

K.R. Rao

Wind Energy for Power Generation

Meeting the Challenge of Practical Implementation

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This publication is dedicated to my father Kocherlakota Satya Narayana Murthy (K. S. N. Murthy) for inculcating in me the value of scholarly achievements which motivated me to take up this project which subsumes in this endeavor not only all of my years of education but also six decades of professional skills.

This publication is further dedicated to my mother K. Annapoorna who instilled in me the value of “commitment to a cause” that I earnestly believe – sharing with others what all I achieved. This effort is the result of following my mother’s lifelong ambition that I should share my education for the “benefit of others.”

I also dedicate this book to my paternal aunt V. Chandramathi who subsidized funds in 1950s for completing my bachelor’s degree in a prestigious engineering college of India.

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Prologue

The title portrays the intent of this book is to unravel the “Wind Energy for Power Generation – Meeting the Challenge of Practical Implementation” so that “intricacies” involved in making policy decisions for selecting “Wind Energy for Power Generation” around the globe are unraveled. The author recognizes that public policy decisions would involve several layers of details, interknit with multidisciplines, for end users who could be individuals, neighborhood groups, township committees, utilities, or even operators of a national grid.

This publication is divided into seven chapters, first chapter dealing with technical considerations, the second dealing with wind energy economics, and chapters three, four, five, six and seven sequentially deal with socioeconomic factors, geopolitical parameters, environmental impacts, role of conservation and efficiency and leading to public policy implications respectively.

The first chapter containing technical considerations addresses wind power technology in an easily understandable format starting with historical background. Whereas several publications dealing with wind energy have detailed discussions about technical aspects and few incidentally address economic aspects, there are practically no books which cover other aspects critical for decision-making process. The technical considerations will provide correlations for making public policy decisions taken at all levels of the government, engineering students, and practicing professionals involved in wind as energy and power generation source.

Economic parameters relevant to practicing professionals and decision makers become the vital components of the decision process which are eloquently covered in second chapter of this book. In addition, few examples for professional engineering examinations are also included.

The matrix of the other chapters covered will unravel “comprehensively” all of the details pertaining to socioeconomic parameters, environmental issues and reduction of global warming, geopolitical constraints, and role of conservation that impact public policy decisions. These will be coherently and succinctly paraphrased in this book for the USA as well as the global context. This matrix of coverage is not merely for USA but address developed countries, including Europe, Canada, Japan, and Australasia; developing countries of Asia such as China and India; select Latin American countries such as Brazil and Argentina; as well as Middle East and Africa. Case studies of wind power projects from sources available in public domain such as Canadian, Indian, British, Spanish, and the US wind energy systems, and other global energy systems are succinctly addressed.

The “front matter” and “end matter” of this publication are applicable to all of the seven chapters.

The energy and power generation issues in these current days of globalization do not have national boundaries. The coverage around globe not only envelops diverse interdisciplinary engineering constraints and resource potential of wind for energy and power generation but also delves into optimal techniques to make wind comparable to the conventional energy resources.

The discussions throughout the book, provided with pertinent sketches, graphics, equations, tables, several references, and elaborate bibliographical footnotes are meant for further study to probe into related aspects. Immense use of this publication will be for academia due to the rich scholastic coverage of each of the topics. Author with his editorial experience of professional

publications in the engineering field has focused on the end users in addition to the libraries of engineering schools, schools of public and international affairs, public policy institutes, and professional societies.

Author does not make any pretext about the textual content in this entire publication. Instead of “reinventing the wheel,” author has researched to explore expert opinions pertaining to each paragraph and topic in this publication. Thus, the reader will find several statements are authenticated by foot notes and citations from scholastic sources throughout the book. As mentioned in all of the chapters, “cherry-picking” has been adopted throughout the text, to assimilate the essence of the viewpoint of eminent practicing professionals involved in wind engineering. In several situations the source for the sentences and paragraphs cited in the text could also pertain to the following text and paragraphs. This way author has avoided repetitions of cited references. For an “in-depth” knowledge of any particular aspect, readers are advised to follow the citations in the footnotes to consult the respective authorities for the aspects covered.

All of the chapters have been thoroughly reviewed by at least two independent reviewers. The reviewers have been selected from fields other than Wind Engineering to avoid “piled higher and deeper” attitude. The reviewers are preeminently qualified engineering professionals whose “outside-the-box” opinion would be valuable for advocating the viewpoint advanced by the author. Each of the reviewer’s bio-data with pictures is included in the “front matter” of this publication.

It is worth mentioning that author feels he is uniquely qualified to address all of the topics covered in this publication. With his multidisciplinary educational qualifications, affiliations to August Professional Societies, and five decades of diverse professional achievements, as accounted in his bio-data, he is justly qualified to write a comprehensive document of energy and power generation from wind resource.

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Acronyms

Chapter 1

| | |
|-----------------|--|
| AC | Alternating Current |
| ACCR | Aluminum Conductor Composite Reinforced |
| ACSR | Aluminum Conductor Steel Reinforced |
| AEP | Annual Energy Production |
| AWEA | American Wind Energy Association |
| AWECS, aka AWES | Airborne Wind-Energy Conversion Systems |
| BAPU | Battery Charging Auxiliary Power Unit |
| BEM | Blade Element Momentum |
| BET | Blade Element Theory |
| BTPS | Blade Tip Power System |
| CAES | Compressed Air Energy Storage |
| CAPEX | Capital Expenditures |
| CapEx | Lower Capital Expenditure |
| CDF | Continuous Distribution Function |
| CFD | Computational Fluid Dynamics |
| CfD | Contracts for Difference |
| CFT | Carbon Fiber Thermoplastic |
| CHP | Combined Heat Power |
| CMP | Corrugated Metal Pipe |
| CVT | Continuously Variable Transmission |
| CWKPS | Crosswind Kite Power Systems |
| DC | Direct Current |
| DDSG | Direct Drive Synchronous Generator |
| DER | Distributed Energy Resources |
| DESS | Distributed Energy Storage System |
| DFIG | Doubly Fed Induction Generator |
| DOE | Department of Energy |
| ECD | Extreme Coherent Gust Direction Change Model |
| EDC | Extreme Wind Direction Change |
| EMC | Electromagnetic Compatibility |
| EOG | Extreme Operating Gust |
| EPA | Environmental Protection Agency |
| EPF | Energy Pattern Factor |
| ESP | Electric Service Platform |
| ETM | Extreme Turbulence Model |
| EV | Expected Value |
| EWM | Extreme Wind Speed Model |
| EWS | Extreme Wind Shear |

| | |
|----------|--|
| FEED | Front End Engineering and Design |
| FEM | Finite Element Method |
| FERC | Energy Regulatory Commission |
| FERC | Federal Energy Regulatory Commission |
| FVM | Free Vortex Models |
| HAUWT | Horizontal Axis Urban Wind Axis Turbines |
| HAWP | High-Altitude Wind Power |
| HAWT | Horizontal Axis Wind Turbines |
| HVDC | High Voltage Direct Current |
| IAMU | Iowa Association of Municipal Utilities |
| IEA | International Energy Agency |
| IEC | International Electro-technical Commission |
| IED | Intelligent Electronic Device |
| ISEP | Iowa Stored Energy Park |
| ISO | International Organization for Standardization |
| JEDI | Jobs and Economic Development Impacts |
| LAWP | Low Altitude Wind Power |
| LPO | Loan Programs Office |
| LPVM | Lagrangian Particle Vortex Methods |
| LV | Low Voltage |
| LVRT | Low Voltage Ride-Through |
| MCP | Measure Correlate Predict |
| MCS | Microgeneration Certification Scheme |
| METOCEAN | Meteorological and Oceanographic |
| MHAWT | Modified Horizontal Axis Wind Turbine |
| MV | Medium Voltage |
| MVAWT | Modified Vertical Axis Wind Turbine |
| NACA | National Advisory Committee for Aeronautics |
| NASA | National Aeronautics and Space Administration |
| NEC | National Electrical Code |
| NESC | National Electrical Safety Code |
| NIMBY | Not In My Back Yard |
| NREL | National Renewable Energy Laboratory |
| NTM | Normal Turbulence Model |
| NWPM | Normal Wind Profile Model |
| NWP | Numerical Weather Prediction |
| NWTC | National Wind Turbine Center |
| OC3 | Offshore Code Comparison Collaboration-3 |
| OC4 | Offshore Code Comparison Collaboration-4 |
| OC5 | Offshore Code Comparison Collaboration-5 |
| OPEC | Organization of Petroleum Exporting Countries |
| OpEx | Operational Expenditure |
| OSIG | OptiSlip Induction Generator |
| PBL | Planetary Boundary Layer |
| PDF | Probability Density Function |
| PM | Permanent Magnet |
| PMA | Permanent Magnet Alternator |
| PMG | Permanent Magnet Generator |
| PMSG | Permanent Magnet Synchronous Generator |
| PURPA | Public Utility Regulatory Policies Act |
| R&D | Research and Development |
| RANS | Reynolds-Averaged Navier–Stokes |
| RAPS | Remote Area Power Systems |

| | |
|-------------|--|
| RES | Renewable Energy Systems |
| RO | Renewables Obligation |
| RPM | Revolutions per Minute |
| SAMP | Special Area Management Plan |
| SCADA | Supervisory Control and Data Acquisition |
| SCE | Southern California Edison |
| SCIG | Squirrel Cage Induction Generator |
| SH | Specific Heat |
| SPP | Southwest Power Pool |
| SW | Specific Weight |
| TSR | Tip Speed Ratio |
| UBL | Urban Boundary Layer |
| UCL | Urban Canopy Layer |
| USDOE | US Department of Energy |
| UWT | Urban Wind Turbines |
| VAWT | Vertical Axis Wind Turbine |
| WACC | Weighted Average Cost Of Capital |
| WandSPCSDwg | Wind and Solar Plant Collector System Design Working Group |
| WAsP | Wind Atlas Analysis and Application Program |
| WEA | Wind Energy Area |
| WEB | Wind Energy Bonaire Island |
| WECS | Wind Energy Conversion System |
| WECs | Wind Energy Converters to the Grid |
| WMO | World Meteorological Organization |
| WPD | Wind Power Density |
| WRIG | Wound Rotor Induction Generator |
| WRSG | Wound Rotor Synchronous Generator |
| WTG | Wind Turbine Grounding |

Chapter 2

| | |
|----------------|--|
| \$/kW | Name Plate Rating in Dollars per Kill Watt |
| \$/MWh | Dollars per Mega Watt Hour |
| 2SLS | Two Stage Least Squares |
| 3SLS | Three Stage Least Squares |
| AAR | Average Annual Return |
| AEO | Gross Annual Energy Output (kWh/Y) |
| AEP | Annual Energy Production |
| AF | Availability Factor |
| AFC | Annualized Fixed Costs |
| AOM | Annual Cost of Operations and Maintenance (\$/Y) |
| BCR | Benefit Cost Ratio |
| BOP | Balance of Plant |
| BWR | Boiling Water Reactor |
| C(V) | Normalized Cost |
| c€/kWh | Euro Cents per kilo Watt Hour |
| C _A | Cost per Unit Size of Turbine |
| CC | Capital Cost |
| CCB | Marginal Increase in Capital Costs of Building |
| CCWT | Capital Costs of Wind Turbines |
| CDM | Clean Development Mechanism |

| | |
|-----------|--|
| C_E | Unit Cost of Wind Generated Electricity |
| CEC | California Energy Commission |
| CEE | Comprehensive Economic Evaluation |
| CER | Certified Emission Reduction |
| C_F | Capacity Factor |
| CI | Compound Interest |
| CO_2 | Carbon Dioxide |
| COE | Cost of Energy (\$/kWh) |
| C_{PR} | Cost per kW |
| C_{PR1} | Cost of Turbine per kW |
| CRF | Capital Recovery Factor |
| C_T | Cost of the Turbine |
| DDB | Double Declining Balance |
| DEWI | Deutsches Wind Energy Institute |
| DG | Distributed Generation |
| DNCs | Distribution Network Companies |
| ELSAM | Danish Utility |
| Elspot | NordPool Spot Market |
| EPRI | Electrical Power Research Institute |
| EUAB | Equivalent Uniform Benefits |
| EUAC | Equivalent Uniform Annual Cost |
| e_w | Energy Density (kWh/m ² /y) |
| EWEA | European Wind Energy Association |
| FASB | Financial Accounting Standards Board |
| FCR | Fixed Charge Rate |
| FCR | Levelized Fixed Charge Rate |
| FEMP | US Federal Energy Management Program |
| FITs | Feed-in-Traffics |
| GDP | Gross Domestic Product |
| GMM | Generalized Method of Moments |
| GW | Giga Watt |
| GWEC | Global Wind Energy Council |
| HAWT | Horizontal Axis Wind Turbines |
| IAS 7 | Accounting Standard 7 |
| ICC | Initial Capital Cost or Installed Capacity Costs |
| IEA | International Energy Agency, Paris |
| IPPs | Independent Power Producers |
| IRENA | International Renewable Energy Agency |
| IRR | Internal Rate of Return |
| ISO4 | Interim Standard Offer Number |
| JEDI | Jobs and Economic Development Impact |
| kW | Kilo Watts |
| LBL | Lawrence National Laboratory |
| LBNL | Lawrence Berkeley National Laboratory |
| LCC | Life Cycle Costing |
| LCCA | Life-Cycle Cost Analysis |
| LCOE | Levelized Cost of Energy |
| LOLE | Loss of Load Expectation |
| LOLP | Loss of Load Probability |
| LP | Linear Programming |
| MACRS | Modified Accelerated Cost Recovery System Depreciation |
| MARR | Minimum Attractive Rate of Return |
| MBTU | Million British Thermal Units |

| | |
|------------------|---|
| MWh | Mega Watt Hours |
| NASA | National Aeronautics and Space Administration |
| NETA | New Electricity Trading Arrangements |
| NFW | Net Future Worth |
| NI | Net Income |
| NIMBY | Not In My Back Yard |
| NPV | Net Present Value |
| NPV _C | Net Present Value Cost |
| NPW | Net Present Worth |
| NREL | National Renewable Energy Laboratory |
| O&M | Operation and Maintenance |
| OECD | Organisation for Economic Co-operation and Development, Paris |
| OMC | Annual Operating and Maintenance Costs |
| OTC | Over-the-Counter Trading |
| PG&E | Pacific Gas and Electric |
| PPA | Power Purchase Agreements |
| P _R | Rated Power of Turbine |
| PTC | Production Tax Credit |
| PUC | Public Utilities Commission |
| PURPA | Public Utilities Regulatory Policies Act |
| PWR | Pressurized Water Reactor |
| PX | Power Exchange |
| REC | Renewable Energy Credit |
| RECs | Renewable Energy Certificates |
| ROCs | Renewable Obligation Certificates |
| ROI | Simple Return on Investment |
| ROR | Rate of Return Method |
| RPM | Regulating Power Market |
| RPS | Renewable Portfolio Standards |
| SI | Simple Interest |
| SOYD | Sum-of-the-Years' Digits (Depreciation) |
| TGC | Tradable Green Certificates |
| TIC | Total Installed Cost |
| TSO | Transmission System Operator |
| UGPW | Uniform Gradient Present Worth |
| US DOE | US Department of Energy |
| US GAAP | United States Generally Accepted Accounting Principles |
| VAWT | Vertical Axis Wind Turbine |
| WE | Wind Engineering |
| WEC | World Energy Council, London |
| W _R | Wind Regime |
| BV _j | <i>Book Value</i> |

Chapter 3

| | |
|-------|--|
| ASEAN | Association of Southeast Asian Nations |
| AWE | Airborne Wind Energy |
| BNEF | Bloomberg New Energy Finance |
| EAP | East Asia and Pacific |
| ECA | Europe and Central Asia |
| EPA | Environmental Protection Agency |

| | |
|------------|--|
| EUCSEE- EU | Central and South Eastern Europe |
| FAO | Food and Agriculture Organization |
| FPL | Federal Poverty Level |
| GDP | Gross Domestic Product |
| HHS | Health and Human Services |
| HYVs | High Yielding Varieties |
| ICT | Information Communication Technology |
| IMF | International Monetary Fund |
| ISM | Institute for Supply Management |
| IT | Information Technology |
| LAC | Latin American and Caribbean Region |
| LICO | Low-Income Cut-Off |
| LSM | Large-Scale Manufacturing |
| MENA | Middle East and North Africa |
| NIMBY | Not In My Back Yard |
| OECD | Organisation for Economic Co-operation and Development |
| OTPP | Ontario Teachers' Pension Plan |
| PPP | Purchasing Power Parity |
| PTC | Production Tax Credit |
| RPS | Renewable Portfolio Standard |
| SDR | Special Drawing Rights |
| SWF | Sovereign Wealth Fund |
| UN | United Nations |
| WE | Wind Energy |
| WITB | Working Income Tax Benefit |

Chapter 4

| | |
|----------|---|
| AD | Accelerated Depreciation |
| ADB | Asian Development Bank |
| AEDB | Alternate Energy Development Board |
| AEPC | Alternative Energy Promotion Centre |
| BOO | Build-Own-Operate |
| BOOT | Build-Own-Operate-Transfer |
| CanWEA | Canadian Wind Energy Association |
| CDM | Clean Development Mechanism |
| CED | Compagnie Eolienne du Détroit |
| CSTEP | Centre for Study of Science, Technology and Policy |
| CTF | Clean Technology Fund |
| C-WET | Center for Wind Energy Technology |
| DFI | Development Finance Institutions |
| EEZ | Exclusive Economic Zone |
| EIJLLPST | Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey |
| ENTSO-E | European Network of Transmission System Operators for Electricity |
| FAA | Federal Aviation Administration |
| FFCEL | Fauji Fertilizer Company Energy Limited |
| GBI | Generation-Based Incentive |
| GCC | Gulf Cooperation Council |
| GCF | Gross Capacity Factor |
| GPCL | Gujarat Power Corporation Limited |
| GWEC | Global Wind Energy Council |

| | |
|----------|---|
| IDB | Inter-American Development Bank |
| IEA | International Energy Agency |
| IITM-FRU | Field Research Unit of Indian Institute of Tropical Meteorology |
| KA-CARE | King Abdullah City of Atomic and Renewable Energy |
| KAMM | Karlsruhe Atmospheric Mesoscale Model |
| LIDARs | Light Detection and Ranging |
| MENA | Middle East and North Africa |
| MNRE | Ministry of New and Renewable Energy |
| MRSR | Multilateral Regional Security Reservoirs |
| NAST | Nepal Academy of Science and Technology |
| NCF | Net Capacity Factor |
| NIMBY | Not in My Back Yard |
| NMS | New Member States |
| NOWA | National Offshore Wind Energy Authority |
| NWEM | National Wind Energy Mission |
| ODA | Official Development Assistance |
| OECD | Organisation for Economic Co-operation and Development |
| ONE | Office National de l'Électricité |
| OPIC | Overseas Private Investment Corporation |
| REC | Renewable Energy Certificates |
| REIPPP | Renewable Energy Independent Producers Procurement Programme |
| RES | Renewable Energy Sources |
| RET | Renewable Energy Technology |
| RPO | Renewable Purchase Obligation |
| SAWEP | South Africa Wind Energy Program |
| STEG | Société Tunisienne de l'Électricité et du Gaz |
| SWEG | Elsewedy for Wind Energy Generation |
| SWERA | Solar and Wind Energy Resource Assessment |
| SWMB | South West Mediterranean Block |
| TEDA | Tami Nadu Energy Development Agency |
| UCTE | Union for the Coordination of Transmission of Electricity |
| WEC | Wind Energy Converters |
| WISE | World Institute of Sustainable Energy |

Chapter 5

| | |
|-----------|--|
| AEZ-WFS | Agro-Ecological Zoning-World Food System |
| AQMG | Air Quality Modeling Group |
| BC and OC | Black and Organic Carbon Aerosols |
| BCCSAP | Bangladesh Climate Change Strategy and Action Plan |
| CDM | Clean Development Mechanism |
| CEGIS | Center for Environmental and Geographic Information Services |
| CEP | Coastal Embankment plan |
| CERs | Certified Emission Reduction |
| CLC | Corine Land Cover |
| CMIP5 | Coupled Model Intercomparison Project |
| CMP | Canada-Mexico Partnership |
| CNP | Central North Pacific |
| CPRS | Carbon Pollution Reduction Scheme |
| CRI | Climate Risk Index |

| | |
|----------|---|
| DIMA | Dynamic Integrated Model of Forestry and Alternative Land Use |
| EDF | Environmental Defense Fund |
| EIA | Environmental Impact Assessment |
| ENSO | El Niño Southern Oscillation |
| EPA | Environmental Protection Agency |
| EU ETS | European Union Emissions Trading Scheme |
| EWEA | European Wind Energy Association |
| GAINS | Greenhouse Gas and Air Pollution Interactions and Synergies model |
| GHG | Greenhouse Gas |
| IEA | International Energy Agency |
| IFAD | International Fund for Agricultural Development |
| IPCC | Intergovernmental Panel on Climate Change |
| IRD | Institute of Research and Development |
| IRENA | International Renewable Energy Agency |
| IWM | Institute of Water Modelling |
| LDC | Least Developed Country |
| MEF | Major Economics Forum on Energy and Climate |
| MESSAGE | Model for Energy Supply Strategy Alternatives and Their General Environmental Impacts |
| MOST | Ministry of Science and Technology |
| NAPA | National Action Plan on Adaptation |
| NEPA | National Environmental Policy Act |
| NFPCSP | National Food Policy Capacity Strengthening Program |
| NGOs | Non-governmental Organizations |
| NOAA | National Oceanic and Atmospheric Administration |
| NPH | North Pacific High |
| OA | Office of the Administrator |
| OAR | Office of Air and Radiation |
| OARM | Office of Administration and Resources Management |
| OCFO | Office of the Chief Financial Officer |
| OCSP | Office of Chemical Safety and Pollution Prevention |
| OECA | Office of Enforcement and Compliance Assurance |
| OEI | Office of Environmental Information |
| OGC | Office of General Counsel |
| OIG | Office of Inspector General |
| OITA | Office of International and Tribal Affairs |
| OLEM | Office of Land and Emergency Management |
| ORD | Office of Research and Development |
| OW | Office of Water |
| PNAS | Proceedings of the National Academy of Sciences |
| RCPs | Representative Concentration Pathways |
| SEMARNAT | Secretariat of Environment and Natural Resources |
| SRI | Socially Responsible Investments |
| SST | Sea-Surface Temperature |
| TOR | Tortillas on the Roaster |
| UNEP | United Nations Environment Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WFS | World Food System |

Chapter 6

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| ACEEE | American Council for an Energy-Efficient Economy |
| APERC | Andhra Pradesh Electricity Regulatory Commission |
| AVERT | Avoided Emissions and Generation Tool |
| BEC | Building Energy Consumption |
| BEE | Bureau of Energy Efficiency |
| CHP | Combined Heat and Power |
| DOE | Department of Energy |
| DSIRE | Database of State Incentives for Renewables and Efficiency |
| EC | Energy Conservation |
| ECBC | Energy Conservation Building Codes |
| EERE | Energy Efficiency and Renewable Energy |
| EIA | Energy Information Administration |
| EISA | Energy Independence and Security Act |
| EVN | Electricity of Vietnam |
| FNCCI | Federation of Nepalese Chambers of Commerce and Industry |
| GHG | Greenhouse Gas |
| HHV | Higher Heating Value |
| IAPMO | International Association of Plumbing and Mechanical Officials |
| ICC | International Code Council |
| KERC | Karnataka Electricity Regulatory Commission |
| LEDs | Light-Emitting Diodes |
| LHV | Lower Heating Value |
| LSEB | Lagos State Electricity Board |
| MERC | Maharashtra Electricity Regulatory Commission |
| MEW | Ministry of Energy Water |
| MoU | Memorandum of Understanding |
| MPERC | Madhya Pradesh Electricity Regulatory Commission |
| NREL | National Renewable Energy Laboratory |
| OERC | Orissa Electricity Regulatory Commission |
| PCRA | Petroleum Conservation Research Association |
| SHP | Separate Heat and Power |
| TNEC | Total National Energy Consumption |
| UNDP | United Nations Development Program |
| UVIG | Utility Variable-Generation Integration Group |
| ZNE | Zero Net Energy |

Chapter 7

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| AB | Assembly Bill |
| AEPCC | Alternative Energy Promotion Centre |
| AQMG | Air Quality Modeling Group |
| BEC | Building Energy Consumption |
| BECCS | Biomass with Carbon Capture |
| BEE | Bureau of Energy Efficiency |
| CAPEX | Capital Expenditures |
| CCS | Carbon Capture and Storage |
| CEB | Ceylon Electricity Board |
| CEC | California Energy Commission |
| CMP | Canada-Mexico Partnership |

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| CPI | Consumer Price Inflation |
| C-WET | Center for Wind Energy Technology |
| DFIs | Development Finance Institutions |
| ECERA | Energy Development in the Eastern Caribbean |
| EDF | Electricite de France |
| EFL | Electricity Feed Law |
| EIB | European Investment Bank |
| EISA | Energy Independence and Security Act |
| EPA | Environmental Protection Agency |
| FEED | Front End Engineering and Design |
| FITS | Feed-in-Tariff |
| GDR | Greenhouse Development Rights |
| GHG | Greenhouse Gases |
| GPCL | Gujarat Power Corporation Limited |
| GWEC | Global Wind Energy Council |
| HWAT | Horizontal Wind Axis Turbine |
| IPW | Integrated Program Wind Energy |
| IRENA | International Renewable Energy Agency |
| LNG | Liquefied Natural Gas |
| MENA | Middle East and North Africa |
| METOCEAN | Meteorological and Oceanographic |
| NAST | Nepal Academy of Science and Technology |
| NFFO | Non-fossil Fuel Obligation |
| NIMBY | Not In My Back Yard |
| NOWA | National Offshore Wind Energy Authority |
| NREL | National Renewable Energy Laboratory |
| NTDC | National Transmission and Dispatch Company |
| NWEM | National Wind Energy Mission |
| OAR | Office of Air and Radiation |
| OSW | Offshore Wind |
| PTC | Production Tax Credit |
| RFIT | Renewable Feed-in-Tariffs |
| RTP | Real-Time Pricing |
| SVAWT | Savonius Vertical Axis Wind Turbine |
| SWERA | Solar and Wind Energy Resource Assessment |
| TNEC | Total National Energy Consumption |
| VWAT | Vertical Axis Wind Turbine |
| WISE | World Institute of Sustainable Energy |