

Renewables Integration in India



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At the core of NITI Aayog’s creation are two hubs –Team India Hub and the Knowledge and Innovation Hub. The Team India Hub leads the engagement of states with the Central government, while the Knowledge and Innovation Hub builds NITI’s think-tank capabilities. These hubs reflect the two key tasks of the Aayog. NITI Aayog is also developing itself as a State of the Art Resource Centre, with the necessary resources, knowledge and skills, that will enable it to act with speed, promote research and innovation, provide strategic policy vision for the government, and deal with contingent issues.

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Abstract

This report suggests ways for India to maximise the amount and value of solar and wind power in its electricity system. It addresses demand-side flexibility, power plant flexibility, storage (pumped-storage hydro and batteries) and grid flexibility, as well as policy, market and regulatory solutions for the short to medium term. It adds to existing research by focusing on renewable integration in individual states, rather than at the national level, as the power system flexibility challenges, solutions and priorities are different in each state. The report presents findings from consultations with national and regional stakeholders and the results of parallel in-depth analysis, including two newly developed, detailed power sector production cost models developed at the IEA to illustrate flexibility challenges and solutions specific to the India context – the five-region India Regional Power System Model and the Gujarat State Power System Model.

Foreword

India has made remarkable progress in recent years bringing energy services to its citizens. In less than two decades, 900 million people have gained access to electricity – including 100 million in 2018 alone – and the country’s energy demand has more than doubled over the same period. But India’s per capita electricity consumption is still only one-third of the global average.

Such steep growth in energy demand inevitably poses challenges for this diverse and dynamic nation, particularly to establishing the policy and market conditions to provide secure, affordable and clean energy for all its people. To facilitate these goals, the International Energy Agency (IEA) has developed a close working relationship with the National Institution for Transforming India (NITI Aayog). Together, they have produced a series of reports and held workshops to support India in its quest to provide much-needed energy to its economy and people while minimising the associated environmental impacts.

Renewables Integration in India 2021 is the latest result of our collaboration with NITI Aayog. This report suggests ways for India to securely maximise the amount and value of solar and wind power in its electricity system. The Government of India plans to increase renewable electricity capacity to 175 GW by 2022 and to 450 GW by 2030, but even faster growth will be needed in the following decades to meet ongoing growth in demand and reach climate targets. The *Renewables Integration* report explores pathways for bringing greater flexibility to the entire electricity system. It also suggests policy, market and regulatory measures to incentivise renewables and ease their integration into the energy system.

This joint project with NITI Aayog drew on the IEA’s expertise in modelling to focus on renewable power in individual Indian states, rather than at the national level, since the challenges, solutions and priorities differ across the country. Some Indian states already derive a larger share of power from renewable sources than some entire countries, although a number of states are facing challenges in smoothly integrating the variable electricity output.

Because of its size and the dynamism of its economy, India has a key role to play in the world’s transition to a clean energy future. India faces unique challenges to meet the demands of its citizens, and I’m hopeful that our work with NITI Aayog can help guide the way towards a successful expansion of renewables in India’s energy mix.

Dr. Fatih Birol
Executive Director
International Energy Agency



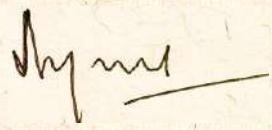
FOREWORD

NITI Aayog and International Energy Agency (IEA) have collaborated to work on joint analysis and research projects, including energy policy analysis and market research, analytical research and econometric modelling to analyze energy sector trends. Under this endeavour IEA carried out independent In-depth Analysis of Indian Energy Policies. Analysis report "**India 2020-Energy Policy Review**" was launched in January, 2020. Apart from this, NITI Aayog and IEA have been working with the states on RE-Integration issues. A series of workshops have been organized with the states starting from 2018 onwards with regional workshops followed by National level workshop. This was a good beginning to identify the various integration issues in the context of increasing penetration of Renewable Energy into grid system.

In September 2019, Hon'ble Prime Minister Shri Narendra Modi, announced long-term ambitious RE targets of 450 GW by 2030 moving beyond the target of 175 GW by 2022. Aligning with the goals of Central Government, India's RE rich States are expanding the RE capacity and generation which definitely require these RE rich States to develop a holistic understanding of full range of flexibility options for RE integrations. Starting from 2020, NITI Aayog and IEA with the support from the British High Commission, has convened series of State-level Power System Transformation Workshops. The objective of these workshops is to sensitize the state governments and to initiate action for system integration of RE Power. During 2020, two workshops were conducted with the states of Maharashtra and Gujarat while another workshop was conducted for Karnataka in early 2021.

NITI Aayog and IEA have come out with a compilation of outcomes of the workshops in the form of a Report. At the time when more and more Indian States are facing increasing RE integration challenges, the recommendations in this report will help India to maximize the amount and the value of solar and wind energy in its power system by providing options to improve power system flexibility in Indian States by 2030. This report provides an international framework for renewables integration in India and highlights a full repertoire of power system flexibility solutions. Power system transformation pathways and renewables integration challenges, solutions and priorities are vastly different in India's states and union territories. This report highlights the findings relevant to many states and regions in India and across the globe.

I would like to congratulate the Energy Vertical at NITI Aayog- Additional Secretary, Dr. Rakesh Sarwal and Rajnath Ram, Adviser (Energy) and their dynamic team for closely working with the Renewable Integration and System Security (RISE) team at the IEA. Both the teams were instrumental in bringing out this publication. I hope that the Indian States take cognizance of the solutions. I look forward to support the implementation of recommendations of this report that need to be tailored to each state to support the smooth transitions to RE integration in the States.


(Amitabh Kant)

Acknowledgements, contributors and credits

The analysis for this report began in 2018, and draws upon IEA team visits to India for a series of Power System Transformation Workshops between 2018 and 2020, and virtual workshops in 2020 and 2021, organised in association with NITI Aayog. In New Delhi, Chennai, Pune, Kolkata, Mumbai and Gujarat, the IEA team met with government officials, state regulators, industry associations, and stakeholders in the public and private sectors as well as other organisations and interest groups, all of which helped the team identify the challenges facing the power sector. The IEA and NITI Aayog are grateful for the hospitality, high-quality presentations, co-operation and assistance of more than 250 people throughout the analysis, workshops and visits. Thanks to their engagement, openness and willingness to share information, the Power System Transformation Workshops were informative, productive and enjoyable.

The IEA's gratitude goes to NITI Aayog, specifically Dr Rakesh Sarwal (Additional Secretary), Mr Rajnath Ram (Adviser – Energy) and Mr Manoj Kumar Upadhyay (Deputy Adviser). Our appreciation extends to our workshop partners who facilitated the individual workshops:

- For the Maharashtra workshop, the Prayas Energy Group led by Mr Ashwin Gambhir and Mr Srihari Dukkipati.
- For the Gujarat workshop and power sector modelling, the Centre for Energy Regulation (IIT Kanpur) led by Dr Anoop Singh.
- For the Karnataka workshop, the Center for Study of Science, Technology and Policy (CSTEP) led by Mr Abhishek Nath.

The following officials have shown immense leadership and co-operation throughout the process of the workshops and in reviewing the analysis:

- Mr Arun K. Mishra (Director, National Smart Grid Mission), Mr S. R. Narasimhan (Director, System Operation, POSOCO) and Mr Soonee Sushil Kumar (Advisor, POSOCO).
- From the Government of Maharashtra, Mr Dinesh Waghmare (Principal Secretary – Energy Department, Chairman and Managing Director, MSETCL), Mr Subhash Dumbare (Director General, MEDA), Ms Shaila A. (former Chairman and Managing Director, Mahagenco), Mr Prashant Badgeri (Deputy Secretary, Energy Department), Mr Abhijit Deshpande (Secretary, MERCI), Mr Satish Chavan

(Director – Commercial, MSEDC) and Mr Manoj Pise (General Manager, Coordination).

- From the Government of Gujarat, Ms Sailaja Vacchrajani (General Manager IPP and RE, GUVNL), Mr B. N. Trivedi (Chief Engineer Project, GETCO), Mr A. B. Rathod (Additional Chief Engineer, Gujarat SLDC), Mr Dipak H Patel (Deputy Engineer, STU, GETCO), Mr J. J. Gandhi (Chief Engineer, PGVCL) and Mr Anand Kumar (Chairman, GERD).
- From the Government of Karnataka, Mr Kapil Mohan (former Additional Chief Secretary, Energy Department), Dr N. Manjula (Managing Director, KPTCL), Ms G. Sheela (former General Manager – DSM, BESCOM) and Mr P. Krishnamurthy (Chief General Manager – Operations, BESCOM).

Mr Tarun Khanna of the Hertie School made a significant contribution in setting up the Gujarat State Power System Model, as well as providing analysis on agricultural demand shifting. The analysis also benefited from the contribution of Mr Thomas Spencer of The Energy and Resources Institute (TERI), Dr Nikit Abhyankar of the Lawrence Berkeley National Laboratory (LBNL) and Dr Gabrielle Kuiper. The analysis, workshops and report benefited from the co-ordination and financial contribution of the UK Government Foreign, Commonwealth and Development Office, British High Commission. The report was prepared under the oversight of the IEA Acting Head of Renewables Integration and Secure Electricity (RISE), Dr Alejandro Hernandez. The Clean Energy Programme management, analysis and report drafting was led by Ms Szilvia Doczi (lead author), the power system modelling was led by Dr Zoe Hungerford (lead author), and significant work has been carried out by Ms Astha Gupta, Mr Kartik Veerakumar, Mr Ramit Debnath and Ms Anna Kalista. Government relations were co-ordinated by the India Programme Manager, Ms Nicole Thomas, with the invaluable assistance of Ms Astha Gupta, who supported the analysis, workshop and drafting of the report as the IEA's India consultant in New Delhi.

The report benefitted from expert review and suggestions from Ms Sailaja Vachhrajani (GUVNL), Mr Dipak H. Patel (GETCO), Mr A. B. Rathod (SLDC), Mr B. A. Gandhi (GSECL), Mr Ashwin Gambhir (Prayas), Dr Anoop Singh (CER, IIT Kanpur), Mr Abhishek Nath (CSTEP), Mr Milind Ravindranath (CSTEP), Mr Harikrishna K. V. (CSTEP), Mr Christopher Westling (CPUC), Ms Erica Petrofsky (CPUC), Mr Akhilesh Magal (GERMI), Mr Abhinav Goyal (World Bank), Dr Vaibhav Chaturvedi (CEEW), Ms Poulami Choudhury and Ms Reshma Ranjith (BHC), Mr Reji Kumar and Ms Reena Suri (India Smart Grid Forum), Mr Joerg Gaebler (GIZ), Mr Ramaswamy K. V. (Ampacimon), Mr Tarun Khanna (Hertie School), Ms Ruth Ku and Dr Nikit Abhyankar (US FRI), Mr David Palchak (NREL), Mr Sunil Kumar Sharma (GIZ), Mr Edmund Andrew (Arup), Dr Emanuele Taibi (International Renewable Energy Agency), Mr Deepak Krishnan and Mr Tirthankar

Mandal (World Resources Institute), and from the IEA: Mr Keisuke Sadamori, Mr Laszlo Varro, Mr Simon Mueller (former IEA), Dr Peerapat Vithayascrichareon, Dr Jacques Warichet, Mr Craig Hart, Ms Randi Kristiansen, Ms Vida Rozite, Mr Enrique Gutierrez, Dr Peter Zeniewski, Ms Insa Handschuch, Dr Stefan Lorenczik and Mr Brent Wanner.

The authors would also like to thank Ms Elspeth Thomson and Mr Justin French-Brooks for skilfully editing the manuscript and the IEA Communication and Digital Office, in particular Ms Astrid Dumond, Ms Therese Walsh and Ms Isabelle Nonain-Semelin, for their assistance.