



ENERGY TRANSITION SKILLS REPORT **2023**



BRICS
ENERGY RESEARCH COOPERATION PLATFORM

ISBN 978-0-7961-0629-2

The work covers diverse skills required for the energy transition and security for BRICS countries as they shift from traditional, non-renewable sources of energy to renewable, sustainable sources of energy. There is a growing demand for individuals with specific skills to support and accelerate energy transition as the world transitions to a greener and more sustainable future. For this reason, the BRICS Energy Transition Skills Report focuses the skills and approaches for the transition.

The material was prepared by experts of the BRICS Energy Research Cooperation Platform based on the national information provided and with the active participation of relevant ministries of the BRICS countries. The study consists of three chapters, the first chapter touches on the status and progress of the labour market in the BRICS countries to support energy transition. The second chapter provides an analysis of the BRICS countries' national parts. The last chapter outlines prospects for cooperation between the BRICS countries in the development of the labour market in the energy sector, energy education and human potential.

The research is intended for government officials, representatives of science and business, and can be used for educational purposes.



ACKNOWLEDGEMENTS

This report was made possible thanks to the support and advice of many individuals and organisations.

The committee of BRICS Senior Energy Officials plays a key role in providing guidance and support at all stages of the report's lifecycle. BRICS ERCP would like to thank each of its members for their priceless time.

The BRICS ERCP would like to acknowledge the support from the Ministry of Mines and Energy of the Federative Republic of Brazil, Ministry of Energy of the Russian Federation, Russian Energy Agency by the Russian Ministry of Energy, the State Atomic Energy Corporation "Rosatom", National Energy Administration of the People's Republic of China, Department of Mineral Resources and Energy of the Republic of South Africa and South African National Energy Development Institute.

The following ERCP experts took part in the preparation of the report: (Brazil) JULIATTO Marco Antonio, MACHADO Giovani Vitória, SOARES Jeferson Borghetti, de MAGALHÃES Gustavo Miranda, de FREITAS Gomes Maria das Graças, (Russia) NEDASHKOVSKAYA Tatyana, BIKKULOVA Gulnara, SAVCHUKOVA Anastasia, ZAITSEVA Alena, KOZYREVA Mariia, (India experts missing), (China) WEI Xiaowei, XIANG Qianfei, JIANG Hao, HUO Jingying, XIE Yuetao, LIU Jianpeng, FAN Dewen, WU Zhen, ZHAO Xinyu, XIE Yihan, WANG Jianliang, ZHENG Xinzhu and LI Lingyun, DING Jian and LIANG Meng from China, (South Africa) YUSUF Teslim Mohammed, MOOKAPELE Mpho, NAIDOO Raj, SERFONTEIN Dawid E., POPOOLA Olawale, LYDALL Joslin.

BRICS ERCP are also grateful to (Russia) Russian Energy Agency by the Russian Ministry of Energy, Rosatom Corporate Academy, (China) China Renewable Energy Engineering Institute (CREEI), China Southern Power Grid International Co., Ltd, China Electric Power Planning & Engineering Institute (EPPEI), CNPC Economics & Technology Research Institute, China University of Petroleum, Beijing (CUPB), (South Africa) South African National Energy Development Institute (SANEDI), South African National Energy Association (SANEA), (International Organisations) International Labour Organization (ILO), International Renewable Energy Association (IRENA).

BRICS ERCP would like to express gratitude to South African Chairmanship for leading the preparation of the Energy Transition Skills Report and its publication. Overall guidance was provided by the Mr. Jacob Mbele - Director General of Department of Mineral Resources and Energy of the Republic of South Africa.

Special thanks to Yusuf Teslim Mohammed from the South African National Energy Development Institute, who coordinated, oversaw production of this report and overall publication process.

We are also very grateful to Litha Publications for the design of the cover page and University of Pretoria for the printing of the report.

CONTENTS

2023 Energy Transition Skills Report





FOREWORDS


	Alexandre Silveira: Brazil	1
	Shulginoc Nikolay: Russia	3
	Raj Kumar Singh: India	5
	Zhang Jianhua: China	7
	Samson Gwede Mantashe: South Africa	9

INTRODUCTION 11

CHAPTER 1

ENERGY TRANSITION SKILLS OF THE BRICS COUNTRIES 13

	1.1 BRAZIL	15
	1.1.1 Current demographics	16
	1.1.2 Labour market analysis in the energy sector	42
	1.1.3 Planning horizon for national development	59
	1.1.4 Incorporation of women and youth in the energy sector	62
	1.1.5 Case studies	63
	1.2 RUSSIA	71
	1.2.1 General demographics on the country	72
	1.2.2 Energy sector labor market	75
	1.2.3 System of professional education for the FEC	82
	1.2.4 Engagement of potential employers in professional education	84
	1.2.5 Women and youth representation in FE	85
	1.2.6 Case study	86
	1.3 INDIA	91
	1.3.1 Current demographics	92
	1.3.2 Labour market analysis in the energy sector	92
	1.3.3 Labour market analysis in the energy sector	93
	1.3.4 Incorporation of women and youth in the energy sector	94
	1.4 CHINA	97
	1.4.1 Current demographics	98
	1.4.2 Current state and development trends in energy education in the energy transition	99
	1.4.3 Planning horizon for the energy sector	106

	1.5 SOUTH AFRICA	111
	1.5.1 Current demographics	112
	1.5.2 National education system	114
	1.5.3 Labour market analysis in the energy sector	117
	1.5.4 The main challenges in the field of personnel training for the fuel and energy complex	120
	1.5.5 Planning horizon for the skills transition	125
	1.5.6 Incorporation of women and youth in the energy sector	128
	1.5.7 Case studies	130
	CHAPTER 2	
	BRICS UNIVERSITIES, ENERGY COMPANIES SURVEY RESPONSE AND ANALYSIS	138
	2.1 ENERGY TRANSITION SKILLS SURVEY AND ANALYSIS	139
	2.1.1 Best practices	143
	2.1.2 Research and development initiatives	144
	2.1.3 Regional integration of the energy labour market	145
	2.1.4 Educational programs and research initiatives	145
	2.1.5 Exchange programs for students and professors	146
	2.1.6 Energy education curriculum development	147
	CHAPTER 3	
	PROSPECTS FOR COOPERATION BETWEEN THE BRICS COUNTRIES	152
	3.1 LABOUR MARKET DEVELOPMENT, ENERGY SECTOR REFORMS, ENERGY EDUCATION AND HUMAN POTENTIAL	153
	3.1.1 Purpose of cooperation	153
	3.1.2 Main directions for future cooperation	156
	3.1.3 Facing challenges to cooperation	157
	3.1.4 Current state of cooperation	158
	3.1.5 Potential areas for further cooperation	159
	3.1.6 Prospects for future cooperation	160
	CONCLUSION	161



Alexandre Silveira

Minister of Mines and Energy of the Federative Republic of Brazil

FOREWORD

The energy transition has been a recurring theme in global discussions, mostly associated with the need to mitigate environmental impacts and decarbonize economies. Brazil, starting from a favorable outlook with predominance of renewables in the energy and electricity matrices, has been nevertheless proactive in identifying opportunities arising from this recent perspective.

It is worth highlighting the relationship between the transition and the growing need for mechanisms to increase energy security. The energy transition can play a vital role in security, not only as a requirement - given the aforementioned need to decarbonize economies - but also acting as a catalyst for energy security itself, by allowing for the rational use of energy resources in each country, in order to ensure greater stability and guarantee of supply.

This calls for the development of a qualified workforce that can support the transition to low-carbon energy sources, such as wind, solar, biomass, hydroelectric, nuclear and others with the adoption of emission abatement technologies. It also requires investment in education and training programs that may provide citizens with the necessary skills to be an integral part of this process, especially in a scenario of growing perspectives for the renewables sector. Our country has made some progress in this field and experienced the growth of jobs in areas related to renewable energies.

Brazil is capable of being one of the vectors and proponents of this change, and we do believe that efforts and cooperation will be necessary for us to tread a more prosperous path for all. BRICS members share some similar perspectives and challenges and should work together to strengthen as well as expand cooperation in the energy sector, ensuring that we are prepared to face this call and explore our synergies. In this sense, the Energy Transition Skills report is a direct product of collaborative work within the BRICS. It shows that we are ready to participate in the global energy transition process, bringing our own perspectives regarding the use of low-emission energy, in a rational, pragmatic, but also just and lasting way.



Shulginov Nikolay

Minister of Energy of the Russian Federation

FOREWORD

Representing the world's largest energy producers and consumers, BRICS countries also form a major global repository of labour force. It is extremely important to get the maximum out of this competitive advantage. Likewise, there is an outstanding need to keep the five countries' focus on the issues related to the development of energy labour market, human resources, and extend their cooperation in that regard.

The world is now embarking on energy transition, which would eventually transform the global labour market. Our countries chose to follow that path as well. We are fully aware that such conversion would require additional measures with regards to specialists' training and professional development. Attracting young specialists to the industry and providing them with decent working conditions is of particular importance here.

Therefore, we warmly welcome the launch of BRICS study dedicated to the development of human resources in the era of energy transition. It was drafted and finalised by the experts of the BRICS Energy Research Cooperation Platform. In the process of its preparation, we have managed to summarise the best practices from our countries with regards to personnel training, as well as to form a community of experts committed to fully implement the report's recommendations, in the format of the Informal Steering Committee consisting of the representatives of BRICS energy companies, universities, as well as the International Labour Organization.

I am confident that the results of the study would serve as a solid basis for the development of energy cooperation between our countries and lead to the launch of new practically oriented projects!



Raj Kumar Singh

Minister of Power of the Republic of India

FOREWORD

In an interconnected world where economic growth, technological advancement, and quality of life are increasingly intertwined with the availability and stability of energy resources, the concept of energy security has risen to the forefront of global discussions. As nations grapple with the challenges posed by rapid industrialisation, urbanisation, and population growth, the quest for a reliable, affordable, and sustainable energy supply has become paramount. Among these nations, the BRICS group – comprising Brazil, Russia, India, China, and South Africa, stands as a vital coalition that plays a pivotal role in shaping the global energy landscape.

This report stands as a testament to the collective commitment of scholars, policymakers, and stakeholders to unravel the complexities of energy security and contribute to the informed dialogue that will guide our global energy trajectory. We extend our sincere gratitude to all the contributors, researchers, and experts whose dedication and insights have enriched these endeavours.

[Foreword from the Energy Security Report]



Zhang Jianhua

Administrator of National Energy Administration, the People's Republic of China

FOREWORD

Representing the world's largest developing and emerging markets, the BRICS are experiencing rapid economic growth and have a high demand for energy. From 2010 to 2022, Our share in global energy consumption increased from 34.7% to 41.1%, significantly transforming the world's energy landscape. Embracing the global trend of green and low-carbon development, the BRICS are actively promoting the clean transition of energy and becoming a crucial driving force for global energy transformation.

In response to climate change, each member of the BRICS has set its own energy transition goal. China aims to increase the share of non-fossil energy in primary energy consumption to around 25% by 2030 and over 80% by 2060.

The advancement of renewable energy technologies like wind and solar power has substantially reduced the cost to generate electricity, making the green transformation of energy an irreversible global trend. In line with Xi Jinping's Thought on Ecological Civilization and his important statements on energy revolution, China is steadfastly pursuing clean and low-carbon energy transition and actively responding to the climate change. With continuous efforts, China has built the world's largest clean energy power system, with the total installed capacity of renewable energy exceeding 1300 GW, and that of the wind and solar power growing by 12 times over the past decade. Sincerely, China is willing to uphold the spirit of "Openness, Inclusiveness and Win-win Cooperation" to work alongside other BRICS countries, to strengthen clean energy cooperation, jointly promote energy transition, address climate change, and build a green, low-carbon, clean and beautiful home for the Earth.



Samson Gwede Mantashe

Minister of Mineral Resources and Energy of the Republic of South Africa

FOREWORD

BRICS country energy sectors are being driven by several key global and local trends. These trends have critical implications for skills development as current jobs are impacted together with new occupations and skills needed to support our energy transition. Our citizens and workforce continue to play a pivotal role in driving the transition of our energy systems, supporting our goal and aspirations for alternatives to cleaner sources of fuels and technologies. In our efforts to strengthen the role of the BRICS countries in global energy discussions, we must continue to work together to achieve a better quality of life for people most impacted like women and the poor through the just energy transition and investing in the development of our workforce.

The BRICS approach to energy transition skills is primarily based on the energy strategies of each country, relative to its peculiar energy sector. The BRICS countries have a common and shared goal of just energy transition, ensuring energy security through the expansion of energy access, and creating cleaner, low carbon energy systems to reduce the impact of climate change amongst others socio-economic benefits.

As the population of the BRICS countries continues to grow, the demand for energy is equally expected to follow the same trend. An inclusive approach of upskilling and reskilling our workforce through targeted training programmes and labour market development in the context of the energy transition is crucial for BRICS countries.

South Africa is pleased to present a study focused on future thinking and providing a bases for discussions and an inclusive approach towards energy transition skills. I am confident that this report will contribute towards strengthen and enhance BRICS contribution in ensuring a successful skills development in our energy transition journey. Finally, I would like to acknowledge the authors of this year's BRICS Energy Transition Skills Report and Russia as co-organisers, well done.

INTRODUCTION

Each of the BRICS countries - Brazil, Russia, India, China, and South Africa – has formulated a concrete timeframe goal to achieve carbon neutrality: Russia and China – by 2060, Brazil and South Africa – by 2050, and India – by 2070. To achieve this goal of carbon neutrality, it is widely acknowledged that new skills are needed, making reskilling of the current labour force in the energy sector a priority for these countries.

The BRICS countries possess immense potential for collaborative efforts aimed at advancing the labour market within the energy sector, promoting energy education, and unlocking human potential. By leveraging their collective strengths and synergies effectively, these nations could achieve remarkable strides in transitioning towards sustainable energy sources, thereby creating substantial employment opportunities, fostering skill development, and elevating energy education to new heights. This cooperation not only facilitates their individual energy transition but also contributes significantly to global sustainability objectives.

To grasp the magnitude of future cooperation, it is essential to recognise the significant role played by each BRICS country. As of 2021, BRICS countries represented nearly 42% of the world's population and accounted for over 23% of the global Gross Domestic Product (GDP). Moreover, China and India, among the largest consumers and producers of energy worldwide, contribute substantially to the collective energy resources. For instance, in 2019, China alone employed an estimated 20 million workers in its energy sector, highlighting the sector's vast workforce on a global scale, which was approximately 65 million, as reported by the International Energy Agency (IEA).

To harness the full potential of sustainable efforts, it becomes essential to explore the distribution and focus of skills provided by each BRICS country and determine how they can be effectively implemented to promote ongoing growth and emissions reduction globally. The existing focus on economics, trade, finance, technology, sustainable development, and global governance within BRICS provides a robust platform for cooperation that can yield significant global impacts. Notably, the transition to sustainable energy sources will act as a catalyst for job creation, as emphasised by the International Renewable Energy Agency (IRENA) report, which highlights the renewable energy sector as a significant source of job creation, with global employment potential projected to reach 42 million jobs by 2050.

One pivotal aspect of this collaboration lies in the sustainable energy transition. By pooling their resources and expertise, BRICS countries can expedite the adoption of renewable energy technologies, such as solar, wind, and hydroelectric power. The International Renewable Energy Agency (IRENA) report from 2019 indicates that the renewable energy sector employed around 11.5 million people globally, and BRICS, especially China and India, have witnessed substantial growth in renewable energy installations with investments amounting to billions of dollars. The

establishment of institutions like the New Development Bank (NDB) further paves the way for the future implementation of infrastructure and sustainable developments in BRICS countries, emerging economies, and developing nations, thereby unlocking a wave of new employment opportunities and addressing critical social and economic challenges.

Moreover, the focus on energy education becomes paramount in this context. Equipping their populations with the necessary skills and knowledge is crucial for effectively deploying and managing of energy sector's development. By investing in energy-related education and vocational training, BRICS nations can empower their workforce to meet the demands of an evolving energy landscape. Additionally, fostering research and innovation in clean energy technologies will pave the way for ground-breaking advancements that benefit all member countries. As observed by the QS World University Rankings, BRICS universities accounted for 10% of the top 800 universities globally in 2016, marking a significant increase from 7% in 2009, which emphasizes the region's commitment to quality education.

BRICS is committed to fostering inclusive growth and addressing societal inequalities, particularly concerning women's empowerment in the energy sector. As part of their collective efforts, BRICS countries aim to create opportunities and initiatives that include the disadvantaged and marginalized populations, ensuring they actively participate and benefit from the energy industry's growth. With a focus on gender equality, BRICS nations promote policies and programs that support the advancement of women in the energy sector, advocating for equal access to education, training, and leadership positions. By striving for an inclusive and diverse energy workforce, BRICS seeks to tackle gender disparities and foster a more equitable and sustainable energy landscape.

Ultimately, the overarching goal of this cooperation extends beyond individual nation-building efforts. By aligning their energies and ambitions, the BRICS nations aspire to forge a global path towards sustainability. Their dedication to sustainable energy practices and shared knowledge exchange, in line with the United Nations' Sustainable Development Goals (SDGs) and the Paris Agreement, holds the potential to significantly contribute to international targets, driving the world towards a more sustainable and prosperous future.

This report addresses the existing state of energy skills within the BRICS countries and the challenges they face in ensuring energy skills development both in the present and for the future, especially concerning their energy transitions. It also emphasizes significant areas of collaboration in the context of energy skills. It is recognised that the BRICS countries have distinct energy strategies that complement each other, presenting opportunities for enhanced intra-BRICS cooperation in advancing energy skills to bolster domestic energy security and fuel economic growth.

CHAPTER 1



ENERGY TRANSITION SKILLS OF THE BRICS COUNTRIES

BRAZIL



[1.1]

1.1.1 CURRENT DEMOGRAPHICS

The Brazilian Institute of Geography and Statistics (IBGE) is responsible for collecting and disseminating the main demographic data in Brazil. According to the most recent information, the total population of the country is approximately 213.9 million people (2021), occupying an area of 8,510,345.538 km². Based on this data, we can conclude that Brazil is a country with a large population in absolute terms, placing it among the largest in the world, but with a low population density, with only 22.43 inhabitants per square kilometer.

The distribution of the population across the Brazilian territory is irregular. The most populous region is the Southeast, with 89,632,912 inhabitants, with about half of them residing in the state of São Paulo. On the other hand, the Midwest region is the least populated, with 16,707,336 inhabitants. In terms of federative units, Roraima is the least populous state, with an estimated 652,713 inhabitants in 2021.

In recent years, the country's population growth has slowed down, due to the gradual reduction in fertility and birth rates. The fertility rate, which was already higher than two children per woman in the mid-twentieth century, has remained stable at around 1.76 since at least the year 2000. Furthermore, infant mortality has declined in recent decades, reaching current rate of 11.56 per thousand live births.

Another important and more recent phenomenon is the aging of the Brazilian population. This is due to several factors, such as a reduction in the number of births, improvements in health, broader economic development indices and other aspects of everyday life that ensure life expectancy. Currently, life expectancy at birth in Brazil is 76.6 years (IBGE, 2020), being higher for women (79.9 years) than for men (73.1 years).

National Education System

Education in Brazil, according to what is determined by the Federal Constitution and the Law of Guidelines and Bases of National Education (LDB – 9.394/96), is the responsibility of the Union, states, Federal District and municipalities, which must manage and organize

their respective education systems. Each of these public education systems is responsible for its own maintenance, which generates funds, as well as the mechanisms and sources of financial resources. The Brazilian educational system is divided into Basic Education and Higher Education. Basic Education, from the Law of Guidelines and Bases of Education (LDB - 9.394/96), started to be structured by stages and teaching modalities, encompassing Early Childhood Education, compulsory Elementary Education of nine years and High School.

Basic Education

Basic Education, from the Law of Guidelines and Bases of Education (LDB - 9.394/96), started to be structured by stages and teaching modalities, encompassing Early Childhood Education, compulsory Elementary Education of nine years and High School. It is mandatory and it is the duty of parents or guardians that children and young people complete basic education, just as it is the duty of the State to provide this education.

Modalities:

- i. Early Childhood Education: duration of 4 years, with students from 0 to 3 years old;
- ii. Pre-school: duration of 3 years, with students from 4 to 6 years old;
- iii. Elementary School: duration of 9 years, with students from 6 to 14 years old;
- iv. High School: duration of 3 years, with students from 15 to 17 years old;
- v. Technical High School: schools can offer technical courses in non-shift periods, which are extra-class periods for their students. The duration is variable and can be from 1 to 3 years.

Other Modalities of Basic Education:

Special Education - Special Education exists to meet the demand of students with disabilities or mental illnesses. It is applicable in any type of educational institution that must meet technical demands in terms of material, technology and pedagogy. Even so, it is more common to find educational centers dedicated to this type of education.