
capital stock
and bottom-up energy models and macroeconomic hybridization 274–5
and CIMS 269, 270–71, 274–5, 317, 318, 319
and climate change 1A models 778, 779, 780, 781
and energy demand theory 91, 92, 94–5, 97
and general equilibrium theory 192
and induced technological change (ITC) policy models 311
and macroeconomic hybridization of top-down models with bottom-up characteristics 276
and modelling energy demand 98–9, 100, 101
and multi-equation approaches to modelling energy demand 117, 118, 119, 120
and social discount rate in cost–benefit analysis 26, 27, 28
capital utilization 91, 92, 97, 98, 100
carbon dioxide emissions
and coal combustion 444–5
developed countries 749
developing countries 742, 749
and history of energy 14–15
in OECD versus non-OECD countries 742
and simulation models 268
and UK MARKAL model 290, 291, 293, 294–6, 297
carbon dioxide emissions abatement 303, 308
carbon dioxide emissions abatement costs and carbon permits versus carbon tax 775–8
and CGE models 314, 354–63
and electricity and transport markets in Australia 686–7, 695, 697–8
carbon dioxide emissions abatement policy 260, 264, 266
carbon dioxide emissions caps
and developed countries 690–91
and electricity and transport markets in Australia 690–91, 692
and UK MARKAL model 295–6, 297–300, 301, 302, 304, 305–6, 308, 309
carbon dioxide emissions trading 17, 353, 355, 360, 361, 773
carbon dioxide emissions trading and convergence of electricity and transport markets in Australia
costs of GHG abatement in electricity and transport sectors 686–7
Energy Sector Model (ESM) 687–90
key assumptions 692–4
modelling results 694–701
scenario description 690–92
carbon dioxide prices 304, 305, 306, 307, 308
carbon permit prices 686–7, 689, 690, 695, 697–8
carbon permits 775–8
carbon tax
versus carbon permits 775–8
developing countries 749
and theoretical foundations of the rebound effect 166, 167, 168–9, 170, 173, 178, 195, 196–7
cars see automobiles
cartels 41, 76–7, 384, 443
cash flow 24–5, 67, 410–11, 707, 710, 752–3
cash markets 425
Caspian states 389–94
Caves, D.W. 620, 666
CCS (carbon capture and sequestration) 689, 694, 698, 699, 700, 763–4
see also coal CCS (carbon capture and sequestration)
Central America 3, 588, 741
central banks 396
centralization, and energy visions 763, 764, 765, 767, 768
centralized generation (CG) plants 688, 694, 695, 698
certainty 35–6, 37–8
see also uncertainty
CES (constant elasticity of substitution) production function
and empirical modelling of energy demand 116, 118
and energy efficiency in a stylised small open economy 155–6
and MACRO 272–3
and macroeconomic hybridization of top-down models with bottom-up characteristics 277, 278
CGE (computable general equilibrium) models algebra of equilibrium and social accounting matrix 335–7
and bottom-up models 257, 273, 274, 276
and carbon emission abatement costs 314
and CIMS 327–8
critique 332–3, 347, 350, 361–3
and energy and climate change policies 346, 347–54
foundations; circular flow and Walrasian general equilibrium 333–5
and macroeconomic hybridization of top-down models with bottom-up characteristics 277, 278
numerical calibration and solution 341, 343–7
and rebound effect 221–4, 227
from a SAM to a CGE model: the CES economy 337–41, 342
theories 368–9
worked example: carbon dioxide emission abatement in US 354–63
Chambers, R.G. 600, 601–2
Cherniwchan, J. 249–52
China
biofuel demand 765
cash flow 422, 437–8, 760
coal consumption 110
clean Coal Society 763–4, 767, 768
circular flow, in CGE models 333–7
cities 764, 766, 767, 768
Clean Coal Society 763–4, 767, 768
clearinghouses 706, 725
Cleveland, C.J. 205, 228, 373, 377, 378
climate 2
climate change
and energy policy 761–3
and energy vision ideal types 763–9
integrated assessment models 778–81
Stern Review 25, 28, 144, 203, 691, 773, 781–9
see also carbon dioxide emissions; GHG emissions
climate change mitigation 166, 173, 178
climate policy 328, 329, 346, 347–54, 761–3
clothes washing, and energy efficiency 213, 214, 235
Clounies-Ross, A. 410
coal
characteristics 444
and CO₂ emissions trading and convergence of electricity and transport markets in Australia 688–9, 689, 695, 700
CTL (coal-to-liquid technologies) 763–4, 766
and environmental problems 14–15
in history of energy 5–8, 11–12, 13, 14–15, 90, 445–6
international trade 447–8
problems of 444–5
see also coal prospects in the 21st century
col coal CCS (carbon capture and sequestration) 299–300, 305–6, 309, 444, 689, 698, 699, 700
coal companies 446–7
coal consumption 11, 12, 110, 297, 298, 306, 308
coal crisis 86
coal demand 6, 7–8
coal exports 447, 448
coal futures contracts 718–19, 721, 723, 726
coal imports 447, 448
coal industry 84, 85, 444
coal leasing 450–53
Coal Leasing Amendment Act 1976 451–2
coal-mines 448–9
coal-mining costs 85, 86
coal prices 5, 6, 7, 8, 85
coal production 445–6
coal production costs 444
c coal prospects in the 21st century
coal leasing and fear of windfall profits in US 450–53
coal-mine and land disturbance health and safety in the US 448–9
and energy transition 441–3
and problems of coal 444–7
world coal trade 447–8
coal protectionism 85–6
coal supply 7–8
Coase, R.H. 82
Cobb–Douglas production function
and efficiency measurement in electricity and gas distribution industries 609, 610, 611, 614, 616–17
and empirical modelling of energy demand 116, 118
and energy efficiency in a stylised small open economy 148–9, 152–3, 155, 156–8, 159
Cobb–Douglas utility function 191
coke 6–7
Colombia 447, 448
COLS approach, efficiency measurement 605–6, 615–16, 617, 618, 619
combustion 2, 14, 444–5
commercial energy, and energy accounting 91
commercial traders 428, 733–6, 737
commercialization, of new technology 313–14, 316
commodities, CGE models 333–4, 335–6, 337, 339, 340
commodity demand, CGE models 334, 335, 338
Commodity Futures Trading Commission 719, 730, 733–6, 737
compensated demand function, cost–benefit analysis and market structure 22
competition
and access pricing problem 45–6
and coal leasing in US 451, 452
and cost–benefit analysis and market structure 23
and depletable resources 442
and electricity industry 457, 458, 459, 460
and electricity transmission expansion mechanisms 588
and energy choice 83
and energy efficiency in a stylised small open economy 145, 152, 153
and energy network industry structure 471, 472, 473
and energy policy 76
and history of energy 14
and natural gas industry 458, 459, 460, 466–7
versus regulation 473–5
and wholesale energy markets 39–44, 633
see also basin competitiveness; competition policy; electricity retail competition and pricing; yardstick competition
competition policy 636–7, 639
complementary slackness, and CGE models 340, 341
computable general equilibrium models see CGE (computable general equilibrium) models
concessionary fiscal regimes 412–14, 416
concessions, oil industry phase 402
conflict, in Middle East 384, 392, 393, 422
congestion costs, and incentive regulation of electricity transmission expansion 583–4, 585–6
Connecticut 673, 676
conservation of value, and CGE models 334–5
consumer information 242, 249
consumer preferences
   and CIMS 270, 318–19, 321–6
   and ITC (induced technological change)
      policy models 313, 316
   and theoretical foundations of the rebound
effect 185–90, 191, 192, 193, 196, 197
consumer surplus 47–8, 586
consumer utility 186, 187, 188, 189, 192, 193, 202
consumers
   and efficiency measurement in electricity and
gas distribution industries 602–3, 610, 611, 612, 613, 615, 616–17
   electricity distribution costs 514, 515, 516, 517
   and electricity security in large hydropower systems in Brazil 654
   and electricity transmission expansion
      mechanisms 584, 585, 593
   and Energy 2.0 Society 767
   energy consumption 84
   energy demand 120–27
   and energy security 761–2, 772, 773
   and market power in wholesale electricity markets 639
   and modelling adoption of energy saving
      new technologies 242–8, 249, 253, 254–5
   and oil security 385
   and rebound effect 180–85, 200–201, 202
   retail access, and competitive electricity retail pricing 671–2, 673, 675–80, 681
see also consumer information; consumer preferences; consumer surplus; consumer utility; CPI (consumer price index)
consumption
   and climate change IA models 778, 779, 780, 781
   and energy–economy–environment
      modelling 371
   and neoclassical growth theory 175, 188
   and rebound effect 178, 184, 188–9, 190, 200, 202, 203
   social discount rate in cost–benefit analysis
      25–6, 27–8
   and Stern Review 782, 783–4, 785, 787–9
contracts
   and electricity retail competition and pricing
      675, 677, 681–2
   and electricity security in large hydropower systems in Brazil 654, 655
   energy network regulation 476–82, 489–92
   and energy security 761–2
   and natural gas regulation 457
   and wholesale electricity markets 627, 628, 642
see also contracts for differences (CfDs);
   contractual fiscal regimes; energy commodity derivatives contracts;
   forward contracts; futures contracts;
   production sharing contracts (PSCs)
   contracts for differences (CfDs) 627
   contractual fiscal regimes 414–17
   convenience yield, and valuing derivative instruments 709
   conventions bias, floor traders’ behaviour 427
   Cook, P.L. 744
cooking 2, 740, 744, 748, 751, 752
coordination 458, 459, 460, 461, 627–8, 633
corporate income tax 411, 413, 414
cost–benefit analysis
   and carbon permits versus carbon tax 775–8
   and energy market structure 21–4
   and oil imports in developing countries 748
   and optimal resource allocation 29–32
   and social discount rate 24–9
   and Stern Review 28, 784–5
   cost effectiveness 374, 376, 690
   cost efficiency 598, 599, 604–14, 616–19
   cost elasticity of size 601, 602
   cost flexibility 601–2
   cost frontier 604, 605, 609, 614
   cost function
      and CGE models 344–6
      and efficiency measurement in electricity and gas distribution industries 604–5, 606, 609–11, 612–14, 616–17
      and electricity transmission expansion
         mechanisms 585, 591, 592, 593
      and production theory 600–601
      and returns to scale 601
      and theoretical foundations of the rebound effect 180–81, 182, 183, 184, 185
   cost inefficiency 485, 598, 604
   cost-minimization 339, 600, 605
see also cost recovery; cost savings
   cost of carry model, and valuing derivative instruments 709
   cost-of-service 492, 493, 584, 586
   cost of service regulation (COSR)
      and electricity transmission and distribution
         regulation 515, 517–18
      Europe 523, 524, 525, 527, 529, 531, 535
      North America 520, 521, 522, 523, 528, 529, 531, 535
      Pacific Region 528, 530, 534, 535
   cost oil 415, 416
   cost recovery 414–15, 416, 417
see also cost-minimization; cost savings
cost savings
and electricity revenue-capping regulation 664
and life-cycle costs approach to modelling energy savings 236–7
and rebound effect 200, 201, 202, 205, 206, 218
and sliding scale regulation 489–90, 491
and X-factor (productivity offset) 496
see also cost-minimization; cost recovery costs
and bottom-up energy models and macroeconomic hybridization 272, 275
and CO₂e emissions trading and convergence of electricity and transport markets in Australia 689
and competition in wholesale energy markets 41, 43
and cost–benefit analysis and market structure 22, 23
and economies of scale 458, 459, 474, 601
and economies of scope 474–5
and efficiency measurement in electricity and gas distribution industries 605, 606, 607, 608, 609–11, 612–13, 615, 616
electricity distribution 511–15, 516, 517, 518
electricity transmission 500–09, 510, 511
and induced technological change (ITC) policy models 312–13
and MARKAL model 286, 287, 288
and model of extraction of depletable resources 52, 53, 54, 55, 62, 63–4, 65, 67, 69, 71
and modelling energy demand 97, 98, 99, 100, 101
and multi-equation approaches to modelling energy demand 118, 119, 121–2
oil industry 403
and optimal degree of market entry, determinants 44, 45
and peak-load pricing 32–4
and price-capping regulation 483, 484, 485
and production theory 600
and revenue-capping regulation 487, 488, 489
and simulation models 271
and sliding scale regulation 489, 490, 491, 492
and spot pricing, simplified model 35, 36–7, 38
and theoretical foundations of the rebound effect 170, 178
cotton industry 7
CPI (consumer price index) 492–6, 519, 525, 526, 527, 532, 664
CPI-X incentive regulation see price-capping regulation
crack spread, and valuing derivatives 711–14
cross-sectional data, and energy–economy–environment modelling 373
cross-subsidization, electricity industry 666, 668, 669, 674, 680
crude oil 711–14
crude oil demand 430, 436–8
crude oil derivatives contracts
crude oil forwards 718–19
see also behaviour of crude oil futures markets
crude oil options 718–19, 722
open interest positions 733, 734
crude oil prices
and behaviour in crude oil futures markets 420–24, 429–34
and demand and supply 436–8
effect of floor traders’ attributes 426–8
and fear-and-greed analysis 435–6
and model of extraction of depletable resources 51, 56–7
crude oil supply 430, 436, 437–8
CTL (coal-to-liquid technologies) 763–4
currency markets 707, 715–16
customers see consumers
Dargay, J.M. 134, 135, 136, 137, 216, 387, 763
Dasgupta, P. 70, 784, 788
Davis, L.W. 214, 235
day-ahead wholesale electricity markets 464, 625–7, 629, 630
De Vany, A.S. 456, 457, 462, 463, 464
de Vries, L. 667
DEA (data envelopment analysis), and efficiency measurement 605, 616, 617–18, 619
Deaton, A. 122, 229
Debreu, G. 192, 193, 332
default services, and electricity retail competition and pricing 670–71, 672, 673, 674, 675, 679, 681–2
default services pricing, and electricity retail competition and pricing 670–71, 673, 674, 675, 680–81
deforestation 2, 3, 14
deforestation 2, 3, 14
DEFRA 294, 300, 308
developments, electricity industry costs 502, 507, 508, 509, 514–15, 516, 517
Index

demand
and cost–benefit analysis and market structure 21, 22, 23
marginal cost and investment decisions in energy supply 29, 30, 31
and model of extraction of depletable resources 62, 67, 68, 70
and optimal degree of market entry, determinants 44–5
and peak-load pricing 32, 33, 34
and spot pricing, simplified model 34, 35, 36, 37
see also individual types of demand
demand function 41–2, 584, 585, 586, 591, 600
demand technologies 285, 286, 287
dematerialization 94, 103
Demirbas, A.H. 744
Demirbas, I. 744
Denmark 524, 529, 532, 535, 550–11, 560, 567, 572
depletable resources 51, 407, 409, 441–3
see also exhaustion; model of extraction of depletable resources
depreciation flow, and CPI-X incentive regulation 494
derived energy demand 89, 91, 109
Desai, D. 748
descriptive studies, energy intensity in developing countries 747
desirability, and modelling energy savings and environmental benefits of new technologies 247, 251
developed countries 690–91, 741, 747, 749, 762–3
see also Europe; North America; OECD countries; individual countries
developing countries
energy accounting problems 90–91
energy consumption and economic growth and development 740–41, 742, 747, 749
energy intensity, and energy and GDP causal relationships 742–3, 745–8
energy market transitions and market reforms 748–9
energy models 754
energy planning and societal and economic development 750–52
environmental impacts of energy consumption 742, 749
investment and finance 752–4
oil prices 749–50, 754
resource rent tax 410–11
technology transfer and market diffusion 743–5
vehicle ownership 763
see also individual countries
development see developed countries;
developing countries; economic development; social development
development costs, of depletable resources 443
Dick, H. 750
Dievert, W.E. 118, 121, 183
differential rent 407–8
Dimitropoulos, J. 130, 147, 179, 203, 209, 211, 213–14, 215, 228, 235
direct rebound effect
energy services and useful work 205–7
estimates 211–15, 216, 226, 248, 249, 252, 253
estimation approaches 207–11
nature of 199, 200, 201, 202
discount rate 24, 25, 31, 236, 238, 291–2, 296, 322, 323–4
see also levelized discount cost (LDC); social discount rate (SDR)
discounted cash flow 67
discovering cash prices 424–6, 707, 717
discrete choice surveys, and CIMS 321–6
diseconomies of scale 602, 603
diseconomies of scope 615
disequilibrium, and neo-Keynesian economic theory 368
dishwashers 244, 245, 246
disposal costs, and LCC (life-cycle costs approach) to modelling energy savings 241
distance carried 502, 507, 510, 514, 515, 516, 517
distributed generation (DG) electricity plants, in Australia 689, 694, 698, 699, 700
distribution, energy see energy distribution
District of Columbia 673, 674
disutility of effort 479, 481, 483, 484, 487
DME (Dubai Mercantile Exchange) 420, 421, 423, 720–21, 728
domestic market obligation (DMO) 415
DTI (Department of Trade and Industry) 289, 290, 291, 294–5, 296, 308
dual view, and theoretical foundations of the rebound effect 180–83
duality theorem 121, 600–601, 612
Dunkerley, J. 740, 750, 752
duopolies 41
duplication, in natural gas and electricity industries 460–61
dynamic adjustment costs, and empirical modelling of energy demand 117
dynamic energy demand models 114–15, 116, 123–6
dynamic model of household’s energy demand 99–101
early capacity electricity markets 642–3
ECM (error correction model) 128, 129, 130, 131, 747
ecological approach, to energy–economy–environment modelling 377–8
economic activity, and petroleum tax 401–2, 404
economic development 89, 92–5, 403, 740–41, 742, 749, 750–52
economic exhaustion, of depletable resources 55, 58, 60
economic growth 89, 96–7, 200, 740–41, 742, 747, 749
economic measures, of rebound effect 204
economic policy 29, 31
economic rents
and electricity security in large hydropower systems in Brazil 653
and hidden action game 479, 482, 493
and incentive regulation in energy networks implementation 492, 493
and petroleum tax 406–9
and sliding scale regulation 490, 492, 493
and X-factor 496
see also royalties
economic structure, and long run energy demand 92–5
economic welfare see welfare
economies of customer density 603, 612, 613, 615
economies of output density 602–3, 610, 611, 612, 613
economies of scale
and coal industry 444
and competition versus regulation 458–60, 473–4
in electricity and gas distribution industries 602, 603, 610, 611, 612, 613, 615
and electricity distribution costs 511–12, 515
and electricity industry 458–60, 602
and electricity transmission costs 509
and history of energy 4
and natural gas industry 458–60, 602
economies of scope 474–5, 507, 511, 514, 603–4, 609, 614–15
economy-wide rebound effect
embodied energy estimates 215, 217, 218–21
energy modelling estimates 221–7
nature of 200–201, 202–3, 205
secondary effects 217–18
Ecumenical school 368
EEX (European Energy Exchange) 718–19, 726
efficiency
and competition in wholesale energy markets 43–4
econometric approach to measurement 604–10
and electricity revenue-capping regulation 664
and hidden action game 481–2
and incentive regulation of electricity transmission expansion 584
and networks in natural gas and electricity industries 459
and petroleum tax 408
and price-capping regulation 485, 486, 494
and revenue-capping regulation 487
and sliding scale regulation 489, 490, 491, 492
as tax principle 404, 406
see also efficiency measurement in electricity and gas distribution industries; energy efficiency; energy efficiency in a stylised small open economy; inefficiency efficiency measurement in electricity and gas distribution industries benchmarking and regulation in electricity distribution: case study 615–19 econometric approaches to efficiency measurement 604–10 empirical studies on scale and cost efficiency in electricity distribution 612–14 empirical studies on scale and cost efficiency in gas distribution 610–12 empirical studies on scale and scope efficiency in electricity and gas distribution 614–15 production theory 600–601 scale, scope and cost efficiency 599, 601–4 efficiency units 147–8, 149, 150, 153, 155, 156, 160, 161 efficient component pricing rule (ECPR) 46–7, 48 effort 476, 477–8, 479, 481, 483, 484, 485, 487 see also animal effort; exergy; human effort; useful work; work EFOM (Energy Flow Optimization Model) 263 Ekins, P. 229 elasticities of substitution
and bottom-up energy models and macroeconomic hybridization 276
and CGE models 338, 339
and energy–economy–environment modelling 369, 370, 372–4, 378
and energy efficiency in a stylised small, open economy 155–7, 159–60
and multi-equation approaches to modelling energy demand 119, 120 and rebound effect 225

see also capital–energy substitution elasticity; CES (constant elasticity of substitution) production function; energy elasticity of substitution (ESUB)

elasticity of energy demand 56, 102–8, 109, 209, 210, 211, 213

see also MARKAL-ELASTIC DEMAND (MARKAL-ED)

elasticity of energy prices, and rebound effect 209, 210–211

elasticity of export demand 153–5, 225

elasticity of factor supply, and energy efficiency in a stylised small open economy 157, 158

elasticity of scale, and competition versus regulation 474

elasticity of useful work demand 209, 210, 211, 212, 213

electric vehicles (EVs) 688, 694, 695, 700, 701

electricity 444, 763, 765, 766

electricity consumption 11, 586, 653

electricity demand and capacity 650, 651

competitive electricity retail pricing 667, 668, 671–2, 676, 678

and electricity security in large hydropower systems in Brazil 653, 655–6, 657

and UK MARKAL model 293

and wholesale electricity markets 627, 628, 629, 633, 634, 637, 638, 641, 642, 643
electricity derivatives contracts 715, 716, 718–21, 723, 725–6
electricity distribution companies 512, 513, 565–71, 572–3
electricity distribution facilities 502, 503–4, 510–11
electricity distribution industry costs 511–15, 516, 517, 518
described 509–11

legislation 565–6, 567–70, 571

see also efficiency measurement in electricity and gas distribution industries; market structure of electricity distribution industry; regulation of electricity distribution industry
electricity expenditure, and switching electricity supplier 676–7
electricity generation in Brazil 653–5

and energy network industry structures 471, 472, 473

and market power in wholesale markets 631, 633–9

and UK MARKAL model 297, 298–300, 301, 305–6, 308
electricity generation costs

and CO₂e abatement costs in electricity and transport markets in Australia 686

and competitive electricity retail pricing 667

and wholesale electricity markets 626–7, 628, 629, 630, 631, 632–3, 636–7, 638
electricity industry

and CGE models 354, 355–6, 357–8, 359, 360, 361

and coal production 85–6

and history of energy 9, 10–11

legislation 460, 521, 523–4, 525, 526–7, 528, 544–5, 668

regulation 458–61, 471–3, 521, 662, 663–6, 673

see also incentive regulation of energy networks

spark spread 711

see also carbon dioxide emissions trading and convergence of electricity and transport markets in Australia; electricity distribution industry; electricity transmission industry
electricity markets 456, 457–61, 463–6

see also electricity derivatives contracts; electricity retail competition and pricing; wholesale electricity markets
electricity prices

and capacity 650, 651

and CO₂e abatement costs in electricity and transport markets in Australia 686

and electricity security in large hydropower systems in Brazil 651, 653–4, 655, 656, 657–9, 660–61

and history of energy 8, 9, 10

and incentive regulation of electricity transmission and distribution 583

regulation 663

and technological change 663


see also electricity retail competition and pricing
electricity retail competition and pricing competitive retail pricing 667–9
design elements of retail competition 669–74

critical elements for successful competition 680–82

performance of retail competition 674–89

ratemaking regulation 663, 664–6
electricity sales tax 85, 86
electricity security in large hydropower systems in Brazil

electricity generation in Brazil 653–5

missing money problem 651–3, 654, 657–8, 660

security supply simulations 655–61

electricity supply 285–7, 627, 629, 633, 653, 656–8, 740

see also electricity security in large hydropower systems in Brazil

electricity transmission and distribution companies (T&Ds) 547, 548, 566

electricity transmission asset owners (TOs) 542, 544, 545, 546

electricity transmission capacity 584, 585, 586, 588, 589–90, 591, 592, 626–7

electricity transmission companies, US 504, 505

electricity transmission congestion management, and wholesale electricity markets 628, 629, 631

electricity transmission costs 584, 585, 591, 592

electricity transmission expansion mechanisms combined merchant–regulatory approach 591–4

incentive regulation approach 583–6

merchant transmission investment approach 587–90

electricity transmission facilities 502–3

electricity transmission industry costs 500–509, 510, 511

described 500–501

legislation 544, 548–9, 550–53, 554–5, 556–8

see also electricity transmission expansion mechanisms; market structure of electricity transmission industry; regulation of electricity transmission industry

electricity transmission prices 583

Ellerman, A.D. 351, 773

embodied energy, and rebound effect 202

emission reduction scenarios (ERSs), electricity and transport markets in Australia 691–2, 694–701

emissions, GHGs see GHG emissions

empirical modelling of energy demand asymmetric demand responses to price changes 131–7

eyearly approaches to modelling and estimation 113–16

non-stationarity, implications of 127–31

systems of equations approaches 116–27

end-use technology 292

ENDEX (European Energy Derivatives Exchange) 720–21, 726

dependent technology learning (ETL) 262, 264, 266

energy

and CGE models 343, 344, 345, 354, 355–6, 357–8, 359, 360, 361, 369


Energy 2.0 Society 763, 764, 766–8

energy accounting 90–91

energy-augmenting technical change 147

energy choice 83–4, 101

see also fuel choice; switching electricity suppliers

energy commodity derivatives contracts 714–17

see also individual contracts

energy conservation developing countries 744

and energy–economy–environment modelling 377, 378

and model of extraction of depletable resources 55, 56

and theoretical foundations of the rebound effect 173–4

and UK MARKAL model 293, 296–7, 300, 301, 308

energy consumption

and bottom-up energy models and macroeconomic hybridization 272, 273

control, and energy policy 80, 82–4

and early approaches to modelling of energy demand 113, 114, 115

and economic growth and development 740–41, 742, 747, 749

and energy demand theory 91–2

and energy efficiency 144, 145–7, 148, 149, 150, 152, 153

environmental impacts in developing countries 749

and fossil fuels 89–90

in history of energy 11, 12, 15, 16

and modelling energy demand 98, 99

and modelling energy savings and environmental benefits of new technologies 247–8, 250–51

and multi-equation approaches to modelling energy demand 117, 118, 119

and non-stationarity in modelling energy demand 127–8, 129–30

and rebound effect 200, 201, 202, 204, 205, 208, 210, 215, 217, 219, 226

and simulation models 265, 266, 267

and UK MARKAL model 293–4

and urbanization in developing countries 750–51
energy conversion technologies 285, 286
energy cost savings
and LCC (life-cycle costs approach) to modelling energy savings 237, 238, 241
and modelling energy savings and environmental benefits of new technologies 249–50
and rebound effect 200, 201, 202, 205, 206, 218, 225
energy costs
and bottom-up energy models and macroeconomic hybridization 273, 275 and CIMS 317–18, 319, 321–2
and energy efficiency in a stylised small open economy 145, 149, 157
and rebound effect 209, 210, 211, 212, 216, 224
energy crisis, Californian 630, 638, 663, 675
energy demand
and bottom-up energy models and macroeconomic hybridization 272, 273, 274, 275
and CIMS 269, 270–71, 274, 275, 317, 318, 325
and history of energy 4, 6, 11, 12, 14, 16
and income growth 763
and MARKAL–MACRO 289
and modelling energy savings and environmental benefits of new technologies 250–51, 253, 254
and optimization models 259, 260–61, 264
and rebound effect 176–7, 207, 209, 225, 226
and simulation models 265, 266, 267, 268, 269, 270, 271
energy demand theory
and derived demand 89, 91, 109
and elasticity of energy demand 102–8, 109
and energy accounting 90–91
and energy–capital relationship 91–2
and energy policy 102, 109–10
and environmental policy 110
and long-run energy demand 92–7, 103–6
modelling 97–101
and price changes 106–8
energy distribution 471, 472–3, 509–11
see also electricity distribution companies; electricity distribution industry; regulation of electricity distribution industry
energy economics, theory of see theory of energy economics
energy–economy–environment modelling
applied models 369–71
and economic theories 367–9
and GHG emission abatement policies 367
role of energy and environment in economic models 371–8
energy efficiency
and bottom-up energy models and macroeconomic hybridization 272–3, 274
and capital equipment in empirical modelling of energy demand 132–4
defined 204
developing countries 745
and energy demand theory 91, 92, 96, 97
and energy–economy–environment modelling 377
versus energy intensity 97
and energy policy 80, 84
and energy visions 768
and induced technological change (ITC) policy models 312
macroeconomic hybridization of top-down models with bottom-up characteristics 276–7
and Maslow’s pyramid of human needs 761
and model of extraction of depletable resources 70
and modelling energy demand 98–9, 100, 101, 106, 107
and Nuclear Society 764–5
and rebound effect 209, 210, 211, 212, 213, 216
and UK MARKAL model 292–3, 294, 296–7, 303, 308
see also backfire; energy efficiency improvements; energy efficiency in a stylised small open economy; modelling energy savings and environmental benefits from energy policies and new technologies; rebound effect; theoretical foundations of the rebound effect
energy efficiency improvements 199, 200, 201, 202–3, 204–5, 206
energy efficiency in a stylised small open economy
and elasticity of export demand 153–5
and elasticity of substitution in production 155–7, 159–60
and energy consumption 158–61
and energy price changes 150–53
and energy productivity 147–8
and energy use 148–50
and production frontier zero elasticity of substitution 156–7, 162
simple model 144–7
and supply of other factors 157–8
energy efficiency policies 266
energy efficiency standards, European Union 234
energy-efficient buildings 206
energy-efficient end-use technologies 292, 298
energy-efficient equipment 200, 201, 206, 207, 215, 216, 217, 218–19
energy-efficient process technologies 200, 201, 206, 217–18, 222, 223, 224, 225
energy-efficient technologies 312
energy-exporting countries 743
see also Middle East; oil-exporting countries; Russia
energy exports 269, 447, 448
energy imports 269, 771
energy inequality 740, 751–2
Energy Information Administration (EIA) 436–7, 559, 561
Energy Intelligence 421, 423
energy intensity
and energy–economy–environment modelling 375
versus energy efficiency 97
and GDP causal relationships in developing countries 742–3, 745–8
and induced technological change (ITC) policy models 316
and long-run energy demand 92–6
and neoclassical growth theory 175
and theoretical foundations of the rebound effect 164, 165, 171, 174, 175–6, 178, 179, 181, 182, 187, 189
Energy Market Authority 551, 552, 567
energy markets 11–12, 13–14, 16, 39, 40, 671, 675, 748–9
see also behaviour of crude oil futures markets; electricity markets; forward energy markets; international energy derivatives exchanges; wholesale electricity markets
Energy Markets Inspectorate 558, 570
Energy Modeling Forum 388–94
energy modelling estimates, indirect and economy-wide rebound effect 221–7
energy networks 459, 460, 462, 463, 466, 471–3
see also incentive regulation of energy networks; regulated energy networks
energy-only markets, and wholesale electricity markets 644–5
energy planning, developing countries 750–52
energy policy
bottom-up energy models and macroeconomic hybridization 271–2
and CGE models 346, 347–54
and climate change 760–2
and coal 84–6, 110
and consumption control 82–4
and cost–benefit analysis and market structure 23
and electricity security in large hydropower systems in Brazil 654
and energy demand theory 102, 109–10
and energy efficiency in a stylised small open economy 145–7, 151–3, 157
and energy security 759–61, 770–73
and energy vision ideal types 763–8
and environmental policy 81–2
and history of energy 4, 12–14, 17
macroeconomic hybridization of top-down models with bottom-up characteristics 276–7, 279–80
and MARKAL model 288–9
and market failure 770–73
and Maslow’s hierarchy of human needs 761–2
and rebound effect 166, 167, 168–70, 173, 178, 196–7, 201–2
and risk 770–73
and simulation models 265, 266–7
and social cost of carbon 773–6
Stern Review 25, 28, 144, 203, 691, 773, 781–9
theory of energy intervention 73–7
and UK MARKAL model 290, 294, 296
US 77–81
see also carbon permits; carbon tax; energy tax; modelling energy savings and environmental benefits from energy policies and new technologies; tariffs
energy poverty 740, 751–2
energy price changes
and asymmetric demand in empirical modelling of energy demand 131–7
and bottom-up energy models and macroeconomic hybridization 267, 273, 274, 275
and CIMS 275, 318
and empirical modelling of consumer energy demand 123–6
and energy demand theory 100–101, 102, 104, 106–8
and energy efficiency in a stylized small open economy 150–53
and international derivatives markets 728–30, 731–3
macroeconomic hybridization of top-down models with bottom-up characteristics 276, 277
Index 805

and MARKAL–MACRO 289
and rebound effect 175–8, 180, 181–2, 184–5, 188–9, 196, 200, 216, 225
and simulation models 265
energy prices
and asymmetric demand responses to price changes in empirical modelling of energy demand 136
and CIMS 275, 318
and CPI-X incentive regulation 493, 494
and early approaches to modelling of energy demand 113, 114, 115
and elasticity of energy demand 102, 103, 105
and empirical modelling of consumer energy demand 121, 122, 123, 125
and energy efficiency in a stylised small open economy 144, 145, 146, 147, 154, 155
and energy policy 109–10
and induced technological change (ITC) policy models 313
legislation 79
and modelling energy demand 98, 99, 100–101
and non-stationarity in modelling energy demand 127–8, 129–30
and rebound effect 165–6, 167, 168–9, 170, 174, 181–2, 209, 210, 213
and revenue-capping regulation 487, 488, 489
and simulation models 267, 268, 269
and sliding scale regulation 489, 490, 491, 492
and wholesale electricity markets 638
and X-factor 495
see also price elasticity of energy demand
energy productivity 147–8, 149
energy resource stock, and energy–economy–environment modelling 372
energy savings 199, 204, 224, 226, 236, 237, 238, 241
see also energy efficiency; modelling energy savings and environmental benefits from energy policies and new technologies
Energy Sector Model (ESM) see carbon dioxide emissions trading and convergence of electricity and transport markets in Australia
energy security
and capacity 650, 651
and climate change 760–62
and energy demand theory 109–10
and energy policy 759–61, 770–73
and energy vision ideal types 763–8
and Maslow’s hierarchy of human needs 761, 762
see also electricity security in large hydropower systems in Brazil; oil security
energy service demand
and MARKAL model 261, 285, 286, 287, 289
and SIMS 317–18
and UK MARKAL model 290, 291, 292, 296
energy services, and rebound effect 205–7
energy supply
and bottom-up energy models and macroeconomic hybridization 273, 274, 275
and CIMS 269, 270–71, 274, 275, 317, 318, 325
and competition in wholesale energy markets 40, 41, 42–3
and energy network industry structures 471, 472, 473
and history of energy 4, 11, 13, 14, 16
investment decisions and marginal cost 29–32
and MARKAL model 285–7, 288
and optimization models 259, 260, 264
and simulation models 265, 266, 267, 268
and theoretical foundations of the rebound effect 176–8
see also electricity security in large hydropower systems in Brazil; model of extraction of depletable resources
energy surplus 144, 145
energy tax 147, 151, 152–3, 157, 771
energy theory of value 378
energy transmission 471–2, 473, 500
see also electricity transmission industry; regulation of electricity transmission industry
energy use in production
and energy efficiency 144, 145, 147, 151, 152, 153, 154, 155–6, 157, 158, 159, 161, 162
and rebound effect 164–5, 166–7, 168–9, 170, 171, 172–3, 177, 178, 179, 183, 184, 185, 187, 189, 190, 191, 195, 196, 197, 201
see also energy intensity
energy-using equipment 132–4
energy vision ideal types 763–8
engineering approaches to energy-saving evaluation 235–41, 248, 253–4
engineering efficiency 167, 170, 172–3, 182, 199
engines 6, 7, 9, 10, 688, 700, 701
England and Wales 583, 626, 627, 631, 637–8, 640–41, 678
Engle–Granger procedure, and non-stationarity in modelling energy demand 128
Engsted, T. 115, 128, 129
ENPEP/BALANCE 265–6
Enron 630, 753
environmental impact statements (EISs) 450–51, 453
environmental impacts
biofuels 765–6
and climate change IA models 780, 781
coal combustion 444–5
of energy consumption in developing countries 749
and history of energy 14–15, 17
nuclear power 445, 764–5, 768
and Stern Review 773, 784, 785, 786–7, 788
see also air pollution; carbon dioxide emissions; externalities; GHG emissions
environmental input, and energy–economy–environment modelling 371, 374
environmental legislation 81, 82, 449
environmental policy 81–2, 110, 290, 295, 296, 450–51, 452–3, 749
see also climate policy; GHG emissions abatement policy; induced technological change (ITC) policy models
environmental resource constraint, and energy–economy–environment modelling 374
environmental viability, and Maslow's pyramid of human needs 761
equity, as tax principle 404–5, 406
estimates, and direct rebound effect 211–15, 216, 226, 248, 249, 252, 253
estimation approaches 127, 207–11
ETA (Energy Technology Assessment) 259–60
ETA (Energy Technology Assessment) – MACRO 272, 273
Eurasia 741
Europe
climate change policy 762
coal international trade 447, 448
derivatives markets 712, 713
electricity distribution regulation 531–3, 535, 599
electricity markets 458
electricity retail competition and pricing 672–3
electricity transmission expansion mechanisms 590, 593
electricity transmission regulation 519, 523–7, 529
energy security and energy policy 760–61
and history of energy 3, 4, 14–15
market structure of electricity distribution industry 566–70, 572
market structure of electricity transmission industry 547, 549–59, 560
petroleum fiscal regime 411
primary energy consumption 741
rebound effect 211
wholesale electricity markets 627, 631, 635, 645–6
European options 708
European Union
carbon emissions trading 773
coal production 85
competitive electricity retail pricing 671–2, 678, 679
electricity distribution industry 566–8, 569, 570
electricity transmission expansion mechanisms 590
electricity transmission industry 548–9, 550–53, 554, 555, 556–7, 558, 559
energy efficiency standards 234
energy market liberalization and history of energy 14
energy network regulation 476
modelling energy savings and environmental benefits of new technologies 253
natural gas and electricity markets 456, 463
exchanges 626, 627, 632–3
see also international derivatives exchanges; individual exchanges
exercise prices 707–8, 709, 710
exergy 378
exhaustion 52, 53, 55, 62, 176–7, 442
expansion in electricity transmission industry see electricity transmission expansion mechanisms
expected energy cost savings, of new technologies 242
expected energy costs, and life-cycle costs approach to modelling energy savings 235–6, 240
expected energy savings, and rebound effect 200
expected lifetime of appliance, and life-cycle costs approach to modelling energy savings 236, 238
expected ultimate recovery (EUR), and model of extraction of depletable resources 67 expenditure 121–6
exploration, and model of extraction of depletable resources 61–2, 69, 443
exports see coal exports; elasticity of export demand; energy-exporting countries; oil-exporting countries
externalities 383–6, 388, 770
see also environmental impacts
extraction, depletable resources see model of extraction of depletable resources
extraction costs 58–61, 62, 63–4, 65, 69, 442, 443

F-statistic, and non-stationarity in modelling energy demand 129–30
Fabbri, P. 611
factor prices 98, 149, 157, 338, 339, 340, 343
factor substitution 119, 120
factor supply 157–8
factors, and CGE models 333, 334, 335
failure of appliances, and modelling energy savings and environmental benefits of new technologies 246, 247
failure of appliances, in modelling energy savings and environmental benefits 246, 247
fairness, petroleum tax 401
Farsi, M. 511, 607, 608, 609, 610, 611–12, 613–14, 615
FDI (foreign direct investment) 746
fear-and-greed analysis, behaviour of crude oil futures markets 430, 435–6
Federal Land Policy and Management Act 1976 (FLPMA) 451
Fernandez, V. 244
Field, B.C. 56, 119‒20
Filippini, M. 476, 511, 607, 609, 613
final energy demand 293, 294
finance 752–4
financial transmission rights (FTR) 587–8, 589–90, 592, 593
Finland 524, 529, 535, 551–2, 560, 567, 572, 667, 674, 678
Finon, D. 552, 678
firms 65–7, 97–9, 333–4, 335, 762, 768
first generation energy demand models 114–16
fiscal regimes, and petroleum tax 411–17
fiscal risk 405, 406
Fischer, C. 17, 84
fixed costs, and cost–benefit analysis and market structure 23–4
fixed-effects approach, and efficiency measurement 606, 608–9
fixed prices 584, 585, 586, 592, 593, 665, 681, 682, 710–11
flexibility, and history of energy 9–10
see also trans-log function
food 2, 3, 4, 421
food security 765–6, 767, 768
forecasting models, and economy–environment modelling 369–70
forestry industry 218–19
formula rates, North America 521, 529
forward contracts 706, 707, 709
forward energy markets 625, 629, 718–21
fossil fuel capacity 654, 660
fossil fuel consumption 653, 654
fossil fuel costs 655
fossil fuel import prices 291, 296
fossil fuel imports 291, 296, 298, 299
fossil fuel prices 656
fossil fuel production 298, 299
fossil fuel supply 741
fossil fuels versus biofuels 744
and CGE models 351, 352–4
characteristics and uses 444
and Clean Coal Society 763–4
and energy demand 89–90
and history of energy 5–8, 15, 16, 90
see also coal; natural gas; oil
Fouquet, R. 1, 3, 5, 7, 8, 9, 13, 14, 16
Foxon, T. 221, 224, 226
France coal production 84, 85, 445
electricity distribution regulation 535
electricity retail competition and pricing 678–9
electricity transmission regulation 525, 529
energy policy 76
market structure of electricity distribution industry 567–8, 572
market structure of electricity transmission industry 552, 560
oil consumption 131, 133
oil prices 131, 132
wholesale electricity markets 627, 628, 646
see also PowerNext
Fraquelli, G. 615
Frei, C.W. 278, 316, 761, 763
frontier analysis, and efficiency measurement
604, 605–9, 611–12, 614, 615–19
fuel choice 80–81
fuel oil futures contracts 718–19, 720–21, 726–7
fuel prices 710
Fuente, C. 667, 678, 680
full fuel cycle CO2 emissions factors 694
see also CES (constant elasticity of substitution) production function;
Cobb–Douglas production function;
Leontief production function; trans-log function
functionally independent operators (FIOs)
in electricity distribution industry 566–7, 568–70, 570, 572, 573
in electricity transmission industry 542, 543, 547, 548, 549–50, 552, 553–4, 555, 558, 560
Fundamentalist school 368, 369
funds, and crude oil futures markets 428, 429, 430, 431
funds of funds, and crude oil futures markets 429, 430, 431
furnace oil futures contracts 727
future consumption 25–6, 27, 442–3, 780
future demand, depletable resources 62
future energy demand 265
future energy prices 106, 107, 235, 236, 237–8, 239
future energy service demand 291
future generations 147, 783
future generations’ utility 779, 780, 781
future prices 62, 63, 67
future profits 407
future technology costs 293, 313
futures contracts 706, 707, 708–9, 710, 711–17
futures energy markets
behaviour of petroleum markets 420–21
crude oil 422–6
and energy production 83
and international energy derivatives exchanges 714–17, 718–21, 722–30, 731–3, 734–6, 737
futures price 708, 709, 710
Gallagher, K.S. 743
game theory 41, 475–82, 489–92, 493
Garis, D. 437
Garnaut, R. 410
Garnaut Climate Change Review 690
gas see efficiency measurement in electricity and gas distribution industries; natural gas; town gas
gas prices 8
gasoil derivatives contracts 718–19, 720, 721, 723, 724
gasoline consumption 104–5, 107, 108
gasoline derivatives contracts 713–14, 716, 718–19, 720, 721, 722, 723, 724–5, 736, 737
gasoline prices 75, 104, 105, 107, 108
Gately, D. 106, 134, 135–6, 137, 216, 387
GDP
and energy intensity in developing countries 742–3, 745–8
and income elasticity of energy demand 102, 104, 105
and long-run energy demand 92–4, 96–7
and MARKAL–MACRO 289
and oil import premium estimates 388
and oil price changes 397
and rebound effect 225
GDP elasticity of energy consumption, and capital intensity in developing countries 747–8
Geltner, D. 748
general equilibrium theory 190–93, 196, 367–8, 373
generalized trans-log, and efficiency measurement in electricity and gas distribution industries 615
generations 778, 779, 780, 781
see also future generations
geographic scale, and applied energy–economy–environment modelling 369
geological uncertainty 62–3
géopolitics 69–70
geothermal power 689
Germany
coal industry 445, 447
c oal international trade 447, 448
c oal production 84, 85–6, 445
competitive electricity retail pricing 667, 680
electricity distribution regulation 535
electricity retail competition and pricing 678
electricity transmission regulation 525, 529
energy network regulation 486–7, 489
market structure of electricity distribution industry 568, 572
market structure of electricity transmission industry 552–4, 560
wholesale electricity markets 627, 628, 639
Getachew, L. 511, 540
GHG emissions 14–15, 444–5, 750–51
see also carbon dioxide emissions; nitrogen oxide emissions; sulphur dioxide emissions
GHG emissions abatement costs 314
GHG emissions abatement policy 260, 264, 266, 367, 694
GHG emissions abatement targets 271, 276, 277, 312, 317, 328, 329
GHG emissions caps 350–51, 352–3, 357
GHG emissions permit prices 638
GHG emissions tax 317, 352–3
GHG emissions trading 169–70
see also carbon dioxide emissions trading
GHG intensity cap 351
Gilmartin, M. 227
Glachant, J.-M. 552
Global 2100 272, 273
global economies of scope 603–4
global energy prices 290
global warming see climate change
GLS (generalized least squares), and efficiency measurement 606, 608, 614, 615
Goldemberg, J. 740, 746, 747
Goldstein, G.A. 260, 261, 262
Gomez, T. 526, 533, 556, 557
goods markets 368
Gordon, R.L. 83, 84, 441‒2, 443, 453
Goldemberg, J. 740, 746, 747
Goldstein, G.A. 260, 261, 262
Gomez, T. 526, 533, 556, 557
goods markets 368
Gordon, R.L. 83, 84, 441‒2, 443, 453
Gould, L.H. 344, 345, 355, 376
government and CGE models 333, 334, 335
and Energy 2.0 Society 767
and investment in developing countries 752–3
and oil industry 401, 402, 403, 404
risk sharing 405, 406, 408, 410
see also climate policy; energy policy; environmental policy; regulation; subsidies; taxes
Gowen, M.M. 744
Graham, P. W. 686, 688, 694
Gray, L.C. 71, 442
Grebenstein, C. 120
Green, R. 39, 40–41, 43–4, 626, 637–8, 640, 775
Greene, W.H. 113, 244, 252, 255, 605, 608, 614
greenhouse gas emissions see GHG emissions
Greening, L.A. 199, 217–18, 229, 260, 261, 262
gridcos in electricity transmission industry 542, 543, 546, 548
Griffin, J.M. 136
Gupta, J.P. 753
Hall, D.O. 744
Harvey, S. 631, 632, 634, 637, 638, 640
Hatcher, J. 4, 5, 6
hazard rates, modelling energy savings and environmental benefits of new technologies 243–6
health and safety 2, 10, 11, 13, 14, 448‒9, 764
heating see space heating
heating oil derivatives contracts 713–14, 717, 718–19, 721, 722, 723
hedging behaviour 426–7
Hestnes, A.G. 220
hidden action 475–82, 493, 496
hidden information 475–6, 489–92, 493, 496, 588–9
high-emissions technology 687, 695, 698
Hill, J. 314
history of energy
agricultural world economy 1–4, 14, 16
energy policies 4, 12–14, 16
environmental effects of energy 14–15, 17
fossil fuels, transition to 5–8, 16, 90
global need for energy 11–12, 16
importance of history 1
modern energy systems 8–11, 16
organic energy economy, limits of 3–5, 16
hoarding 384, 442–3, 771
Hoffman, K.C. 257, 258
horses 3
Hotelling, H. 51, 52–7, 58, 67, 70, 71, 407, 409, 441–2, 453
household appliances 220, 234, 244–6
household composition 242, 243, 246, 751
households and CGE models 333–4, 335, 338, 348–50, 353, 354
dynamic model of household’s energy demand 99–101
energy consumption on developing countries 751
and indirect rebound effect 224
and modelling energy savings and environmental benefits of new technologies 242, 243, 246
and UK MARKAL model 291, 294, 297, 303
see also direct rebound effect
HRV model, and electricity transmission expansion mechanisms 591–4
Hubbert, M. King 68, 441, 453
human capital 374–5, 376
human effort 3
Hunt, L.C. 130–31, 136
hybrid energy–economy models 276–80
see also macroeconomic hybridization; top-down and bottom-up hybrid energy–economy models
hybrid vehicles 688, 693, 700, 701
hydrogen economy, and energy visions 763, 764, 765, 766–7, 768
hydrology 651‒3, 654, 655, 656–8, 660–61
hydropower 3, 11, 689, 699, 700
see also electricity security in large hydropower systems in Brazil

ICE (Intercontinental Exchange)
trading 717
futures energy contracts 421, 423, 718–19, 720, 721, 723, 727
options energy contracts 718–19, 720, 721, 723
ideal types 759, 763–8
Illinois 670, 673–4, 675, 681–2
IMACLIM-S CGE 277, 278
imitation, floor traders’ behaviour
imports see coal imports; energy imports; fossil fuel import prices; fossil fuel imports; oil import control; oil import premium; oil-importing developing countries
incentive power of the control 476–8, 479, 480, 481, 490
incentive regulation of electricity transmission and distribution
combined merchant–regulatory approach to electricity transmission expansion 583, 591–4
described 518–19, 599
electricity transmission expansion 583–6
Europe 525–7, 529, 531–3, 535
North America 518–19, 520, 522, 523, 531, 535
Pacific Region 527–8, 530, 533–4, 535
incentive regulation of energy networks
characteristics of regulated energy networks 471–3
competition versus regulation 473–5
implementing incentive regulation 492–3
price-capping regulation 482–6
regulatory models 475–82
revenue-capping regulation 486–9, 664
sliding scale regulation 489–92
X-factor, meaning of 494–6
X-factor, setting in CPI-X incentive regulation 493–4
see also incentive regulation of electricity transmission and distribution
incentives 411, 413, 630–31
income
and CGE models 335, 336, 337, 339, 341, 342, 348–9, 350, 351, 353, 354
and early approaches to modelling of energy demand 113, 115
and elasticity of energy demand 102, 103, 104–6
and energy demand 763
and energy efficiency in a stylised small open economy 159, 160
and life-cycle costs (LCC) approach to modelling energy savings 241
and modelling energy savings and environmental benefits of new technologies 242, 246, 247, 248, 251
and non-stationarity in modelling energy demand 127–8, 129–30
and rebound effect 182, 183–5, 188–9, 200, 202
and switching electricity supplier 676–7
income balance, and CGE models 335, 336, 339, 341, 342, 343, 351, 353
income elasticity of energy demand 102, 103, 104–6, 113, 115, 159, 160
income tax see corporate income tax
incremental cost of access provision 45–6
incremental surplus subsidy scheme (ISS) 586, 591
independent power producers (IPPs) 502
independent system operators (ISOs) in electricity transmission industry
described 542, 543, 545, 546
electricity transmission expansion 582–3, 584, 587–90, 591
Europe 549, 554–5, 680
North America 542, 545, 547, 548
independent transmission companies (ITCs) in electricity transmission industry
described 542, 543
and electricity transmission expansion 583–6, 591, 592–4
Europe 551, 555, 556, 557, 558–9, 560
North America 544, 545, 546, 548
Pacific Region 561–2, 564
independent transmission providers (ITPs) in electricity transmission industry 542, 543
see also functionally independent operators (FIos); gridcos in electricity transmission industry; independent system operators (ISOs) in electricity transmission industry; independent transmission companies (ITCs) in electricity transmission industry; transmission asset owners (TOs) in electricity transmission industry
India 3, 16, 438, 445, 446, 744–6, 753, 760
see also MCX (Multi Commodity Exchange of India); NDEX (National Commodity and Derivatives Exchange)
indirect energy costs, and energy–economy–environment modelling 373
indirect rebound effect
embodied energy estimates 215, 217, 218–21
energy modelling estimates 221‒7
nature of 199‒200, 201, 202‒3
secondary effects 217‒18
individual consumer surplus, and cost–benefit analysis and market structure 21‒2
individual demand curve, and cost–benefit analysis and market structure 21, 22
Indonesia 414, 415, 445, 448, 745‒6
induced technological change (ITC) policy models 257, 258, 311‒17, 374‒6
see also CIMS
industrial power supply 4, 6‒8, 10‒11, 12, 444
industrialization 3, 4, 6‒8, 12, 14‒15, 92‒4, 747
inefficiency
and efficiency measurement in electricity and gas distribution industries 604, 606, 608, 614
and price-capping regulation 485‒6
and regulated rates in electricity industry 665‒6
and sliding scale regulation 489, 490, 491, 492
and wholesale electricity markets 629, 630‒31, 632, 633
and X-factor 496
see also cost inefficiency; efficiency; scope inefficiency
inflation 395‒6, 397, 495, 496, 584
information asymmetry 83, 84, 588‒9, 770
see also hidden information
information provision 83, 84, 242, 249, 324, 325
information technology 766
informational uncertainty 776‒8
infra-marginal rents 650, 651, 653
infrastructure 762, 763, 765‒8
initial price, and CPI-X incentive regulation 493, 494
input 474, 475, 601
input data, MARKAL model 287, 288, 290, 291, 293, 296
input prices
and bottom-up energy models and macroeconomic hybridization 275
and efficiency measurement in electricity and gas distribution industries 605, 606, 607, 608, 610, 611, 612‒13, 615, 616
and electricity distribution costs 514
and electricity transmission costs 506‒7, 508, 509, 510
and macroeconomic hybridization of top-down models with bottom-up characteristics 276
and neoclassical growth theory 175
and production theory 600
and theoretical foundations of the rebound effect 181, 192‒3
and X-factor (productivity offset) 494, 495
inputs
and CO₂e emissions trading and convergence of electricity and transport markets in Australia 689
and economies of scope 474, 475
and energy–economy–environment modelling 370, 371
and MARKAL–MACRO 289
and neoclassical growth theory 174
and production theory 600
and returns to scale 601
and theoretical foundations of the rebound effect 164, 165‒6, 168‒9, 170, 186‒7, 190‒91, 192, 196
see also capital; energy use in production; labour supply
installation costs 235, 236, 238, 240, 241, 242
insulation 248
intangible costs of new technology 313, 316, 318, 322, 324, 325
integrated assessment (IA) models 778‒81, 782‒9
inter-fuel substitution 136‒7
interest rates
and model of extraction of depletable resources 52, 54, 55, 59, 60, 61, 442‒3
and modelling energy savings and environmental benefits of new technologies 247
and neoclassical growth theory 175
and oil price changes and shocks 395‒6
and swaps 707
and valuing derivative instruments 708, 709, 710
intergenerational consumption 27‒8
intermediate goods, and CGE models 344
intermediate inputs 334‒6, 377‒8
internal combustion engines (ICEs) 9, 688, 700, 701
international derivatives exchanges 706, 717
international derivatives markets
derivative instruments 706‒8
energy commodities derivative contracts 714‒17
international energy derivatives exchanges
see international energy derivatives exchanges
price trends, volatility and role of market participants 728, 730‒37
valuing derivative instruments 708‒14
International Energy Agency (IEA) 436‒7,
550, 552, 553, 554, 555, 563, 566, 740, 741, 759, 760, 763

international energy derivatives exchanges 717–28
see also ICE (Intercontinental Exchange); Nord Pool; NYMEX (New York Mercantile Exchange)

international energy markets 11–12, 14, 16, 267, 268–9
see also international derivatives markets

international investment 752–3

international oil companies (IOCs) 411–17
international petroleum fiscal regimes 411–17
international relations 75–6, 384
international trade 4, 361, 447–8
see also coal exports; coal imports; elasticity of export demand; energy-exporting countries; energy imports; fossil fuel import prices; fossil fuel imports; oil-exporting countries; oil import control; oil import premium; oil-importing developing countries

investment
and CGE models 361
and climate change and energy security 762
and corporate income tax 411
developing countries 752–4
electricity ratemaking regulation 664
and electricity transmission expansion mechanisms 584, 585, 586, 587–90
and energy–economy–environment modelling 371, 374–5, 376
and general equilibrium theory 192
and low-emissions technologies 762, 763
and neoclassical growth theory 175, 188
petroleum tax 401–2
and resource rent tax 410–411
and theoretical foundations of the rebound effect 184, 188
investment decisions 29–32, 61–2, 65–6
investment rule, and peak-load pricing 33–4
investor-owned utilities (IOUs)
and electricity distribution industry in North America 565
and electricity transmission costs 502, 503, 506–7
and electricity transmission industry in North America 544, 545, 546, 547, 548
and energy network industry structure 471, 472–3
and hidden action game 478–9
and wholesale electricity markets 464–5
investors 405, 406, 408, 410
IPCC (Intergovernmental Panel on Climate Change) 203, 690, 773

Iran 75, 760
Iraq 75, 386
Ireland 525, 529, 535, 554, 560, 568, 572
iron industry 6–7
Islamic fundamentalism 74, 75–6
Italy
coal production 445
efficiency measurement in electricity and gas distribution industries 611, 615
electricity distribution regulation 535
electricity transmission regulation 525–6, 529
market structure of electricity distribution industry 568, 572
market structure of electricity transmission industry 554–5, 560
wholesale electricity markets 627, 628, 637, 638, 641–2

Jaccard, M. 258, 269, 272, 315, 316, 317–18, 321, 322, 324, 328, 376, 377
Jacoby, H.D. 277, 362
Japan
coal international trade 447, 448
coal production 85, 445
derivatives markets 716
electricity distribution regulation 534, 535
electricity transmission regulation 528, 530
energy policy 76
and history of energy 3
market structure of electricity distribution industry 571, 573
market structure of electricity transmission industry 562–3, 564
oil consumption 131, 133
oil prices 131, 132
see also TOCOM (Tokyo Commodities Exchange)
jet fuel swaps 710–11
Johansen, S. 128–9
Johnston, D. 412, 413, 414
Jones, D.W. 750
Joutz, F.L. 128, 129
Jung, T.Y. 749
Kahn, E. 636, 638, 664, 665
Kanagawa, M. 752
Kannan, R. 293, 295
Kaufmann, R.K. 215, 218–19, 228, 378
Kehoe, P.J. 333
Kehoe, T.J. 333, 343, 347
Kemfert, C. 376
Index

Kemmler, A. 752
kerosene futures contracts 716, 718–19, 721, 724
Kim, T.-Y. 610
Klemperer, P. 41
Kolstad, C.D. 778, 780, 781
Koopmans, T.C. 442
Kraft, A. 745
Kraft, J. 745
Kristiansen, T. 588, 589–90, 594, 596
Kubursi, A.A. 754
Kuwait 75
Kyoto Protocol 14, 17, 314

labelling 234
labour costs
  electricity distribution industry 515, 516, 517
  electricity transmission industry 501, 504, 505, 506, 508, 509, 510
labour markets 368
labour productivity 206, 218
labour supply
  and bottom-up energy models and macroeconomic hybridization 272
  and CGE models 344, 345, 354, 355, 362, 369
  and energy–economy–environment modelling 371, 378
  and energy efficiency in a stylised small open economy 157, 158, 161
  and general equilibrium theory 192
  and history of energy 3, 4, 7
  and modelling energy demand 98
  and multi-equation approaches to modelling energy demand 117, 118, 120
  and neoclassical growth theory 174–5
  and theoretical foundations of the rebound effect 178, 192
Labriet, M. 258, 261, 263
Laffont, J.-J. 47–8, 476, 489, 490
lagged dependent variable, and empirical modelling of energy demand 114, 115, 116, 117
lagged expenditure shares, and empirical modelling of consumer energy demand 123–5
LAIDS (linear approximation to the almost ideal demand system) 122–6, 137
Lamech, R. 752–3
land management 449, 450–53
land use 3–4
last entrant, optimal degree of market entry determinant 44, 45
latent variable models, and energy savings of new technologies 246–8, 251–2
Lave, L.B. 666, 667, 682
learning by doing 260, 262, 274, 375–6
Léautier, T.-O. 582, 583, 588
Lee, C.-C. 746–7
Lee, J.-D. 610
Lee, L. 608, 614
legislation
  coal-mine health and safety in US 448–9
  electricity distribution industry 565–6, 567–70, 571
  electricity industry 460, 521, 523–4, 525, 526–7, 528, 544–5, 668
  electricity markets in US 457
  electricity transmission industry 544, 548–9, 550–53, 554–5, 556–8
  energy prices in US 79
  environmental 81, 82, 449
  land management in US 449 450–53
  natural gas in US 79, 80, 460
Leiby, P.N. 386–8
leisure 192
Leontief production function 118, 167, 172, 273, 277
levelized discount cost (LDC) 31–2
leverage, and behaviour of crude oil futures markets 431, 432
liberalization 14, 471, 472–3, 478–9, 483–4, 485, 653–4, 667, 753
Libya 75
licences, oil industry 402
lighting
  and fossil fuels 444
  and history of energy 2, 9, 10, 11
  and modelling energy savings of new technologies 236–7, 238–9, 240–41, 242, 249
  and non-commercial fuels in developing countries 740
Lind, R. 773, 786
Lindmark, M. 749
linear demand, and model of extraction of depletable resources 54–5, 56
liquid fuel economy, and energy visions 763, 764–6, 767, 768
liquidity, and derivatives markets 706, 707, 717, 733
Littlechild, S.C. 29, 476, 537, 583, 588
load factor 616, 617
see also load pockets; loss of load probability; lost load; peak load; peak load pricing; value of lost load
load pockets 634, 635
local electricity delivery companies 509–11
local product prices 160
local products 160
local resource income 151, 152, 159
local resource prices 155, 156
local resources 144, 145, 147, 148, 151, 153, 155, 162
localization, and energy visions 763, 764, 766, 767, 768
location, and wholesale electricity markets 629
locational arbitrage 630
locational market power, and wholesale electricity markets 634–5, 637–8
Lockerbie, M. 238–9
log-linear demand equation, and elasticity of energy demand 102–3, 104–5
log-linear functional equations, and early approaches to modelling of energy demand 15–16, 113–14
logit models, of energy savings and environmental benefits of new technologies 247–8
long position holders 733–7
long-run capital costs 584
long-run costs 600, 611
long-run energy demand 92–7, 103–6, 107, 114
long-run marginal costs (LRMC) 29, 30, 31, 33–4, 36, 686, 687
long-run price elasticity of demand 106–7
long-term financial transmission right (LTFTRs) 587, 588, 589, 592–3
long-time periods, and electricity transmission expansion 585, 586, 587, 588, 589, 590, 592, 593
loop flows, and electricity transmission expansion mechanisms 584, 588, 589, 591
Losekann, L. 654
loss of load probability 640, 641
lost load 35, 36–9, 640–41
Loulou, R. 258, 261, 262, 263, 287, 289
low-emissions technology 687, 695, 698, 762, 763, 764
Lowry, M.N. 511, 536–7, 540
LSCO (light, sweet crude oil) futures 705, 714, 716, 718–19, 720, 722, 727
lumpy capital investment 63–5, 66
lumpy projects 591, 592
MACRO 260, 264, 272–3
macroeconomic hybridization 271–6, 279
see also top-down and bottom-up hybrid energy–economy models
macroeconomy
and induced technological change (ITC) policy models 311, 315, 316, 317
and oil price changes and shocks, impacts of 397
and rebound effect 224, 226, 227
and simulation models 265, 269, 270–71
see also MARKAL–MACRO
Mahadevan, R. 743, 745, 747
Maine 673, 675
maintenance costs see operating and maintenance costs
Malanima, P. 2–3
MAM 273–4
Mandatory Renewable Energy Target (MRET) 694
Manne, A.S. 164, 165, 166, 167, 257, 259, 260, 272
Mantzos, L. 253
Marcotullio, P.J. 741, 748–9
marginal carbon dioxide prices 304, 305, 306, 307, 308
marginal cost of carbon abatement 775–6
marginal cost of energy, and access pricing problem 45–6
marginal cost of investment, and model of extraction of depletable resources 62
marginal costs and capacity 650, 651
and competition in wholesale energy markets 41, 43
and cost–benefit analysis and market structure 22, 23, 24
and economic rent 407, 408
and economies of scale 474
and electricity security in large hydropower systems in Brazil 651, 653
and electricity transmission expansion mechanisms 586, 587, 593
and investment decisions in energy supply 29–32
and optimal degree of market entry, determinants 44, 45
and price-capping regulation 483, 484, 485–6
and regulated rates in electricity industry 665–6
and revenue-capping regulation 487
and sliding scale regulation 489, 490, 491, 492
and spot pricing, simplified model 36
and theoretical foundations of the rebound effect 181
marginal extraction cost (MEC), and extraction of depletable resources 53, 54, 55, 59, 62, 442
marginal GHG abatement costs 695, 698
marginal oil production costs, and benchmark crude oil prices 422
marginal opportunity cost of access, and access pricing problem 45, 46
marginal prices, and competition in wholesale energy markets 40
marginal productivity, and theoretical foundations of the rebound effect 192–3
marginal revenue 56, 482–3, 484, 485, 487, 488, 489
marginal social cost of carbon 775–6
marginal social return to capital, and social discount rate in cost–benefit analysis 26, 27
marginal user cost (MUC), and extraction of depletable resources 53, 54, 55, 60
marginal utility, and social discount rate in cost–benefit analysis 25, 28
MARKAL-ELASTIC DEMAND (MARKAL-ED) 262, 289
MARKAL-ETL (MARKAL-Endogenous Technology Learning) 262
MARKAL–MACRO 272, 273, 288, 289, 293
MARKAL-MICRO (MICRO) 262
MARKAL models 260–64, 279, 285–9, 376
MARKAL Stochastic 262–3
market clearance, and CGE models 334, 335, 336, 337, 339, 341, 342, 343, 346, 353
market–demand prorationing, and US energy policy 77–8
market entry 23, 44–5
market failures 73–7, 82–3, 384–5, 770–73
market heterogeneity, and CIMS 318–19, 322–3, 324
market monitoring 639, 645–6
market power 384, 385, 387–8, 464–5, 588, 631, 633–9, 770
market prices, and options 707–8
market share 270, 288, 316, 318–19, 325
market splitting, and wholesale electricity markets 628
market structure of electricity distribution industry
Europe 566–70, 572
industry structure 471, 472–3, 563, 565
North America 565–6, 572
Pacific Region 570–71, 573
market structure of electricity transmission industry
Europe 547, 549–59, 560
industry structure 471–2, 473, 541–2, 543
North America 542, 544–7, 548
Pacific Region 559, 561–3, 564
markets 368, 458–61
see also behaviour of crude oil futures markets; capital markets; cash markets; competition; currency markets; electricity markets; energy markets; futures energy markets; goods markets; international derivatives markets; market structure of electricity distribution industry; market structure of electricity transmission industry; money markets; natural gas markets; wholesale electricity markets
Marron, D.B. 84
Maryland 669, 670, 674
see also PJM (Pennsylvania–New Jersey–Maryland)
Maslow’s pyramid of human needs 761–2
Massachusetts 673, 674, 675, 676, 681
materials
and CGE models 343, 344, 345
and energy–economy–environment modelling 371
and energy efficiency in a stylised small open economy 157, 158
and modelling energy demand 98
and multi-equation approaches to modelling energy demand 117, 118, 120
Mathiesen, L. 340, 346
Meyer, M. 41
Mayo, J.W. 614–15
McFadden, D. 600
McGregor, P. 227
McKinsey & Company 687
MCX (Multi Commodity Exchange of India) 720–21, 727–8
MDM-E3 model, and rebound effect 224, 226
Medlock, K.B., III 71, 93, 102, 126
Meier, P. 743, 754
Mendelsohn, R. 63, 774, 784
merchant transmission investment of electricity transmission expansion 583, 587–90, 591–4
MERGE 260
MERGE 4.5 272, 273
MESSAGE 264, 272, 376
MESSAGE Stochastic 264
Mexico 765
microeconomics 367–8, 373
Middle East
benchmark crude oil prices 420–21
conflict 384, 392, 393, 422
oil crises 9, 10, 11, 74–5, 77, 79
and oil in history of energy 9, 10
oil production costs 421, 422, 423
oil supply 74–7, 78, 388, 760
peak oil 69
population 3
see also DME (Dubai Mercantile Exchange); Iran; Iraq; Kuwait; Libya; oil-exporting countries; Persian Gulf countries; Saudi Arabia
Middle East sour crude oil futures 420–21, 718–19, 720–21, 727–8
Midwest 628, 634–5, 639, 645
Mielnik, O. 746
military expenditures, and oil security 385–6
minerals tax 77
mining industries 6–7, 85, 86, 407, 448–9
missing money problem 640–42, 644, 651–3, 654, 660
MIT–EPPA 277, 278
MLE (maximum likelihood estimates), and efficiency measurement 605, 606, 614
mobility 763, 764
model of energy demand 97–101
model of extraction of depletable resources complications of simple model 51, 57–65
firm behaviour 65–7
peak oil 67–70
simple model 52–7, 442
modelling energy savings and environmental benefits from energy policies and new technologies
adoption by consumers 242–8, 249, 253, 254–5
aggregate energy savings potential and economic behaviour 248–52, 253
engineering approaches to energy-saving evaluation 219–20, 235–41
strengths and weaknesses of approaches 253–5
Mommer, B. 406, 412
monetary policy 396, 397
money markets 368
monopolies
and coal leasing in US 451, 452
and competition in wholesale energy markets 43, 44
and efficiency measurement in electricity and gas distribution industries 611–12
and electricity distribution industries 599, 611–12, 668
and electricity generation in Brazil 653
and electricity industry 457–8, 459, 460, 515, 542–3
and energy network industry structure 471, 472
and model of extraction of depletable resources 56
and natural gas industry 458, 459, 460, 466, 599
and oil security 384, 385
and price-capping regulation 482–3, 485
and returns to scale 601
monopsony 384, 385, 387, 771, 772
Montana 675
moral hazard see hidden action
motor fuel consumption 92, 103–5, 107, 108, 199–200, 211, 212–13, 700–701
motor fuel demand 302, 303, 308
motor fuel prices 75, 104, 105, 107, 108, 421, 686
motor fuels 688
see also gasoline consumption; gasoline derivatives contracts; gasoline prices
Mubayi, V. 754
Muellbauer, J. 122, 229
Müller, T. 377
multi-equation approach, empirical modelling of energy demand 116–27
multiple energy services 100, 101, 117, 120–21
multiple products, and theoretical foundations of the rebound effect 185–90, 191, 192–3, 196
Musgrave, R. 411
mutual funds 429
Nakata, T. 752
Nakhle, C. 402, 408, 412
Nalebuff, B. 748
Narayan, P.K. 129–30
National Environmental Policy Act 1969 (NEPA) 450–51, 453
national models, applied energy–economy–environment modelling 369, 373
nationalization 74, 84
natural energy flow 651–3, 656
natural gas
and CO₂ emissions trading and convergence of electricity and transport markets in Australia 689, 698, 699, 700
and electricity security in large hydropower systems in Brazil 654, 660, 661
and history of energy 10, 11
substitution potential 443
and US economic policy 79, 80
see also efficiency measurement in electricity and gas distribution industries
natural gas CCS (carbon capture and sequestration) 689, 698, 699, 700
natural gas consumption 297–8, 299, 300, 306, 308
natural gas demand 760
natural gas derivatives 717, 718–19, 720–21, 722
natural gas CCS (carbon capture and sequestration) 689, 698, 699, 700
natural gas consumption 297–8, 299, 300, 306, 308
natural gas demand 760
natural gas derivatives 717, 718–19, 720–21,
see also incentive regulation of energy networks
natural gas markets 456–7, 458–63, 467–8
natural gas prices 79, 457
natural gas shortages 457
natural gas supply 760
natural resources 407
NDEX (National Commodity and Derivatives Exchange) 720–21, 727
negative cash flows, and resource rent tax 410–11
NEMS (National Energy Modeling System) 266–8, 273–4
neo-Keynesian economic theory 368–9
net economic benefit 23, 35–6, 37, 39, 44, 45
net effective cost of capacity (NEC), and investment decisions in energy supply 31
net present value (NPV)
life-cycle costs (LCC) approach to modelling energy savings 236, 237, 239, 253–4
and marginal cost and investment decisions in energy supply 30–31
and model of extraction of depletable resources 52, 58, 62
and scarcity rent 407
and social discount rate in cost–benefit analysis 24–5
Netherlands
coal industry 85
col production 445
electricity distribution regulation 532, 535
electricity transmission regulation 526, 529
and history of energy 4–5
market structure of electricity distribution industry 568–9, 572
market structure of electricity transmission industry 555–6, 560
wholesale electricity markets 627, 628, 646
see also ENDEX (European Energy Derivatives Exchange)
networks see energy networks; incentive regulation of energy networks; regulated energy networks
neutrality, and taxation 404, 405–6, 408, 410–11
New England 628, 631, 632, 635, 639, 643, 644, 645
New Jersey 669, 673, 681–2
see also PJM (Pennsylvania–New Jersey–Maryland)
new technologies
bottom-up energy models and macroeconomic hybridization 272
and CIMS 269, 270, 271, 318, 319, 320
and CO₂ abatement costs in electricity and transport markets in Australia 686
developing countries 743–5
and Energy 2.0 Society 766, 768
and ITC (induced technological change) policy models 311, 312–14, 315, 316
macroeconomic hybridization of top-down models with bottom-up characteristics 276, 277
and simulation models 268, 269, 270–71
and theoretical foundations of the rebound effect 167, 170–74, 178–9, 180
see also modelling energy savings and environmental benefits from energy policies and new technologies; technological change; individual technologies
new technology costs 270, 290, 312–13, 316, 319, 320
New York 628, 632, 634–5, 639, 644, 669, 671, 673, 674, 675, 676
New Zealand
competitive electricity retail pricing 667, 674, 679–80
electricity distribution regulation 533–4, 535
electricity transmission regulation 528, 530
market structure of electricity distribution industry 571, 573
market structure of electricity transmission industry 562, 564
merchant transmission investment of electricity transmission expansion 588
wholesale electricity markets 627, 628, 631, 645
Newbery, D.M. 14, 31, 40–41, 43–4, 590, 637
NGOs 766, 767–8
Ninomiya, Y. 130–31, 136
nitrogen oxide emissions 82, 444, 638
nodal prices 584, 587, 588, 591, 592, 628, 631
non-commercial energy 91, 740
non-commercial traders 428–9, 733–6, 737
non-constant costs, and model of extraction of depletable resources 60–61
non-depletable resources 51
non-frontier methods, and efficiency measurement 604–5, 609–11, 612–14, 616–17
Joanne Evans and Lester C. Hunt - 9781849801997
Downloaded from Elgar Online at 04/17/2019 02:20:47AM
via free access
non-MENA (Middle East–North Africa) oil production 422, 423, 438
non-Middle East oil supply 760
non-reporting traders 733–6, 737
non-stationarity, and empirical modelling
  energy demand 127–31
non-substitutability, and petroleum tax 408
Nord Pool
clearinghouse activities 725
described 556, 590, 638–9, 646
trading 552, 717, 718–19, 720, 725
Nordic countries 627, 638–9, 646, 667, 678, 679
see also Denmark; Finland; Nord Pool; Norway; Sweden
North Africa 3, 421, 422, 423
North America
derivatives markets 712
electricity distribution regulation 518–19, 528, 531, 535
electricity transmission regulation 518–23, 529, 669
energy consumption 16
market structure of electricity distribution industry 565–6, 572
market structure of electricity transmission industry 542, 544–7, 548
natural gas markets 456
oil industry in history of energy 9, 10
primary energy consumption 741
see also Canada; US
Norway
efficiency measurement in electricity and gas distribution industries 612–13
electricity distribution regulation 532, 535
electricity retail competition and pricing 678
electricity transmission regulation 526–7, 529
incentive regulation of electricity transmission and distribution 583
market structure of electricity distribution industry 569, 572
market structure of electricity transmission industry 556, 560
wholesale electricity markets 628
nuclear power 445, 689, 699, 700
nuclear power consumption 11, 297, 298, 299
nuclear power generation costs 305–6, 307, 309
nuclear power supply 305–6, 307, 308, 309
Nuclear Society 763, 764–5, 767, 768
nuclear waste 764–5, 768
NYMEX (New York Mercantile Exchange)
  price volatility 728–30, 731
  regulation 719, 730
  trading 717, 720, 724
  energy commodity options 718–19, 720, 722
  traders’ positions 733–7
  obligations, and derivative instruments 707, 709, 715
  observed cost, and hidden action game 476, 477, 478, 479, 480, 481
  obsolescence, and life-cycle costs approach to modelling energy savings 240, 241
OECD countries 136, 210, 213–15, 226, 273, 384, 562, 742
see also developed countries; individual countries
off-peak demand, and peak-load pricing 32, 33, 34
off-peak pricing 32, 33, 34
Ohio 669, 673, 675
oil 443, 654, 660
see also cost oil; crude oil; fuel oil futures contracts; furnace oil futures contracts; gasoil derivatives contracts; gasoline consumption; gasoline derivatives contracts; gasoline prices; heating oil derivatives contracts; kerosene futures contracts; petroleum banks; petroleum tax; profit oil
oil banks 428
oil companies 401, 411–17
oil consumption
  and asymmetric demand in empirical modelling of energy demand 131, 133, 135
  and history of energy 9, 11
  and UK MARKAL model 297, 298, 299, 300, 306, 308
oil demand 9, 131–7, 394–5, 422, 437–8, 760
oil disruption 394–7, 435
oil disruption risk 384, 385, 388–94, 422, 770–73
oil distribution companies 428
oil exploration 402
oil-exporting countries 384, 385–6, 387–8, 389–94, 396, 749, 750
see also Middle East; OPEC (Organization of Petroleum Exporting Countries); Saudi Arabia; individual countries
oil extraction 402
oil import control 74, 76, 77, 78–9
oil import premium 384–8
oil-importing developing countries 748, 749–50, 754
oil industry 74, 401, 402–3, 404
oil intensity 394
oil price changes
   and asymmetric demand in empirical modelling of energy demand 131–7
   and economic impact estimates 397
   and oil extraction activity 402
   and oil security 384, 385, 386, 387, 388, 394–7
   sudden and gradual 394–7
oil price shocks 9, 10, 11, 74–5, 77, 79, 107, 388, 394–7, 413, 435, 749, 750
   see also oil disruption; oil disruption risk
oil prices
   and cartels 76–7, 384, 443
   and coal production 85
   and CO2 emissions trading and convergence of electricity and transport markets in Australia 692
   and developing countries 749–50, 754
   and economic policy 75, 76, 79, 80
   and history of energy 8, 9
   and oil supply and demand 437–8
   see also crude oil prices; motor fuel prices; oil price changes; oil price shocks
oil-producing countries 405
   see also Middle East; North Africa; individual countries
oil production 9, 19, 67–70, 82–3, 403, 409–10, 437, 438
oil production companies 428
oil production control 77–8
oil production costs 422
oil refining, and valuing derivatives 712–14
oil resource ownership 404
oil resource recovery 401
oil security
   as an externality 383–6, 388
   and energy policy 759–61
   and history of energy 9, 10
   and oil disruption impacts 394–7
   and oil disruption risks 384, 385, 388–94, 770–73
   and oil import premium estimates 386–8
   and political unrest 384, 392, 393, 396, 422
   and theory of energy intervention 73–7
oil stockpiling 389–94, 435
oil supply
   and benchmark crude oil prices 422
cartels 76–7, 384, 443
concentration 760
and economic policy 73–7
and history of energy 9, 13, 760
and oil price shocks 394–5
and oil prices 437–8
see also oil disruption; oil disruption risk; oil security
oil supply companies 428
oil tax 79–80, 385
OLG (overlapping generation) models 369
oligopolies 41, 635
OLS estimation 128, 604, 605, 606
Oman heavy sour crude oil futures 420, 421, 423, 724, 728
OPEC (Organization of Petroleum Exporting Countries) 9, 56, 74, 76–7, 384, 387, 435, 759, 760, 771
open access transmission 544, 569, 678–9, 680
open access transmission tariff (OATT) 544, 546, 547
open access transportation 457, 461–2, 463, 466, 471, 472–3
open interest positions 733–6, 737
operating and maintenance costs
   and CIMS 318, 319
   and CPI-X incentive regulation 494
and efficiency measurement in electricity and gas distribution industries 613
and electricity distribution costs 510, 512–13
and electricity security in large hydropower systems in Brazil 660
and electricity transmission costs 501, 503, 504–5, 506–7
and electricity transmission expansion mechanisms 587
and life-cycle costs (LCC) approach to modelling energy savings 235–6
opportunism, and regulation in natural gas and electricity industries 459
opportunity cost bidding, and wholesale electricity markets 630–31
opportunity costs 407, 409, 630–31, 632, 638
optimization 43–5, 259–64, 279
see also MARKAL models; UK MARKAL model
options energy markets 707, 709–10, 718–21, 722–3
Oregon 674
organic energy economy 1–5
OTC (over-the-counter) transactions 706, 717
out-turn and incentive regulation of electricity transmission and distribution 583
Outhred, H. 559
output
   and CGE models 343, 344, 345
   and CO2 emissions trading and convergence of electricity and transport markets in Australia 689
   and economies of scale 474
   and economies of scope 474
and efficiency measurement 604, 605, 606, 607, 608, 609–10, 611–12, 615, 616
and electricity distribution costs 515, 518
and electricity transmission 509, 511
and electricity transmission costs 507
and energy efficiency in a stylised small open economy 144, 145, 146, 147–8, 149–50, 151–2, 153, 154, 155, 156–8, 159, 160, 162
and multi-equation approaches to modelling energy demand 118
and neoclassical growth theory 174, 175
and price-capping regulation 483, 484, 485–6 and production theory 600
and returns to scale 601
and revenue-capping regulation 487, 488, 489
and static model of firm’s energy demand 97, 98
output data, and MARKAL model 288, 290
output demand 217, 325
output price changes 181, 182, 183, 184–5, 187, 189, 217
output prices 154, 180, 181, 182, 183, 184–5, 186, 187
output quality variable 506, 514
over-the-counter (OTC) transactions 706, 717
overseas development aid (ODA) 753–4
own-price elasticity of aggregate energy demand, and rebound effect 218
own-price elasticity of energy demand 102, 113, 114, 115, 119
ownership 404, 412–17, 471–3
see also investor–owned utilities (IOUs); privatization; publicly owned utilities (POUs); transmission asset owners (TOs) in electricity transmission industry

Pachauri, S. 751, 752
Pacific Region 527–8, 530, 533–4, 535, 559, 561–3, 564, 570–71, 573
Paltsev, S. 333, 340, 361
panel data 606, 607–9, 615, 746–7
Pareto optimum, cost–benefit analysis and market structure 21, 22, 23
Parikh, J. 750–51
Park, S.-H. 754
payback period 220, 237, 238, 239, 241, 243, 253, 313, 316
peak demand, and peak-load pricing 32, 33, 34
peak load 502
peak-load pricing 32–4, 584, 666
peak oil 67–70
Pearce, D.W. 773–4, 782
Pearson, P.J.G. 8, 9, 16
peak 4–5
Pennsylvania 9, 544, 667, 672, 673, 675, 678, 681
see also PJM (Pennsylvania–New Jersey–Maryland)
pension funds 429
Perekhodtsev, D. 635, 638
performance-based regulation (PBR) see incentive regulation of electricity transmission and distribution; incentive regulation of energy networks
Persia 411–12
Persian Gulf countries 389–94
Persian Gulf War (1st) 397
personal technology 764, 766
personal transport 220–21
see also automobiles
Pesaran, M.H. 129, 130
petroleum banks 428
petroleum tax functions 401–2, 403–11
international petroleum fiscal regimes 411–17
objectives 401–2
Philippines 745–6
physical exhaustion, of depletable resources 55
physical measures, and rebound effect 204, 206
Pindyck, R.S. 59–60, 61, 456, 750
Pitt, M. 608, 614
pivotal supplier index (PSI) 635
pivotality, and wholesale electricity markets 635–6, 637
PJM (Pennsylvania–New Jersey–Maryland) 587, 626, 628, 629, 630, 634–6, 638, 643–4, 665–6
planning, in natural gas and electricity industries 460, 465
Plourde, A. 114, 131, 132, 133, 135, 136, 137
plug-in hybrid electric vehicles (PHEVs) 688, 693–4, 700, 701
point-to-point transmission (PTP) 586, 587, 592
Poland 445, 446, 447, 448
POLES 4 268–9, 277, 278
policy interventions 73
political instability and unrest 384, 392, 393, 396, 422, 740–41, 751
political theory, and energy policy 74–6
polls 69–70, 666, 667–8, 760, 768
Pollitt, M. 511, 607, 615–16
pollution-reduction allocations 82
pools, and wholesale electricity markets 626, 627, 628, 629, 631, 633
Popp, D.C. 376
population, and history of energy 2–3, 4, 16
Portugal 527, 529, 532–3, 535, 556–7, 560, 569, 572
poverty 783, 788
Powell, A. 41, 369
PowerNext 720–21, 726
present consumption, and social discount rate in cost–benefit analysis 25–6, 27
preset proxy rule, and electricity transmission expansion mechanisms 589–90
prevention of significant deterioration (PSD) 81, 82
price arbitrage 630
price cap indexes (PCIs) 518–19, 584, 591, 593
see also CPI (consumer price index); RPI (retail price index)
price-capping regulation
Australia 527–8, 529, 533, 535
and electricity security in large hydropower systems in Brazil 653, 655
and electricity transmission expansion mechanisms 584, 586, 591, 592–3
Europe 519, 525–6, 527, 529, 533, 535, 599
and hidden action game 477, 480, 481
implementation 492
and incentive regulation in electricity transmission and distribution 518–19
and incentive regulation of energy networks 482–6
and retail electricity industry 664, 681
and sliding scale regulation 490, 491
and wholesale electricity markets 630
X-factor setting, in CPI-X 493–4
price discovery 424–6, 707, 717
price elasticity of energy demand
and bottom-up energy models and macroeconomic hybridization 273, 274
and empirical modelling of consumer energy demand 126, 136
and energy demand theory 102, 103, 106–7
and energy efficiency in a stylised small open economy 160–61
and incentive regulation of electricity transmission expansion 585
and rebound effect 209, 210–11, 213, 216
and wholesale electricity markets 635
price elasticity of product demand 154–5
price information 242
price instruments 348–50, 354
price insurance 422–3
price makers, and crude oil futures markets 429
price regulation
and electricity industry 663, 664–6
and hidden action game 476, 477–8, 479, 480, 481
and market power in wholesale electricity markets 639
natural gas 79, 457
see also price-capping regulation; price instruments
price risk, and futures markets for crude oil 425
price risk insurance, futures markets for crude oil 424
price runs, and behaviour of crude oil futures markets 430, 432, 434
price takers, and crude oil futures markets 429
prices
and CGE models 343, 344, 345, 346
and competition in wholesale energy markets 41–2
and cost–benefit analysis 21–2, 23, 24, 29, 30, 31
and economic rent 407, 408
and electricity transmission expansion mechanisms 588
and empirical modelling of consumer energy demand 121, 122–3, 125–6
and model of extraction of depletable resources 52, 53–4, 55, 56–7, 58, 59, 60, 62, 63, 64, 65, 66, 67–8, 69, 70, 442–3
primary energy demands, and UK MARKAL model 297–8, 308
primary factors 334–5, 336, 337, 344, 354, 378
principal–agent regulation 475–82
see also hidden information
private oil stockpiling 384
privatization 84, 85, 753
probit models, energy savings and environmental benefits of new technologies 247–8, 251–2
process technologies 285, 286
producers 339, 384, 385
product differentiation, and electricity retail competition and pricing 682
production
and CGE models 333, 334, 335
and empirical modelling of energy demand 117–20
and energy efficiency in a stylised small open economy 144, 145, 146, 147, 148–9, 150, 151, 152–3, 154, 155–8, 159–60, 161, 162
energy network industry structures 471, 472, 473
International handbook on the economics of energy

and model of extraction of depletable resources 52, 55, 56, 58, 59, 60, 61, 62, 63–5, 67–8, 69
and modelling energy savings and environmental benefits of new technologies 254–5
and oil price changes and shocks 395–6
and rebound effect 200, 201, 202
theory 600–601
production costs 254–5, 325–6, 407, 409
production frontier, and efficiency in electricity and gas distribution industries 605
production function
and CGE models 339, 344–5
and climate change IA models 778, 779
and efficiency measurement in electricity and gas distribution industries 606
and energy–economy–environment modelling 371, 372
and neoclassical growth theory 174–5
and production theory 600, 601
and theoretical foundations of the rebound effect 164, 165, 181, 186, 191
and top-down energy–economy–environment modelling 370
see also CES (constant elasticity of substitution) production function;
Cobb–Douglas production function;
Leontief production function; trans-log function
production possibility frontier (PPF), and climate change IA models 779–80
production sharing contracts (PSCs) 414, 415–17
production split 415
production tax 452
productive efficiency, and incentive regulation of electricity transmission expansion 584
productivity
and energy–economy–environment modelling 375
and hidden action game 481–2
and price-capping regulation 485, 486, 494
and rebound effect 200, 206, 218
and revenue-capping regulation 487
and sliding scale regulation 489, 492
and technological change in developing countries 744–5
see also X-factors
profit maximization 339, 484, 486, 487, 488, 489, 585–6, 592–3, 771–2
profit oil 415, 416
profit-sharing, sliding scale regulation 490
profits
and access pricing problem 45, 46, 47, 48
and CGE models 334, 335, 339
and coal leasing in US 451, 452
and corporate income tax 411
and electricity transmission expansion mechanisms 585–6, 592–3
and energy efficiency in a stylised small open economy 145, 149–50, 156, 157, 162
and energy supply 771–2
and general equilibrium theory 192
and hidden action game 477, 478, 479, 480
and incentive regulation in energy networks implementation 492, 493
and incentive regulation of electricity transmission expansion 585–6
and model of extraction of depletable resources 52, 53, 55, 56, 58, 59, 61, 67, 442
and oil demand 437
and optimal degree of market entry, determinants 44, 45
and price-capping regulation 484, 485, 486, 492
and resource rent tax 410–11
and revenue-capping regulation 486, 487, 488, 489, 492
and sliding scale regulation 490, 493
and static model of firm’s energy demand 97
and theoretical foundations of the rebound effect 188, 189–90, 192, 194, 197
and X-factor 494, 495, 496
programmable thermostats (PTs) 249–52
property legislation 78
prudence reviews 523–5, 527, 529, 535
public choice 73
public energy monopolies 13–14
public goods 761, 762
public interest 73–7
public oil stockpiling 384
publicly owned utilities (POUs) 471, 472–3
publicly owned utilities (POUs) in electricity distribution industry 565, 566, 567, 568, 569, 570, 572
publicly owned utility (POU) in electricity transmission industry
described 471, 472–3, 541–2, 543
Europe 550, 551, 553, 554–5, 556, 558, 560
North America 545, 546–7, 548
Pacific Region 559, 561–2, 564
purchase costs 235, 236, 238, 240, 250, 254–5
pure time preference, and social discount rate in cost–benefit analysis 28, 782–3
put option prices 709, 710
put options 707
quadratic cost function, and efficiency measurement 609, 610, 614–15
quality, output variable 506, 514
quantity
and CGE models 333–4, 335, 338, 339, 345–6, 350–54
and cost–benefit analysis and market structure 21, 22, 23, 24
quasi-experimental approach, direct rebound effect 208–9
quasi-rent 408
quotas, and US energy policy 78
R-factors, and contractual petroleum fiscal regime 415, 416
r-percent rule 51, 53, 57, 442
Ramírez, J.C. 585
Ramsay, W. 744, 750
random demand, and simplified spot pricing model 34–9
rapid recovery of investment, North America 521, 529
rate-capping regulation, and electricity retail competition and pricing 671, 673
rate freezes
competitive electricity retail pricing 671, 673
Europe 532, 535
incentive regulation in electricity transmission and distribution 518
North America 518, 520, 522, 529, 531, 535, 565
rate-of-return regulation, and electricity industry 664, 666, 674
ratemaking regulation, electricity retailing and pricing 663, 664–6, 670
rationing, energy 653, 654, 655, 660
rationing constraint, in CGE models 350, 351–2, 353–4
R&D investment, and energy–economy–environment modelling 374–5, 376
re-dispatch, and wholesale electricity markets 628
real-time balancing markets, and wholesale electricity markets 625, 627, 628, 629, 630
real-time pricing, and incentive regulation of electricity transmission expansion 586
rebound effect
definitional issues 203–4
energy–economy–environment modelling 373
and energy efficiency in a stylised small open economy 149, 152–3, 154, 157, 160–61
nature, operation and importance 199–203
see also direct rebound effect; economy-wide rebound effect; indirect rebound effect; theoretical foundations of the rebound effect
recessions 9, 96–7, 388, 395
Reedman, L.J. 703
Reference Energy System (RES), and MARKAL model 285–7, 288
reference prices, and swap valuation 710, 711
refrigerators 246, 247–8
regional models, applied energy–economy–environment modelling 369
regional transmission organizations (RTOs) in electricity transmission industry 544–5, 674, 680
regulated energy networks 471, 472, 479–80
see also incentive regulation of energy networks
regulation
coal-mine health and safety in US 448–9
versus competition 473–5
and efficiency measurement in electricity and gas distribution industries 598–9, 607, 609, 615–19
electricity industry 458–61, 471–3, 521, 662, 663–6, 673, 674
and electricity retail competition and pricing 669–74
and electricity security in large hydropower systems in Brazil 654–5
and electricity transmission expansion mechanisms 589, 590
global energy markets 14, 16
and history of energy 14
induced technological change (ITC) policy models 314–15
international energy derivatives markets 719, 721, 730
versus markets 458–61
natural gas industry 79, 456–7, 458–61
principal–agent models 475–82
uncertainty for climate change policy 762
see also incentive regulation of energy networks; price regulation; regulation of electricity distribution industry; regulation of electricity transmission industry
regulation of electricity distribution industry
Europe 531–3, 535, 599
North America 528, 531, 535
Pacific Region 533–4, 535
types 515, 517–19
regulation of electricity transmission industry
Europe 519, 523–7, 529
North America 519–23, 529, 669
Pacific Region 527–8, 530
types 515, 517–19
regulatory asset base (RAB), and CPI-X incentive regulation 493–4
regulatory uncertainty, and climate change policy 762
reliability, of new technologies 240, 241, 242
renewable energy 15, 668, 682, 689, 694, 699, 765, 766
seen also geothermal power; hydropower;
solar energy; wind power
renewable energy consumption, and UK MARKAL model 298, 300, 301, 306, 308
renewable portfolio standard, and CGE models 350, 351, 352
repair costs 236, 242, 246
replacement of appliances, and life-cycle costs
approach to modelling energy savings 236
reputation, and floor traders' behaviour 427
reservation utility, and hidden action game 477, 478, 479, 480, 481–2
reservoir levels 651–3, 654, 655, 656–8, 660–61
residential sector see households
residual supplier index (RSI) 635
resource adequacy, in wholesale electricity markets 639–42
resource consumption 422
resource costs 452
resource finite stock, and model of extraction of depletable resources 52, 58, 61, 64, 68, 69, 70
resource heterogeneity, and model of extraction of depletable resources 60–61
resource remaining, and model of extraction of depletable resources 52, 53, 58, 59, 60–61, 63–4, 65
resource rent tax (RRT) 410–11
resource technologies 286
resources, and climate change IA models 778, 779, 780, 781
retail access 671–2, 673, 675–80, 681
retail electricity markets 465
seen also electricity retail competition and pricing
returns to scale (RTS) 119, 601–2
revealed preferences 321
revenue 22, 23, 476, 477, 478, 480, 587
revenue-capping regulation
electricity transmission and distribution industries 518, 519
energy networks 486–9
Europe 525, 526–7, 529, 531–2, 533, 535
and hidden action game 477, 481
implementation 492
retail electricity industry 664, 666
Ricardian rent 407–8
ring-fencing, and petroleum tax 413–14
Rippe, R.D. 739
risk 270, 311, 316, 325, 403, 711, 762, 770–73, 785–7
seen also risk aversion; risk-free interest rates;
risk mitigation; risk-service agreement;
risk-sharing; uncertainty
risk aversion 241, 477, 478, 480, 664, 682, 773
risk-free interest rates 709, 710
risk mitigation 706, 707, 717
risk-service agreement 414, 415, 416, 417
risk-sharing 405, 406, 408, 410
Rivers, N. 269, 321, 322, 324, 328, 376
Roberts, M.J. 602–3, 612
Robinson, S. 368–9
Rosellón, J. 585, 588, 589–90, 593, 594, 595, 596
Rothwell, G. 526, 533, 556, 567
Roy, J. 207, 745
royalties 409–10, 413, 415, 442, 451, 452
RPI (retail price index) 519, 527, 533, 599, 686
RPI-X incentive regulation seen price-capping regulation
RPIs (retail price indexes) 519
RS Means 504, 506, 512
Russia 69, 389–94, 445, 446, 448, 760
Rutherford, T.F. 277, 341, 346, 358, 361
Ryan, D.L. 114, 131, 132, 133, 135, 136, 137, 238–9, 249–52
Saeed, K. 752–3
safety and health 2, 10, 11, 13, 14, 448–9, 764
Salvanes, K.G. 511, 612–13
Samuelson, P. 145, 411
Sanstad, A.H. 316, 744–5
Sappington, D.E.M. 476, 481, 494, 495, 586
Sari, R. 746
Sartori, I. 220
Saudi Arabia 9, 75, 76, 389–94, 398
Saunders, H.D. 155, 174, 179, 180, 183, 194, 203, 229
savings 99, 100, 175, 192, 779, 780
scale economies seen economies of scale
scale efficiency 598, 601–3, 610–12
scarcity pricing, and wholesale electricity markets 644–5
scarcity rents 407, 408, 650, 651, 653
Schmalensee, R. 457, 476, 480, 489, 668
Schmidt, P. 208, 608, 614
Schneider, E. 261
Schrade, W.R. 460
Schulman, C.T. 136
Schulz, N.B. 741, 748–9
scope economies seen economies of scope
scope efficiency 614–15
scope inefficiency 598
Scotland 627, 638
seasonality 291, 293, 651–3, 654, 655, 656–8
second-generation models, and empirical
modelling of energy demand 114, 116
secondary effects, and rebound effect 202, 203,
215, 217–18
second markets, derivative instruments
706
sectors
and applied energy–economy–environment
modelling 369
and bottom-up energy models and
macroeconomic hybridization 273
and CGE models 335, 343, 351–2, 354, 355–8
and energy–economy–environment
modelling 373
and simulation models 265, 270
and technological change in developing
countries 744–5
and UK MARKAL model 290, 291, 293–4,
295, 296, 297, 300–303
security see electricity security in large
hydropower systems in Brazil; energy
security; food security; oil security; water
security
seemingly unrelated regression (SUR),
and efficiency in electricity and gas
distribution industries 605
self-fulfilling expectations, and behaviour of
crude oil futures markets 433–4
sensitivity analysis 238–9, 240, 291, 292
sequential clearing, and wholesale electricity
markets 632
service price index for capital 505–6, 514
services sector 95, 96
SFA (stochastic frontier analysis), and
efficiency in electricity and gas
distribution industries 605, 606–11, 614, 615–16, 617, 618, 619
SFE (Sydney Futures Exchange) 715, 718–19,
725–6
shadow prices 52–3, 54, 59, 487
SHFE (Shanghai Futures Exchange) 720–21,
726–7
Shin, Y. 129
Shleifer, A. 480
short position holders 733–7
short-run congestion, and incentive regulation
of electricity transmission expansion 584
short-run cost function, and efficiency in
electricity and gas distribution industries
612–13
short-run energy demand, and early
approaches to modelling of energy
demand 114
short-run marginal costs (SRMCs) 29, 30, 31,
33, 34, 36, 38, 687
short-run price elasticity of energy demand
106–7
short-run production constraints, and model
of extraction of depletable resources 62,
63–5
short-run rent 408
short-time periods, and electricity transmission
expansion mechanisms 585, 586, 587, 588
Shukla, V. 750–51
Sibley, D. 586
Sickles, R.E. 608, 614
Siddayao, C.M. 753
Silk, J.I. 128, 129
simplicity, as tax principle 405–6
simulation models 264–71, 279, 369–70
Sing, M. 511, 615
single equation approach, modelling of energy
demand 102–3, 104–5, 113–16, 131–6,
137
single-price wholesale electricity markets 628,
629, 631, 634, 637
SIPs 81
Skerk, C.J. 583
'slack' variable, and neo-Keynesian economic
theory 368
sliding scale regulation, and energy networks
489–92, 493
Small, K.A. 105, 211, 212–13, 216
Smyth, R. 129–30
social acceptability, and Maslow's pyramid of
human needs 761
social accounting matrix (SAM), in CGE
models 336–7, 338, 343, 357–8
social cost of abatement 762
social cost of carbon 773–8
social development 740, 750–52
social discount rate (SDR) 24–9, 312, 773–4,
780, 781–9
social opportunity cost of capital (SOC) 25,
28, 29
social time preference rate (STP) 25, 28, 29,
292, 782–3, 784–7
social welfare see welfare
socioeconomic factors, and modelling energy
savings and environmental benefits of new
technologies 241, 242, 243, 244, 246, 247,
248, 251, 253
solar energy 1–2, 4, 15, 445, 689
solid fuels 444
see also biomass; coal; peat; woodfuel
Solow, R. 174–5, 179
Sommerville, M. 208, 213
Soros, G. 420
Sorrell, S. 144, 147, 173, 174, 179, 193–4, 203, 208, 209, 211, 213–14, 215, 228, 235, 373
South Africa 445, 446, 447, 448
South America 667, 741
South Korea 744–5
Soviet Union 445, 446
see also Caspian States; Russia
Soytas, U. 745, 746
space cooling 213, 214, 215, 244, 248, 249–52, 444
space heating
and fossil fuels 444
and history of energy 2, 4, 5, 6, 7–8, 9, 10, 12
and modelling energy savings and environmental benefits of new technologies 244, 248, 249–52
and non-commercial fuels in developing countries 740
and rebound effect 208, 213, 214, 215, 220–21
Spain
coal production 445
competitive electricity retail pricing 667
electricity distribution regulation 533, 535
electricity transmission regulation 527, 529
market structure of electricity distribution industry 569, 572
market structure of electricity transmission industry 557–8, 560
wholesale electricity markets 627, 628, 631, 634, 638, 641, 642
spark spread, and futures valuation 711
special petroleum tax 413
speculators 425
spot markets 456, 461, 463, 467, 655
spot prices 32–9, 462, 463, 467, 654–5, 707, 708–9
Spreng, D. 752
Spulber, D.F. 83, 462
Sravat, A.K. 753
stability, as tax principle 405, 406, 408
stakeholders 767
Standard Oil 9
market structure of electricity transmission industry 558, 560
rebound effect 220–21, 222
wholesale electricity markets 628
Sweeney, J.L. 218, 624, 666, 673
switching electricity suppliers 671–2, 675–80, 681
Switzerland 611–12, 613–14, 615, 616–19
system boundary, and economy-wide rebound effect 200, 204, 205
Tanaka, M. 591
tariffs 78–9, 544, 546, 547, 771–3
tax revenues 404–5
taxes
and CGE models 333, 334, 346, 348–50, 351, 354–5, 357–8, 359, 360, 361
and coal protectionism 85–6
and induced technological change (ITC) policy models 314–15
instruments 409–11
and macroeconomic hybridization of top-down models with bottom-up characteristics 277
principles 404–6
see also ad valorem tax; Brown tax; carbon tax; corporate income tax; electricity sales tax; energy tax; GHG emissions tax; minerals tax; oil tax; production tax; resource rent tax (RRT); special petroleum tax; subsidies; tariffs; tax relief; tax revenues
technical efficiency 145, 598, 613
technical inefficiency 145, 604
technological change
and asymmetric demand responses to price changes in empirical modelling of energy demand 136
and competitive electricity retail pricing 668–9
and electricity prices 663
and energy–economy–environment modelling 371, 374
and induced technological change (ITC) policy models 313–14, 315, 316
and long run energy demand 92, 93, 95–6, 107
macroeconomic hybridization of top-down models with bottom-up characteristics 277
and MARKAL–MACRO 289
and model of extraction of depletable resources 55, 63, 65, 66, 69, 70
and optimization models 260
and rebound effect 165, 204, 206, 211
and technology transfer and diffusion in developing countries 743–4
types 375–6
and UK MARKAL 294, 306, 307
see also new technologies; individual technologies
technological leapfrogging 743
technology
and bottom-up energy models and macroeconomic hybridization 274–5
and CIMS 269, 270, 319–20
and history of energy 2, 3, 6–7, 10–11
and ITC (induced technological change) policy models 311, 312
and macroeconomic hybridization of top-down models with bottom-up characteristics 277, 278
and optimization models 264
and simulation models 265, 266
technology input data, and MARKAL model 287, 288, 290, 291, 293, 296
technology policies 277
technology transfer 743–5
Templet, P.H. 749
terrorism 385, 396
Texas 635–6, 637, 645, 670–71, 673, 674, 675, 676
Thailand 745–6
Tharakan, P.J. 753–4
theoretical foundations of the rebound effect
cautions and limitations 194–5
dual view 180–83
economic conclusions 195–6
energy–economy interactions, simplified model 164–7, 168–70
energy–economy interactions, time dynamics 174–80
energy–economy interactions with new technology 167, 170–74, 178–9, 180
and energy policy 166, 167, 168–70, 173, 178, 195, 196–7
general equilibrium 190–93, 196
measuring rebound 193–4
multiple products and consumer preferences 185–90, 191, 192–3, 196, 197
output versus income 183–5
theory of energy economics
access pricing problem 45–8
competition in wholesale energy markets 39–44
cost–benefit analysis and market structure 21–4
energy market architecture 39, 40
marginal cost and investment decisions in energy supply 29–32
optimal degree of market entry, determinants 44–5
peak-load pricing 32–4
simplified spot pricing with and without random demand 34–9
social discount rate in cost–benefit analysis 24–9
thermal insulation 201, 216
thermal power plants 653, 655, 656, 660
thermodynamic measures, and rebound effect 204–5, 206, 208
thermodynamics, laws of 378
third-generation models, of energy demand 114, 116
third party access (TPA)
and electricity retail competition and pricing 669–70, 680
and electricity transmission expansion mechanisms 590
in electricity transmission industry 547, 548, 549, 550, 551, 553–4, 555–6, 557–8, 562–3
thresholds rate, and resource rent tax 410–11
time
and applied energy–economy–environment modelling 369–70
and CGE models 345–6, 369
coal leasing in US 451–2
and efficiency measurement in electricity and gas distribution industries 611, 612–14
and electricity transmission expansion mechanisms 584, 585, 586, 587–90, 591–3
and energy–economy–environment modelling 371, 374
and model of extraction of depletable resources 52, 53, 54, 55, 57, 58, 59–61
and multi-equation approaches to modelling energy demand 118
and rebound effect 200, 204, 205, 206–7, 209, 211, 212–13, 216
and theoretical foundations of the rebound effect 174–80, 190–91
and valuing derivative instruments 708, 709, 710
time-of-use pricing 666, 682
time series 127–31, 136, 370, 431–4
TIMES (integrated MARKAL–EFOM system) 263–4
Tirole, J. 47–8, 463, 476, 489, 490, 582, 583, 584, 588, 680
Tjøtta, S. 511, 612–13
TOCOM (Tokyo Commodities Exchange) 716, 717, 718–19, 721, 724–5
Toman, M.A. 58, 383, 386, 388, 771–3, 778, 780, 781
top-down and bottom-up hybrid energy–economy models 276–80, 316–17, 370
see also CIMS
top-down models 117–20, 312–15, 370, 376, 377
total factor productivity, and energy-efficiency improvements 204, 206
total final consumption (TFC) 90, 91
total primary energy consumption 741, 747
total primary energy requirement (TPER) 90, 91
town gas 9
trade see international trade
traders 426–8, 433, 730, 733–7
transaction costs 430, 676–7
transcos see independent transmission companies (ITCs) in electricity transmission industry
transformation function, and production theory 600–601
transition, energy markets 671, 675, 748–9
transition, electricity industry see electricity transmission industry
transmission and distribution companies (T&Ds) in electricity distribution industry 547, 548, 566
transmission asset owners (TOs) in electricity transmission industry 542, 544, 545, 546
transparency, as tax principle 405
transport
and history of energy 4, 6, 7, 9, 10
and UK MARKAL model 291, 292, 294, 297, 300, 302–3, 308
see also airline industry; automobiles;
carbon dioxide emissions trading and convergence of electricity and transport markets in Australia; motor fuels
transport costs 421, 686, 689, 694
transport demand 689, 693
transport policies 764
trilateral market coupling (TMC), and electricity transmission expansion mechanisms 590
true random effects (TRE), and efficiency in electricity and gas distribution industries 606, 608–9, 614
Turner, K. 162
Twelemaann, S. 553
UK
benchmarking and regulation in electricity distribution sector 615–16
coal industry 5–7, 445, 446–7
coal international trade 447
coal production 84, 85, 445
competitive electricity retail pricing 667, 670, 674, 678, 679, 680
cost–benefit analysis in energy supply 25, 28, 29, 31
electricity industry 29, 31, 39–41, 43–4
electricity industry regulation 664
electricity markets 458
energy market liberalization and history of energy 14
energy policy 76
energy prices in history of energy 5, 6, 7, 8
incentive regulation in electricity transmission and distribution industries 519
natural gas markets 463
oil consumption 131, 133
oil prices 131, 132
petroleum tax 405, 411
rebound effect 201, 223, 224, 225
social discount rate in cost–benefit analysis 25, 28
wholesale electricity markets 627, 628, 631, 634, 637, 639, 645
see also England and Wales; Scotland; UK MARKAL model
UK Energy Research Centre (UKERC) 293, 308
UK MARKAL model
development 289–95
indicative findings 295–307
abatement costs 304–5, 306, 307, 308
electricity generation mix 298–300, 301, 305–6, 308, 309
primary energy demands 297–8, 308
sectoral insights 300–303, 308
uncertainty analysis 305–7, 308, 309
unbundling in electricity transmission industry
Europe 547, 549–51, 552–3, 554, 555, 556–7, 558, 560, 566–7, 568, 569, 570, 572
North America 544, 547, 566, 572
Pacific Region 562, 563, 564
uncertainty
and CGE models 362–3
and CIMS 325, 326–7, 328
and climate change policy 762
defined 787
and economies of scale in natural gas and electricity industries 459
and electricity transmission expansion mechanisms 588
and floor traders’ attributes 427
and life-cycle costs approach (LCC) to modelling energy savings 237–9, 240
and MARKAL model 261, 288
and model of extraction of depletable resources 62–3, 65
and modelling energy savings and environmental benefits of new technologies 242
and oil disruption risk 388
and oil industry 403
and spot pricing, simplified model 36–7, 38–9
and Stern Review 785, 787–9
and UK MARKAL model 305–7, 308, 309
see also certainty; informational uncertainty; risk
unemployment 388
unit commitment costs, and wholesale electricity markets 626–7, 632–3, 637
United Nations Framework Convention on Climate Change (UNFCCC) 14
uplift management rule, and incentive regulation of electricity transmission expansion 583
uplift payments, and wholesale electricity markets 626, 633
uranium supply 299, 305
Urban, F. 754
urbanization 4, 95, 750–51
US
CAFE 80, 84, 212
CGE model of carbon dioxide emissions abatement 354–63
coil industry 8, 90, 445, 446–7
coil international trade 447, 448
coil leasing and fear of windfall profits in 450–53
crude oil futures markets 420–21, 423, 432, 435–6
derivatives markets 705, 714–15, 716
see also NYMEX (New York Mercantile Exchange)
efficiency measurement in electricity and gas distribution industries 614–15
electricity demand 667, 668, 670–71, 672, 673–8, 680, 681–2
cross-subsidization, electricity industry 668, 669
crude oil futures markets 420–21, 423, 432, 435–6
derivatives markets 705, 714–15, 716
see also NYMEX (New York Mercantile Exchange)
efficiency measurement in electricity and gas distribution industries 614–15
electricity demand 667, 668, 676
electricity distribution costs 511–15, 516, 517, 518
electricity distribution regulation 528, 531, 535
electricity industry regulation 460, 521, 544–5, 664, 665–6, 668
electricity markets 457, 458, 463–6
electricity transmission costs 501–9, 510, 511

electricity transmission regulation 519–21, 529, 669

energy policy 73–4, 75, 76, 77–81, 760–61

environmental policy 81–2

gasoline consumption 104–5, 107, 108

gasoline prices 104, 105, 107, 108

Kyoto Protocol and GHG emission abatement costs 314

land disturbance legislation 449

lighting energy efficiency 240–41

market structure of electricity distribution industry 565, 572

market structure of electricity transmission industry 542, 544–5

merchant transmission investment of electricity transmission expansion 587–8

modelling energy savings and environmental benefits of new technologies 244, 247

natural gas industry regulation 456–7, 460

natural gas markets 457, 461–2, 463, 466–7

NEMS (National Energy Modeling System) 266–8, 273–4

oil consumption 131, 133

oil import premium 386–8

oil industry 9

oil prices 57, 131, 132, 135

oil production 68

petroleum fiscal regime 411

rebound effect 211, 212–13, 214, 218–19

stock market crash 430


woodfuel 90

useful work 206–7, 208, 209, 210, 214, 215, 216, 377, 378

see also effort; elasticity of useful work demand

user costs 100, 107, 407

utility function

and CGE models 335, 338, 340, 341, 342, 351, 354, 369

and CIMS 321–2

and climate change IA models 778, 779, 780

and dynamic model of household’s energy demand 99, 100, 104

and empirical modelling of consumer energy demand 120–21, 122

and theoretical foundations of the rebound effect 191

utility maximization 99, 104, 338, 369, 477, 478

value in use, and benchmark crude oil prices 422

value of lost load 35, 36–7, 38, 640, 650, 651, 653, 655

valuing derivative instruments 708–14

tandem Bergh, J.C.J.M. 377

tan Dender, K. 105, 211, 212–13, 216

tan Zanden, J.L. 4

variable charges, and incentive regulation of electricity transmission expansion 584, 585–6, 592, 593

variable returns to scale (VRS), and efficiency in electricity and gas distribution industries 617

vector autoregressive (VAR) system, and non-stationarity in modelling energy demand 128–9

vehicles 688, 693–4, 700, 701

see also automobiles

Venezuela 75, 78

venture capitalists 766, 767, 768

vertically integrated utilities (VIUs) in electricity distribution industry 565, 566, 567, 571, 572, 573

vertically integrated utilities (VIUs) in electricity transmission industry described 471, 472, 541–2, 543

Europe 553

and incentive regulation of electricity transmission expansion 584

Japan 562, 563, 564

North America 501–2, 544, 546, 547, 548

Vickers, J. 46–7, 48

Virginia 675

Vogelsang, I. 493, 536, 582, 583, 584–5, 586, 592, 595, 596

voltage of receipts and deliveries, and electricity transmission costs 502

wages 175, 178, 276, 368

Walls, W.D. 456, 457, 460, 462, 463, 464, 465

Walrasian general equilibrium, and CGE models 334–5, 341, 368

wars 385, 392, 393, 396

wasting machines 213, 214, 235, 244, 245, 246, 247

water availability 651–3, 654, 655, 656–8, 660–61

water heating 213, 250

water power see hydropower

water security 765, 768

Watkins, C. 408, 411

wealth 401, 783, 788

weather 101, 123, 127–8

Weber, M. 759, 768
weighted average cost of capital, and CPI-X
incentive regulation 494
Weigt, H. 593, 594, 639
Weitzman, M.L. 773, 775–8, 784–9
welfare
and carbon permits versus carbon tax 776–8
and CGE models 350, 354, 361, 369
and climate change IA models 778, 779, 780,
781
and cost–benefit analysis and market
structure 23, 24
and electricity transmission expansion
mechanisms 583, 589, 590
and energy–economy–environment
modelling 372, 374
and energy efficiency in a stylised small open
economy 145, 146–7, 148
and general equilibrium theory 192
and oil security 388
and social discount rate in cost–benefit
analysis 25–6, 27, 28, 29
and Stern Review 25, 28, 781–9
and theoretical foundations of the rebound
effect 192, 195
West Texas Intermediate (WTI) 420, 421, 423,
435–6
Weyant, J. 314
Weyman-Jones, T. 497
wholesale electricity markets
and ancillary services 627–8, 632, 678
capacity markets 642–5
competition 39–41
design elements and flaws 625–33
electricity prices 627, 628, 629, 630, 631,
632–3, 635, 636, 642–3, 665–6
and generators’ market power 631, 633–9
and hydropower in Brazil 653–4, 659–60
market monitoring 639, 645–6
operation 464–6
resource adequacy and capacity mechanisms
639–42, 643
wholesale energy markets 39–44
willingness to pay 21, 23, 421
willingness to supply 421
wind power 3, 4, 445, 689
Wolak, F.A. 39, 595, 635, 637, 638, 645, 666
Wolde-Rufael, Y. 747
Wolfram, C. 637
woodfuel 2, 4, 5–6, 7, 11–12, 90, 740
work 206–7, 208, 209, 210, 214, 215, 216, 377,
378
see also effort; elasticity of useful work
demand
WTI crude oil derivatives 420–21, 423, 434,
717, 718–19, 720, 723, 727, 728, 729
X-efficiency 485, 486
X-factors
defined 494–6
and efficiency measurement in electricity and
gas distribution industries 611, 615–16
and electricity revenue-capping regulation
664
Europe 519, 525, 526, 527–8, 531–2, 533, 599
and incentive regulation in electricity
transmission and distribution 518, 519,
599
and price-capping regulation 485, 486, 492,
493–4
and revenue-capping regulation 486, 487,
492
and sliding scale regulation 493
X-inefficiency 485, 598, 604
yardstick competition 480–81
Yergin, D.H. 9
Young, D. 244–6, 247–8
Zellner technique, efficiency measurement in
electricity and gas distribution industries
605
zero-emissions technology 313–14, 316
zero net savings, and rebound effect 200
zero profits
and CGE models 335, 336, 337, 339, 340,
341, 342, 343, 351, 352, 353
and revenue-capping regulation 488
and X-factor (productivity offset) 495
Zilberfarb, B. 747–8
zonal wholesale electricity markets 628, 631,
634