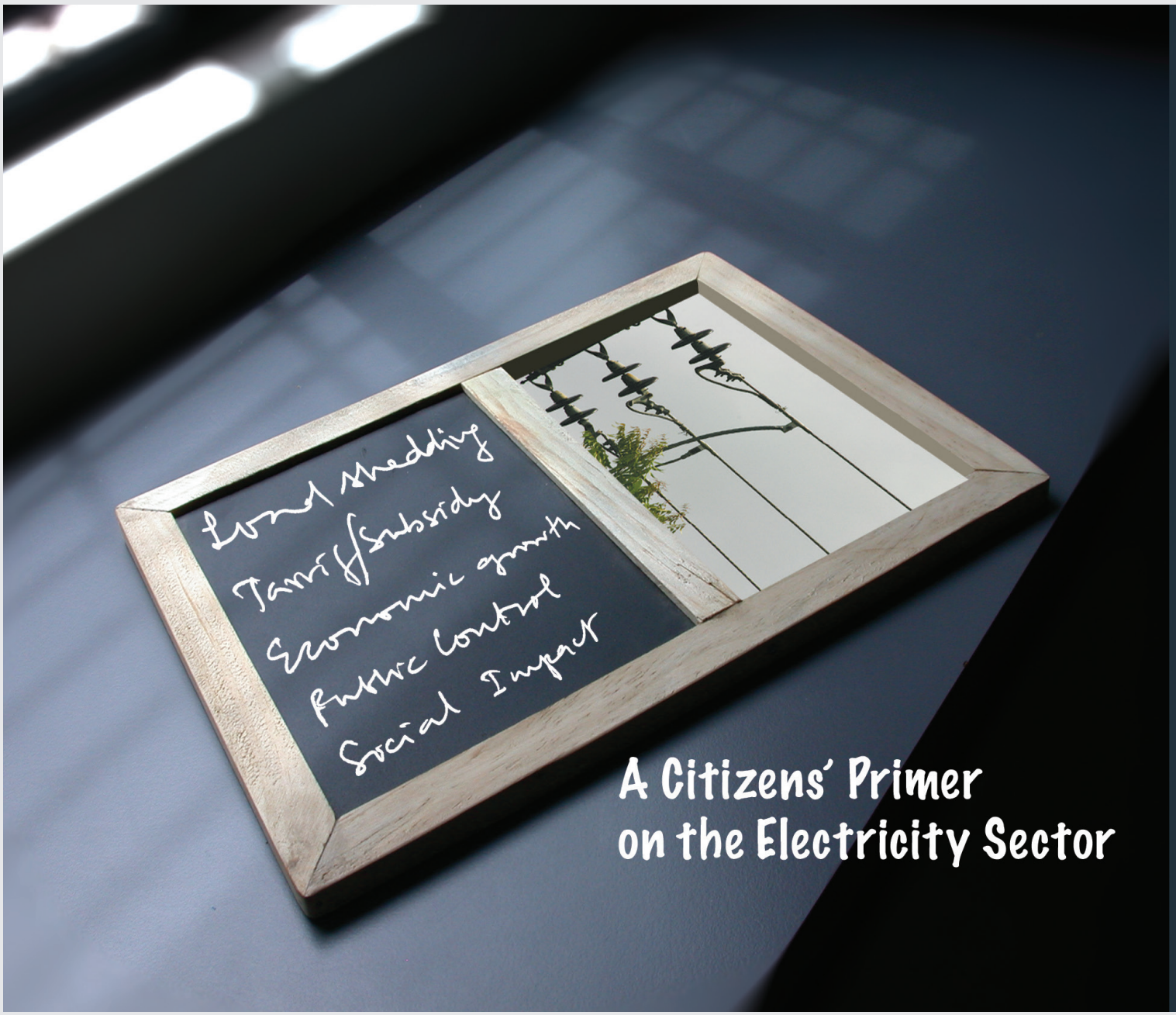
Know Your Power



A Citizens' Primer on the Electricity Sector

3rd Revised Edition

Prayas (Energy Group)

Know Your Power

A Citizens' Primer on the Electricity Sector

3rd Revised Edition

January 2019

Sreekumar Nhalur | Ashwini Chitnis | Saumya Vaishnava | Ashwin Gambhir

Prayas (Energy Group)

About Prayas

Prayas (Initiatives in Health, Energy, Learning and Parenthood) is a non-profit organisation based in Pune, India. Members of Prayas are professionals working to protect and promote the public interest in general, and interests of the disadvantaged sections of society, in particular. Prayas (Energy Group) works on theoretical, conceptual, regulatory and policy issues in the energy and electricity sectors. Our activities cover research and intervention in policy and regulatory areas, as well as training, awareness, and support to civil society groups. Prayas (Energy Group) has contributed to the development of energy sector policy as part of several official committees constituted by Ministries, the erstwhile Planning Commission and NITI Ayog and advisory committee of many Regulatory Commissions. Prayas is registered as a SIRO (Scientific and Industrial Research Organisation) with the Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India.

Prayas (Energy Group)
Unit III A & B, Devgiri, Kothrud Industrial Area,
Joshi Railway Museum Lane, Kothrud, Pune 411 038 Maharashtra
Phone: 020 – 2542 0720
Email: energy@prayaspune.org Website: http://www.prayaspune.org/peg

Suggested citation: Prayas (Energy Group). (2019). Know your power: A citizens' primer on the electricity sector

1st Edition: May 2004
2nd Edition: July 2006
Lead authors: Sreekumar N, Girish Sant
3rd Revised Edition: January 2019
Lead authors: Sreekumar Nhalur, Ashwini Chitnis, Saumya Vaishnava, Ashwin Gambhir

Data and production support: Shilpa Kelkar, Manabika Mandal

Illustrations: Manjiri More, Sandeep Deshpande, Gayatri Joag

Cover Design, Layout and Printing: Mudra, 383 Narayan Peth, Pune. Email: mudraoffset@gmail.com

Suggested contribution: Rs 750/-

Contents

Figures

Tables

Boxes

Preface to the 3rd Revised Edition

We published *Know your power: A citizens' primer on the electricity sector* in 2004. This was in response to the successful sessions on the basic concepts of the Indian electricity sector in our many workshops. A revision was published in 2006, a Kannada translation in 2008 by the Karnataka Electricity Regulatory Commission, and a Marathi translation in 2009 by Prayas with support from the Maharashtra Electricity Regulatory Commission.

Over the years, we have distributed more than 4000 copies of the Primer to government officials, consultants, teachers, students and civil society groups. During this time, we have published many other guides covering topics like addressing electricity complaints, increasing regulatory engagement and using tools like the Right to Information Act. But among our publications, the Primer stands out for providing a comprehensive overview of the technical, economic and institutional aspects of the Indian electricity sector in an accessible manner. It is interesting to note that there is high demand even today for the 2006 Edition of the Primer, even though there have been many major changes in the sector since then. The Primer has played a significant role in our efforts to reach out to officials and civil society groups and has provided them an in-depth understanding of the sector.

Prayas (Energy Group) has also undergone major changes since 2006. From a group with few researchers and publications, we have grown in size and spread, with more than 300 publications. Girish Sant, the co-founder of Prayas (Energy Group) and a lead author of the Primer, sadly passed away in 2012. We also record the sad demise of Professor Amulya Kumar N Reddy and Dr Krishna Prasad who had offered their valuable insights during the writing of the 1st Edition of the Primer. Pallavi Apte, one of the artists who helped with the previous editions, also sadly passed away during this time.

We are happy to present this completely revised edition of the Primer. We have retained the basic structure and style of the previous editions, but all chapters have been completely revised based on feedback and developments in the sector. Chapter 1 locates the electricity sector in the broader social context; Chapters 2, 3 and 4 explain the important technical aspects of the sector; Chapter 5 introduces the major actors in the sector; Chapter 6 and 7 cover the key aspects of sector economics and tariffs; Chapter 8 is on planning; and Chapter 9 gives a brief overview of the reforms in power sector since 1990. Chapter 10 is a new addition, on the challenges of energy transition. Chapter 11 summarises the observations and suggests a framework for citizens' engagement with the sector. This revised edition covers more topics and has more pages compared to the 2nd Edition. In addition to the print version, an electronic version is also available on our website.

While some of us in Prayas (Energy Group) have written the chapters, this Primer is the result of a collective effort involving all our members as well as reviewers and well-wishers. We would especially like to thank Dr Rammanohar Reddy, Dr Ranjit Deshmukh, Jatin Sarode, Gayatri Gadag, Daljit Singh and Ann Josey for review comments. We thank the post graduate students from TISS - Mumbai for feedback on the 2nd Edition. Our thanks also to Neeta Deshpande for improving the language and communication. In producing the Primer, we worked with three artists - Manjiri More, Sandeep Deshpande and Gayatri Jog. We thank them for their patience and creative support. We would also like to thank Mudra for the layout and printing. A very special thanks to Shilpa Kelkar and Manabika Mandal from our group who worked tirelessly on production and data. This Primer would not have been possible without them. A special thanks also to everyone at Prayas (Energy Group)

for their many contributions to the Primer at different stages of production.

In this age of internet and abundance of information, there could be questions on the usefulness of a Primer. Our view is that the Primer helps the citizens to gain an understanding of the basic concepts and broad issues in the sector. This is essential to decide what information to search, where to search and how to search. We hope that citizens will employ this Primer to educate themselves about the electricity sector and meaningfully engage with it by raising focussed questions and providing suggestions.

Prayas was founded 25 years ago. While we reflect on our long journey of public interest oriented policy and governance engagement, we are happy to bring out this completely revised edition of the Primer. We look forward to your feedback.

Prayas (Energy Group)

January 2019

Foreword to the 2nd Edition

Electricity is the prime mover of a modem economy. Not only is it a basic infrastructure, but it has also become an essential part of our daily existence, in the first hundred years of its commercialization, electricity was supplied to consumers by vertically integrated monopolies. It was generally felt that this was the only feasible option due to its complexity as a commodity and its natural monopoly aspects. In many countries worldwide, unbundling of the electricity supply industry was started during 1990s, so that it could be subjected to market discipline rather than being controlled through monopoly regulation. It was around this time that India embarked on the path of reform and restructuring of the sector, the enabling legal framework of which has now been enshrined in the Electricity Act 2003. The Act, which is landmark legislation, aims at development of a power system which catalyses investment, promotes competition and protects consumer interest.

Prayas - a dedicated non-governmental organization with focus on energy, health, learning and parenthood and resources and livelihoods - has been working for quite some time towards improvement of India's power scenario. The Energy Group of Prayas has contributed significantly in capability building through publications and analyses of important issues facing the sector, and also through workshops and discussions.

Originality of approach is the unique feature of the activities of Prayas. The book, "Know Your Power: A Citizens' Primer on the Electricity Sector", bears testimony to this fact. This book exhaustively covers the technical, operational, economic and financial aspects as well as the reform models envisaged in the power sector. It explains each of these issues in a very simple and lucid manner. The book examines with precision the basic concept of the power system, and goes on to describe how the system works. It deals systematically with the economics of electricity, including cost structure and the tariff setting process. The publication also presents, in an unbiased manner, an overview of emerging trends. The book caters to the requirements of ordinary citizens as well as technical experts, by providing a comprehensive overview.

The 1st Edition of the book received overwhelming response from readers cutting across various interest groups, and proved to be a major capacity building tool for individuals and institutions.

I am glad that Prayas has now brought out this 2nd Edition, with finer refinement and updation, based on discussions and feedback from the readers. It is a very handy reference manual for every stakeholder interested in India's power sector and seeking to contribute to its development. I am sure that this excellent publication would continue to serve as a useful primer for civil society and power sector professionals, and prepare them for an informed debate on the complex issues concerning the electricity sector.

Ashok Basu
Chairperson,
Central Electricity Regulatory Commission
May 2006

Preface to the 2nd Edition

The 1st Edition of the Primer was sold out in about a year's time. Considering the limited effort that we could put into distributing the book, this is indeed a sign of citizens' eagerness to 'know their power'. The Primer has reached a varied audience - politicians, bureaucrats, farmer organisations, trade unions, consumer groups, teachers, students, environmental activists and many interested citizens. Institutions which have purchased the Primer include Ministry of Power, Regulatory Commissions, Electric Utilities, Training Institutes, Research Libraries and Funding Agencies.

From our readers, we have received many compliments as well as comments. This feedback has been a great help in bringing out this edition. Our own learnings and the recent changes in the power sector have also influenced us while preparing this 2nd Edition. Data has been updated upto 2005 and major events in 2006 have been taken into account, for example the issuance of the National Tariff Policy. We have added more illustrative examples to present concepts more clearly. Most of the Chapters have some changes and Chapter 9 (The Indian Power Sector: Emerging Trends) has been completely rewritten. Errors have been corrected and the Reference and Index sections updated.

Pushkar Wagle helped with editing two chapters and Daljit Singh helped with the review of the 2nd Edition. Nikit Abhyankar, Ravi Kadam, Abhay Dhamdhere, Pradnya Phagare, Prasanna Wagle and Gorakh Phale from our office have been with us during all stages of production of this edition. Their help was invaluable and we thank all of them. Special thanks to Shri. A.K. Basu (Chairman CERC) for writing a Foreword to this edition.

Some of the readers have pointed out that this book is not a Primer, but rather a handbook. We feel that the book is indeed a Primer if read from cover to cover. However, for understanding a specific area or issue, it could function as a handbook.

We hope this 2nd Edition empowers many more interested citizens and we welcome your feedback.

Prayas (Energy Group)

July 2006

Preface to the 1st Edition

The power or electricity sector is a key infrastructure sector and is the backbone of the Indian economy. The installed power generation capacity in India has grown 77 times since independence. There are around 11 crore electricity consumers in the country and the total revenue of all electricity distribution utilities in the year 2001-02 was nearly Rs 93,000 crore. The total revenue receipt in the Government of India budget of the year 2001-02 was just about twice this - Rs 2,03,000 crore. Rural electrification and spread of irrigation pump-sets have increased the agricultural productivity. With electricity reaching nearly 85% of the villages, industrial activity (small and big) has become more widespread. With electrification of nearly 56% of rural households, the quality of life has improved significantly for those who have access to electricity.

Until the 1980s, the Indian power sector was in the growth phase with many achievements to its credit. But, by the late 1980s, almost all the State Electricity Boards (SEBs) started showing signs of financial, technical and governance failures. The 1990s started with the state supported entry of private companies into generation. The sector reforms commenced in the mid-1990s and many SEBs were restructured with financial support from international financial institutions.

Today, after more than ten years of power sector reforms, we do not have any great successes to boast of. The sector is still financially and technically sick. Moreover, in the 'reform' phase, we had disasters like Enron and admitted failures like Orissa's attempt at reform, staring us in the face. Questions are being raised about the appropriateness of strategies and policies, but it is said that there is no going back on reforms. Today, governments are working out new strategies, governance models and tariff policies. The state supported SEBs are giving way to a mix of public and private corporations. The Electricity Act 2003 and the associated policy changes are expected to correct some of the previous shortcomings.

This state of flux has thrown up many new issues. There have been major changes at the policy level. There are many new players in the sector. Steps have been initiated to reduce the role of the State. The role of market forces has started increasing. Using the window of the Regulatory Commissions, public debate on policy issues has increased.

Policies in this sector should address the concerns of the vast majority of the poor while protecting long-term ecological interests. It is also clear that India cannot afford to copy the high consumption based models of the power sector in the developed countries. The appropriate model and policies of the Indian power sector should be scripted by the people themselves. But, unfortunately, we find that local expertise is not sufficiently involved in the policy process. In order to understand and comment on the reform process, we need to reach out to more people and build skills in technical, economic and legal fields. There is a need to enhance the influence of informed analytical actors in the Indian power sector. Such a collective effort alone can produce a balanced critique of the reform process and exert a healthy pressure on the policy process. This book forms a part of our efforts for building capabilities of common citizens to meet such an objective.

This book covers the basic technical and economic concepts of the power sector. Electricity in the energy context is introduced and components of the power system and their co-ordinated operation are explained. A quick tour of the day-to-day operational centres of the power system gives an overview of how these systems work. Players in the Indian power sector and their roles are briefly covered.

The power sector is quite complex in terms of operations and planning. We have attempted to explain the basic economic concepts, tariff issues, power system planning and the recent trends in the Indian power sector. We have also tried to explain the necessary jargon in a simple nontechnical language, using analogies and diagrams. This includes IPP tariff calculation, T&D loss estimation, Demand Side Management, Generation planning, Pumped storage systems, etc. After reading this, we hope that a citizen would be less mystified about the sector, and would have crossed the first hurdle towards a better understanding of the sector.

This book has emerged from the experiences of Prayas (Energy Group), Pune. Prayas has worked with many citizens' groups in India and abroad on power sector issues. This includes consumer interest groups, industry associations, power sector employee associations, farmers' organisations, power sector professionals, political analysts, energy analysts, journalists, policy makers and academics. This book addresses one of the major training needs expressed by many in India and similar developing countries. We realise that there is lack of material that comprehensively covers the techno-economic aspects of the power sector. This book is expected to fill this gap.

With a broad range of concepts to cover, writing this book has been a challenging experience. Our audience is a mixed lot in terms of background and expectations. If we keep the level of coverage too basic, we run the risk of irritating the knowledgeable. If the level is too complex, then we may distance the vast majority including those with good knowledge in some selected areas of the sector.

We have therefore kept to the middle ground. Certain items requiring complex explanations, equations or high level of detail are given in boxes or endnotes.

We must acknowledge that this primer is an output of a collective effort spanning the past two years. Many friends from consumer groups, the academic world and utilities have helped us. Those who helped at the early stages of conceptualisation include Prof. Amulya Kumar N Reddy, Dr. Krishna Prasad and Dr. Vivek Monteiro. We have benefited from the inputs received from Dr. Uma Rao, Dr. NDR Sarma, Dr. D.V. Ramana, Dr. M. P. Parameswaran, Dr. M. V. Ramana, Dr. Jhumur Lahiri, Danesh Gojer, K. Raghu and many friends from power utilities. Pallavi Apte and Ramesh Dhanokar have prepared the illustrations. Dr. Usha Raman and Ms. Sherna Gandhy have helped with the editing. Abhay Dhamdhere, Pradnya Phagare, Prasanna Wagle and Gorakh Phale from our office have been with us during all stages of production.

It is our hope that this book will be both useful and engaging. We welcome readers' comments and suggestions to improve it further.

Prayas (Energy Group)

May 2004

Indian electricity sector has been in a state of flux from 1990s, when the reforms started with the entry of private power projects. The Enron power project and Odisha state reforms that followed have thrown up many controversial issues. The Electricity Act 2003, prepared with the reform spirit initiated another major policy upheaval in the sector. Today, Electricity Regulatory Commissions are operational in all the states. With all villages electrified and nearly all households connected to the grid, the demand now is for quality power supply. The whole country is connected to one national grid. Renewable energy is no more on the side-lines, and is expected to be a significant source of power. We are witnessing the entry of many new players, introduction of open access and a movement towards cost based tariff. The trend is towards an increasing role of private sector and markets under a regulatory regime.

A public-spirited citizen, who wishes to respond to this flux and participate in the policy and regulatory processes, is faced with too many new issues. A basic understanding of the technical and economic aspects of the sector is necessary to gain a foothold. An insight into the policy, planning and regulatory processes, along with an appreciation of their linkages with the technical and economic issues, is essential to equip oneself for meaningful engagement with the sector.

This 3rd Revised Edition of the primer, giving a comprehensive macro perspective of the Indian electricity sector, is part of our attempts to assist such citizens in their efforts.

Prayas (Energy Group)