



# BRICS Smart Grid Report

# 2022



# ACKNOWLEDGEMENT

This Report was made possible thanks to the support and advice of many individuals and organizations.

The BRICS Smart Grid Report-2022 is the outcome of the collaborative efforts of the committee of the BRICS Senior Energy Officials. BRICS ERCP acknowledged the support provided by the officials from the Brazil; Russian Federation; India; National Energy Administration of the People's Republic of China; and Republic of South Africa.

The following ERCP experts took part in the research: Andre Luiz Rodrigues Osorio, Gustavo Santos Masili, Esdras Godinho Ramos, Joao Antonio Moreira Patusco, Gilberto Kwitko Ribeiro, Leticia dos Santos Benso Maciel, William de Oliveira Medeiros, Nathalia Akemi Tsuchiya Rabelo from Ministry of Mines and Energy of Brazil; Alexey Konev, Irina Volkova from Russian Energy Agency by the Russian Ministry of Energy and NRU Higher School of Economics; Energy officials from Bureau of Energy Efficiency and Ministry of Power, Government of India and experts from India; Mr. Jiang Shihong, Mr. Fang Xiaosong, Mr. Wang Shunchao, Mr. Zhang Ruiqing, Mr. Bao Weining, Mrs. Xu Yue, Mr. Hei Yang from China Electric Power Planning and Engineering Institute (EPPEI); and Ms Lethabo Manamela from South African National Energy Development Institute (SANEDI).

BRICS ERCP are also grateful to Ministry of Mines and Energy of Brazil; Russian Energy Agency by the Russian Ministry of Energy and NRU Higher School of Economics, Bureau of Energy Efficiency of India, Ministry of Power of India, China Electric Power Planning and Engineering Institute, South African National Energy Development Institute (SANEDI)..

BRICS ERCP would like to express gratitude to China Chairmanship for leading the preparation of the Report. Overall guidance was provided by the Director General Mrs. Wei Xiaowei National Energy Administration of the People's Republic of China.

Special thanks to National Energy Administration of the People's Republic of China Division Director Mr. Xiang Qianfei, senior program officer Mrs. Li Yuan and Mrs. Xie Hongye, who coordinated, oversaw production of the Report and overall publication process.

# INTRODUCTION

Creating the conditions for the development and exchange of advanced energy technologies is an essential part of BRICS energy cooperation. The development of technological cooperation between the BRICS countries has long been on the agenda of the leaders of the five countries.

In the Xiamen Declaration of 2017, BRICS leaders encouraged continued dialogue on the establishment of a BRICS Energy Research Cooperation Platform (BRICS ERCP). At the 5th Meeting of BRICS Ministers of Energy in 2020, BRICS countries jointly identified 11 priority areas of cooperation for the BRICS Energy Research Cooperation Platform, and smart grid is one of them.

The report presents the current status and plans for smart grid development in the BRICS countries, as well as analysis on potential cooperation areas within BRICS countries.

The report contains three sections. Chapter I surveys the status quo of the smart grid worldwide and analyze global trends of smart grid development. Chapter II presents the progress of smart grids of each country. The policy-framework to support smart grid development and the key technologies promoted by BRICS countries in the field of smart grid, as well as the R&D projects and relevant demonstration projects are also included. The objective of this section is to share learnings and experiences of each country among BRICS countries and with global audience. Chapter III elaborates prospects for smart grid cooperation between BRICS countries. This section will seek to explore synergy and complementarity within BRICS countries to promote cooperation in smart grid field.

This study will lay a foundation for determining the priority areas and modalities of smart grid cooperation among the BRICS countries.

# CONTENTS

## Chapter 1 Global Smart Grid Development

<b>[ I ] OVERVIEW OF GLOBAL SMART GRID DEVELOPMENT .....</b>	<b>1</b>
I. Global Smart Grid Development Status & Quo .....	1
II. Global Smart Grid Development Trend .....	3

## Chapter 2 Profile of the Smart Grid Development in BRICS Countries

<b>[ II ] BRAZIL .....</b>	<b>9</b>
I. Relevant Policies to Promote Smart Grid Development .....	9
II. Smart Grid Technology and Application .....	12
III. Prospects and Outlook for Smart Grid Development .....	14
<b>[ III ] RUSSIA .....</b>	<b>17</b>
I. Definition and Key Parameters of Smart Grids .....	17
II. Relevant Policies to Promote Smart Grid Development .....	20
III. Smart Grid Technology and Application .....	23
IV. Prospects and Outlook for Smart Grid Development .....	27
<b>[ IV ] INDIA .....</b>	<b>30</b>
I. Understanding of the Smart Grid .....	30
II. Relevant Policies to Promote Smart Grid Development .....	32
III. Smart Grid Technology and Application .....	34
IV. Prospects and Outlook for Smart Grid Development .....	39
<b>[ V ] CHINA .....</b>	<b>42</b>
I. Relevant Policies to Promote Smart Grid Development .....	42

II. Smart Grid Technology and Application .....	43
III. Prospects and Outlook for Smart Grid Development .....	49
<b>[ VI ] SOUTH AFRICA .....</b>	<b>51</b>
I. Understanding of the Smart Grid .....	51
II. Relevant Policies to Promote Smart Grid Development .....	58
III. Smart Grid Technology and Application .....	62
IV. Prospects and Outlook for Smart Grid Development .....	66

### Chapter 3 BRICS Cooperation on Smart Grid Development

<b>[VII] KEY AREAS OF COOPERATION .....</b>	<b>70</b>
I. Brazil .....	70
II. Russia .....	70
III. India .....	71
IV. China .....	71
V. South Africa .....	72

# Chapter 1

---

Global

---

Smart

---

Grid

---

Development

---



# OVERVIEW OF GLOBAL SMART GRID DEVELOPMENT

---

## I. Global Smart Grid Development Status & Quo

---

Against the backdrop of increasingly severe situation of climate change and energy security, the major factor lying in the economic and social development remains energy science and technology, and for its innovation and development, the smart grid becomes not only a major carrier but also the inevitable trend for modern power grid development.

Different countries have different emphases on the smart grid due to national conditions, development stages, and resource endowment. Thus, there is no uniform definition of the smart grid. Some countries and organizations described the smart grid in terms of its adopted technologies and main characteristics.

US Department of Energy (DOE): The smart grid adopts advanced sensing technology, communication technology, and control technology, the power generation, transmission, and supply can be more efficient, economical, and safe. As a modern grid, it integrates a large number of innovative technologies in the fields of power generation, transmission, and distribution, as well as electrical equipment. All these techniques contribute to society and meet the changing needs of the future.

European Technology Forum: The smart grid employs innovative tools and technologies, products, and services, together with intelligent monitoring, communication, and control technologies in order to provide a one-stop service of power generation, transmission, and distribution for terminal consumer devices and equipment. It enables electricity



consumers to become active participants, thus providing more information choices, greater energy output, higher demand participation rate, and energy efficiency.

IBM proposed the smart grid solutions: First, increase the digital maturity of power equipment through sensors. Second, establish a data integration system and collection system. Third, improve the ability of data analysis, optimized operation, and management.

For China, the National Development and Reform Commission & National Energy Administration pointed out in Guidelines on the promotion of smart grids development issued in July 2015 that, the smart grid is a new generation of power system based on the traditional one, which employs new energy, materials, equipment, and advanced sensing technology, information technology, control technology, energy storage technology, and other new technologies. It boasts high levels of IT application, automation, and interaction, thus it can realize a safe, reliable, economical, and efficient operation of the power system.

The above definitions showed that what is a smart grid has no uniform recognition yet. This report regarded the smart grid as a future power system, representing the development direction. Based on the traditional power system, the smart grid employed new materials and technologies including energy storage and power electronics, together with advanced sensing and measurement, communication and information, and control technologies, forming a flexible, reliable, safe, efficient, adaptive, and self-healing grid. As a new grid, it can bear large-scale renewable energy and distributed generation, and respond actively to consumers.