
Index

- AAPG. See American Association of Petroleum Geologists
- abandonment pressures, 73-75, 93, 228
- abiogenic gas. See "deep source gas"
- acidizing, 74
- Alabama, 8, 59, 133, 207, 219
- Alaska, 7, 17, 26, 43, 53, 66, 106, 114-115
- Alaskan Natural Gas Transportation System, 112, 114-115
- Alaskan Natural Gas Transportation Act of 1976, 114
- American Association of Petroleum Geologists, 62
- American Gas Association, 9
- addition to reserves and, 24, 54, 83
- conventional/unconventional boundary and, 140
- decline in RIP and, 95
- economic incentives to recovery and, 66-69
- extensions and new discoveries and, 88-91
- import estimate, 113, 115
- production estimate, 106-107
- tight gas estimate, 169-171
- Anadarko Basin, 22, 45, 57, 65-66, 76, 88, 168
- anaerobic process, 29, 242
- ANGTS. See Alaskan Natural Gas Transportation System
- anticline, 30, 242
- Antrim shale, 183
- Appalachian Basin, 57, 149
- coal seam methane in, 207, 211
- Devonian shales in, 8, 129, 132, 179-181, 183, 185-186, 190-203
- undiscovered resources in, 59
- aquifers, geopressurized, 6, 26, 121
- Arkansas, 59, 88, 168
- Arkoma Basin, 168, 211
- Atlantic shelf, 46
- Austin Chalk, 88
- availability, natural gas. See supply, natural gas
- Baltimore Canyon, 22, 53, 76
- Big Sandy Field, 129
- biogenic gas, 29-30, 147-149
- biomass, 26
- bituminous coal, 218-219
- Black Warrior Basin, 8, 136, 149, 207, 219, 221
- Blanco Basin, 73
- blanket formations, 125, 141-142, 151, 153, 230, 242
- Border Gas, 112
- borehole shooting, 200, 242
- Bromberg/Hartigan, 19-20, 49, 61
- "bubble" of gas, 3, 17, 25
- California, 53, 57, 114
- Canada, 7, 17, 26, 106, 111, 113-115
- carbon dioxide, liquid, 188-189
- Carnegie Natural Gas Co., 207
- "Circular 725," 47, 54
- "Circular 860," 47, 50, 54
- "cleat," 134, 207, 212, 215-216, 242
- coal seam methane
- defined, 6, 133, 207
- estimate uncertainties, 7-9, 134-136, 211-212
- FERC estimate, 135, 210
- in-place estimates, 134-135, 209-212
- NPC projections, 3, 209-210, 217-219, 221-222
- production, 7, 207, 212-224
- as recoverable resource, 3, 5, 7-10, 26, 29, 121-122, 133-136, 210-212, 217-221
- regions, 208
- Colorado, 139, 233
- Colorado School of Mines, 51
- conservation, 3, 94, 112
- Consolidated Coal Co., 215
- conventional gas. See *also* proved reserves; recoverable resources; reserves; resources
- defined, 5
- parameters of supply estimate, 5, 50
- production cycles, 20
- resource estimates of, 5-9, 19
- unconventional boundary, 140
- year 2000 production, 6-7, 18
- Corcoran Cozette, 148
- data availability, 18
- decontrol, iii, 9, 75
- "deep source gas," 6, 29, 43, 53, 60, 66, 75-76, 121
- deliveries, curtailment of, 3
- Delphi approach, 42-43, 48, 50, 192, 196
- Delta provinces, 71
- demand for gas
- exploration and, 5, 17, 45
- production and, 5-6, 17, 94
- Denver Basin, 71, 76, 126, 144, 147-148, 157
- depletion, 39, 41, 69, 105
- desorption, 212-213
- Deul and Kim, 135, 210
- development strategy, 5
- Devonian shales
- in Appalachian Basin, 8, 129, 132, 179-181, 183, 185-186, 190-203
- areas found, 8, 129, 132, 179-187, **90**
- defined, 6, 128, 179-182
- development problems, 122, 130

- FERC estimate, 182
 in-place resource, 182-186, 190
 NPC projections, 3, 131, 182-183, 186, 191, 194-196, 199-203
 OTA assessment (1977), 192
 production from, 7, 181-182, 190-203
 as recoverable resource, 5-6, 8-10, 26, 121-122, 128-133, 190-201
 resource estimates, 131-133, 182-183, 186, 190-201
 dewatering systems, 10, 212-214
 discovery, natural gas
 demand and, 5, 17, 45
 estimate of prospects, 17-18, 39
 extrapolation from past trends, 21, 23-24, 43-45, 66, 88
 inadequate indicators for, 23
 new field, 24-25, 45-46, 61-64, 81-90, 98-99, 105
 technical prospects for, 5, 45
 double counting, 167, 236-241
 Drew, L. J., 71
 drilling, 5, 24. See *also* infill drilling
 advances in deep, 22
 costs, 22, 66-67, 76, 94, 215
 deviated, 189, 242
 directional, 189
 exploratory, 33-34, 44, 46, 54, 73
 improved technology, 10, 83
 low- v. high-risk, 62, 68
 NPGA and, 66
 success rates, 68-69

 East Anschutz Ranch, 66
 Eastern Gas Shales Project, 135, 182, 186, 197
 Eastern Overthrust Belt, 7
 economic conditions, natural gas and, 20, 24, 41, 45, 66-67
Effects of Decontrol on Old Gas Recovery, iii
 EIA. See Energy Information Administration
 Electric Power Research Institute, 3
 Ellsworth shale, 183
 energy conservation. See conservation
 Energy Information Administration, 10, 24, 34, 88-90, 95, 107
 "Enhanced Recovery of Unconventional Gas," 193
 environmental constraints, 223
 Equitable Gas Co., 207
 exploration, natural gas, 69
 basic techniques, 33-34
 evolution of technology, 17, 20, 82-83
 high-risk, 62, 67-68
 history of, 57
 unconventional gas, 130-131, 156, 189-190

 Export Administration Act of 1979, 114
 "extensions," 23-24, 34, 65, 75, 81, 86-90, 98-102, 242
 Exxon, 49, 60, 76, 107

 Federal Energy Regulatory Commission, 121-122
 coal seam methane estimate, 135, 210
 Devonian shale estimate, 182
 tight gas estimate, 123-124, 126, 139-140, 142-144, 166, 236
 Federal Power Commission, 66, 121, 126, 142-144
 foamed fluids, 188
 FERC. See Federal Energy Regulatory Commission
 Fletcher Field, 94
 Florida, 59
 Fort Union, 148
 fracturing, 74, 94
 coal seam methane, 216-217
 Devonian shales, 130, 187-189
 technologies, 229-235
 tight gas, 8-10, 125, 127, 139, 149-154, 163-165

 Garrett, R. W., 49
 gasfields
 field size, 42, 62-65, 69-73
 new discoveries, 24-25, 45-46, 61-64, 81-90, 98-99, 105
 new gas from older, 7, 21-22, 24, 46, 66, 73-75, 227-228
 role of small, 7, 21, 53, 66, 69-73, 84
 gas hydrates, 6, 121
 Gas Research Institute, 9
 coal seam methane estimate, 135-136, 209-210, 215, 217, 219, 222-223
 mineback experiments, 233
 tight gas estimate, 127, 156-158, 160-164, 166, 169-172, 174
 Georges Bank, 7, 22
 Gold, Thomas, 29
 "growth factor" projections, 98-102
 Gulf of Alaska, 46, 53, 76
 Gulf of Mexico, 7, 22, 53, 57, 59-60, 71, 76, 84, 95

 history-based estimates, 43-46, 52-56, 60-61, 66, 99, 203
 Hubbert, M. King
 methodology of, 54-56, 60-61, 81-82, 103-104
 OTA assessment of estimate, 77, 105
 resource estimate, 19-20, 39, 41, 43, 47, 49, 65
 Hugoton field, 62, 65, 73, 95
 Huron Intervals, 197-198
 hydrates, gas, 6, 121
 hydrocarbons, liquid, 29-30

- IGT estimate, 49
 Illinois, 114, 129, 179, 211
 imports, 7, 26, 39, 111-116
 infill drilling, 73-75, 93, 228, 242

 Jensen Associates, Inc., 99

 Kansas, 57, 59, 65, 73, 95
 Kentucky, 129, 192-193, 197, 199
 Kuuskraa and Meyer (KM), 133, 135, 209-210, 217-219, 221

 leases, 46, 83, 123, 190, 201-202
 legal constraints, 3, 222-223
 lenses, 8, 10, 125, 242
 lenticular formations
 defined, 125, 142, 242
 gas recovery from, 127, 148, 151, 154, 156, 162, 172, 175, 230
 Lewin & Associates
 coal seam methane estimates, 219
 Devonian shale estimates, 131-134, 182-183, 191-194, 197-203
 Mexican gas and, 113-114,
 tight gas estimates, 126-127, 142, 144-145, 157-159, 161-162, 165, 168-170, 172-174
 unconventional resource estimates, 121
 limestone formations, 6, 121, 123, 139, 141, 183
 liquefied natural gas, 7, 17, 26, 106, 112, 115-116
 LNG. See liquefied natural gas
 logging, 9
 Louisiana, 59, 65, 84, 88, 91, 95
 Lower Cretaceous-Jurassic, 148
 low-permeability reservoirs, 6, 18, 25, 121, 123-124, 139

 McKelvey Box, 40-41, 45
 Mesaverde, 148
 methane. See coal seam methane
 Methane Recovery From Coalbeds Project, 135, 211-212, 221
 Methanol, 115
 Mexico, 7, 17, 26, 106, 111-113
 Michigan, 129, 179, 183
 Mineral Leasing Act, 223
 mine safety, 8
 Mississippi, 59
 Mobil Corp., 49
 models, 81
 Monsanto Corp., 131, 196
 Monte Carlo simulation, 47-48, 184
 Morgantown Energy Technology Center, 192
 Mound Facility, 131, 182, 185-186, 190-191, 196-197
 Multiwell Experiment, 163, 233

 National Academy of Science, 121, 135
 National Energy Board, 111, 113
 National Energy Plan (Canada), 113-114
 National Gas Survey, 121, 142
 National Petroleum Council
 coal seam methane estimates, 3, 209-210, 217-219, 221-222
 Devonian shale estimates, 3, 131-136, 142, 144-149, 182-183, 186, 191, 194-196, 199-203
 tight gas estimates, 3, 124, 126-128, 142, 144-149, 154, 157-175, 236-241
 unconventional gas estimates, 3, 121
 natural gas basics
 defined, 29
 how formed, 29-31
 nonassociated, 30
 where found, 30-31
 Natural Gas Policy Act of 1978, 22, 66, 74-76, 121-123, 139, 227-228
 Nehring, Richard, 52-54, 58, 60, 71, 77
 New Albany shale, 183
 New Mexico, 8, 65, 133, 207
 "new pool discoveries," 23-24, 34, 65, 81, 86-90, 98-102
 NGPA. See Natural Gas Policy Act of 1978
 nitrogen foam, 188, 216
 Northern Great Plains, 165-166
 tight gas and, 8, 126-127, 140, 147-150, 157, 161, 165-166, 168-169, 172-175
 North Slope gas, 112, 114-115
 NPC. See National Petroleum Council

 offshore natural gas, 8, 25, 46, 50, 57, 60
 Ohio, 57, 132-133, 189, 192, 197-200, 203
 Oklahoma, 59, 65, 73, 94, 168
 onshore deep gas, 7-8
 Outerbanks, California, 53
 Outer Continental Shelf, 66
 Overthrust Belt, 53, 57, 65-66. See a/so Eastern Overthrust Belt; Western Overthrust Belt

 Pennsylvania, 207
 Pennsylvania Supreme Court, 223
 permeability, 6, 30, 94, 145
 Permian Basin, 22, 71, 73, 76, 88
 PGC. See Potential Gas Committee
 Piceance Basin, 126, 144, 146-147, 157, 211, 233
 pipeline imports, 7, 17-18, 26, 39, 112
 policy, energy, 9-10
 policy, natural gas, 9-10, 66
 Potential Gas Committee
 Devonian shales and, 52
 OTA assessment of estimate, 77, 82
 production estimate, 103-106

- resource estimate, 3, 5, 17, 19, 39-40, 49-52, 58-60, 65, 100
- tight gas estimate, 236-241
- unconventional gas estimate, 122, 124, 167-168
- Potential supply of Natural Gas in the United States*, 236
- Powder River Basin, 76
- Powerplant and Industrial Fuel Use Act of 1978, iii, 3
- prices
- controlled, 22, 67, 74, 76
 - conventional gas, 5-6
 - declining, 3, 22, 66
 - and economics of recoverability, 3, 5, 9, 17, 41, 45, 66-67, 73-76, 83, 163, 193-194, 201
 - increased gas, 3, 9
 - market level, 9, 75
 - pressures to decontrol, iii, 9, 75
 - technology development and, s, 9
 - tight gas and, 8
 - unconventional gas and, 5, 7-8, 121, 139, 163, 193-194, 201
 - wellhead, 5, 17, 26
- probabilistic estimates, 46-48, 52
- production, natural gas. *See also* coal seam methane; Devonian shales; tight gas
- AGA estimate, 106-107
 - assessment of, 17-26, 39, 97, 100-106
 - bases for OTA projections, 25
 - basic mechanics of, 35
 - coal seam methane, 7, 207, 212-224
 - demand and, 5-6, 17, 94
 - enhancement, 22
 - 1950-85, 4, 19
 - pessimistic scenarios for, **5, 39, 101**
 - potential, 81-107**
 - projection for year 2000, 6-7, 17-19, 81, 97, 100-102, 105-106**
 - tight gas forecasts, 7, 168-175**
 - uncertainties in estimates of, 5-7, 18-25, 105-106**
 - USGS estimate, 103-105**
- proppants, 125, 150, 152, 188, 216, 243**
- proved reserves, 40. *See also* reserves; recoverable resources**
- additions to, 4, 18, 23-24, 43, 61, 65, 81-97
 - current level of, 3-4, 17, 23
 - rate of additions to, iii, 18
 - revisions to estimates, 90-93
 - total U. S., 1977-1983, 34
 - uncertainties in calculations, 46-47
 - withdrawals, 18
- Prudhoe Bay Field, 111, 114
- Pulle, C. V., and Seskus, A. P., 131, 191-192, 195-196, 199-200
- pumps, 213, 217
- Purchase Gas Adjustment, 122
- RAND Corp.
- OTA assessment of estimate, 77, 105
 - resource estimate, 19-20, 47, 49, 52-54, 61-62
- Reagan, Ronald, 114
- recession, effect of, 112
- recoverable resources. *See also* coal seam methane; Devonian shales; tight gas
- alternative estimates, 49, 55
 - Hubbert estimate, 19-20, 39, 41, 43, 47, 49, 65
 - PGC estimates of, 3, 5, 17, 19, 39-40, 49-52, 58-60, 65, 100
 - price changes and, 3, 5, 9, 17, 41, 45, 66-67, 73-76, 83
 - uncertainties in estimates, 5, 8, 17-18, 52, 58
 - USGS estimates of, 3, 5, 39-40, 47-50, 59-60, 65, 82, 100, 104
- regions, gas supply, 4, 31, 59, 100-102
- regulations, government, 45, 66, 75, 94
- reserves. *See also* proved reserves
- additions to, 4, 18, 23-24, 43, 54, 61, 65, 81-97
 - defined, 3, 40
 - "inferred," 49
 - 1981-2000, 3, 97, 100, 102
 - OTA estimate of, 8, 39-50, 56-74, 97
- reserves-to-production ratio
- decline in, 95
 - implications, 23-25, 81, 93-96
 - projected, 19, 96-97
 - for years 1945-80, 95
- reserves, proved. *See* proved reserves
- resources. *See also* recoverable resources; supply, natural gas
- credibility of estimates, 60-61, 77
 - defined, 3
 - estimate comparison problems, 41, 45-47, 60-61
 - geology-based estimates, 42-43, 45, 48, 52-53, 60
 - OTA assessment of base, 39-50, 77, 82
 - PGC estimate, 3, 5, 17, 19, 39-40, 49-52, 58-60, 100
 - uncertainties in extrapolating discovery trends, 23-24
 - uncertainties of magnitude and character, 7-9, 18-24
 - undiscovered, 54, 59, 82
 - USGS estimate, 3, 5, 17, 19, 39-40, 47-50, 59-60, 65, 82, 100, 104

- responsive reserves, **228**
 "revision s," 23-24, 34, 65, 75, 81, 98-102
 risk taking by industry, 83
 rocks, source, 30, 35, 46, 125, 243
 R/P ratio. See reserves-to-production ratio
- SAI estimate, 196-197
 sandstone formations, 6, 121, 123, 141, 147, 183
 San Juan Basin, 8, 65, 73, 144, 157, 207, 211, 220
 satellite imagery, 156
 Scheunemeyer, J. H., 71
 sedimentary basins, 29-30
 shale oil, 188
 Shell Corp., 19, 49, 76, 107, 227-228
 shortages, 5
 Soter, Steven, 29
 Southeast Georgia Embayment, 22, 53, 76
 South Texas Lobo Trend, 88
 stratigraphic traps, 7, 22-23, 30, 53, 66, 76-77, 243
 "stripper" wells, 22
 subduction, 71
 supply, natural gas
 long-term trends, 3, 5, 17
 national perception of (1 978), 3, 17
 for next few decades, 5, 39
 private sector forecast, 107
 shortage, 5
 short-term, 3, 17
 surplus, 3, 17, 25, 113
 warning of shift in, 9-10
 synthetic gas, 18, 26
- tailored pulse loading, 188, **234**
- technology, new
 and currently uneconomic production, 5, 9
 development, 9
 forecasting problems, 7, 17, 41
 fracturing, 229-235
 gas recovery and, 3-5, 9, 24, 45, 73, 83
 Texas, 59, 65, 84, 88, 95
 Texas Railroad Commission District, 73, 87, 91
- tight gas
 AGA estimate, 169-171
 deep, 167-168
 defined, 6, 123-125, 139-140
 FERC estimates, 123-124, 126, 139-140, 142-144, 166, 236
 in-place estimates, 144-149, 168
 NPC projections, 3, 124, 126-128, 142, 144-149, 154, 157-175, 236-241
 PGC estimate, 236-241
 price, 8
 production forecasts, 7, 168-175
 recoverable, 5-6, 8-9, 122-128, 139-149, 157-168
 sands, 26, 52, 88, 121, 139, 156, 174
 uncertainties in estimates, 139, 145-149, 161-168, 236-241
 TransAlaska Gas System, 112
 traps, petroleum, 30, 32, 46, 243
 TRW, 135
- unconventional gas, 26, 39. See *also* coal seam methane; Devonian shales; tight gas
 defined, 5, 121-122
 exploration, 130-131, 156, 189-190
 Federal role and, 121
 NPC supply projections, 3, 121
 parameters of supply estimate, 5-7, 50, 121-123
 PGC estimate, 122, 124, 167-168
 prices, 5, 7-8, 121, 139, 163, 193-194, 201
 USGS estimate, 103-105, 122, 131, 134, 183-186
 U.S. Bureau of Mines, 223
 U.S. Congress
 Alaska and, 114
 perception of long-term supply, iii
 U.S. Department of Energy
 contractors, 121, 126, 142
 Eastern Gas Shales Project, 135, 182, 211-212, 221
 Methane Recovery From Coalbeds Project, 135, 211-212, 221
 mineback experiments, 233
 Morgantown Energy Technology Center, 192
 policy, 10
 research, 156
 resource estimate, 134, 210
 U.S. Department of the Interior, 223
 U.S. Geological Survey
 coal resource data, 209-210
 Devonian shale estimates, 182-185
 gasfield growth estimate, 99
 production estimate, 103-105
 resource estimate, 3, 5, 17, 19, 39-40, 47-50, 59-60, 65, 82, 100, 104
 unconventional gas estimates, 103-105, 122, 131, 134, 183-186
 USGS. See U.S. Geological Survey
 U.S. House of Representatives
 Committee on Energy and Commerce, iii, 4
 Subcommittee on Fossil and Synthetic Fuels, iii, 4
 U.S. Senate
 Committee on Energy and Natural Resources, iii, 4
 Subcommittee on Energy Research and Development, iii, 4
 U.S. Steel, 136, 219
 U.S. *Steel v. Hoge*, 222

- Van Driest, 11, E. R., 49, 52
- Ventura Basin, 53
- Warrior Basin, 133, 211
- Wattenberg Field, 139, 144
- well. See *also* well stimulation
 - classification, 33-34
 - completions, 67
 - conventional v. tight gas, 150
 - expenditures for, 67
 - exploratory, 69
 - head prices, 5, 17, 26
 - horizontal, 134, 215
 - logs, 155, 235, 242
 - measurement technology, 10
 - number drilled, 43, 65, 67, 69, 201
 - workover, 74, 93
- well stimulation
 - defined, 243
 - Devonian shales and, 130, 187, 189, 203, 215-216
 - new gas from old fields, 73-75
 - safety factors, 223
 - technology, 8-9
 - tight gas and, 153-154
- Western Overthrust Belt, 4, 7, 22, 45-46, 51, 53, 60, 76, 88-89, 189-190
- West Virginia, 129, 132-133, 192-193, 197-200, 203, 207
- Whitney Canyon/Carter Creek, 66
- wildcats
 - new field, 33-34, 45-46, 54, 56, 61-65, 68-69
 - success rate, 69, 84, 144
- Wiorkowsky, J. J., 19, 49, 61
- Wise and Skillern, 135, 210
- Wyoming, 95
- Zielinski, R. E., and McIver, R. D., 131, 191-192, 196-197, 199-200