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Navigating Risk in Sri Lanka's Renewable Energy Transition: *Key Challenges Affecting Investment in Onshore Wind Farms*

> In alignment with the 13 Sustainable Development Goals (SDGs) that emphasize the transition from fossil fuels to renewable energy [1]. Sri Lanka stands at a pivotal juncture in embracing this transformative trend. The country can significantly reduce its carbon footprint, enhance energy security, and foster sustainable economic growth by investing in renewable energy sources such as wind, solar, and hydroelectric power. With its geographical advantages, Sri Lanka has enormous potential to harness energy from renewable sources like wind, and sunlight. However, as of 2018, only 39% of Sri Lanka's energy generation has been utilized through renewable energy sources. Located in one of South Asia's largest monsoon belts, Sri Lanka benefited from excellent wind resources with an estimated 5000 km2 of wind energy potential in 2003 [2].

In addition to its potential for energy generation, wind energy investments are of paramount importance regarding environmental, social, and governance benefits for the nation's sustainable development goals in Sri Lanka (Figure 1).

Figure 1: ESG Benefits
(Source: Developed by the Authors)

Also, Sri Lanka has a variety of barriers that hinder this renewable energy source from being fully utilized. The lack of sufficient infrastructure, such as transmission lines and grid capacity, to enable large-scale wind power generation is one of the primary barriers [3]. Financial limitations are another significant barrier, that makes it difficult for investors to commit to long-term projects due to high upfront capital costs and limited access to low-cost financing. Wind energy projects are hindered from expanding by bureaucratic procedures and regulatory barriers such as lengthy permission applications and processing times. Furthermore, uncertainty is created for potential investors by unstable policies and unclear incentives for investing in renewable energy. To achieve sustainable development, environmental issues including the effect of wind farms on ecosystems and animals must also be specifically considered. To maximize the potential of wind energy investment in Sri Lanka, several issues must be resolved [4]. Therefore, it is urged to have a systematic study to identify the main barriers to Sri Lanka's renewable energy development, outline the important risk factors impacting investment in onshore wind farms there, and suggest solutions to mitigate these risks.

In Sri Lanka, the development of wind energy projects has been contributed significantly by private sector funding [5]. Further, enhancing Sri Lanka's potential for wind energy is the financing support that the Asian Development Bank (ADB) has provided to the Ceylon Electricity Board (CEB) for the development of wind farms that the CEB owns. In Sri Lanka, the private sector provides a significant amount of funding for most wind power projects, even with some governmental sector involvement. This shows how important it is for private investors to support the whole country's transition to renewable energy [6].

The wind energy sector in Sri Lanka is mainly concentrated in Mannar and Puttalam, where Puttalam has infrastructure and is the home of six operational wind farms with a capacity of 80 MW. The Mannar wind farm has a massive capacity of 300 MW after the second phase, and a 250 MW extension and other future projects will be developed. Kilinochchi generates 20 MW, while Pooneryn intends to add 100 MW [7]. The private sector plays a major role in the process [8]. International firms have a keen interest in Sri Lanka's wind energy projects, whose total capacity of 350 MW will be

planned in Mannar and Pooneryn [5]. The scope of the wind energy projects includes both small 3 MW farms, such as Ambewela, and massive infrastructure, such as the 300 MW Mannar wind farm, indicating that the trend is shifting toward the latter by using the most current technology.

Despite Sri Lanka's limited capacity for substantial investments, valuable opportunities in the wind energy sector have been overlooked. Therefore, a team from the Departments of Industrial Management, Faculty of Business, and University of Moratuwa aims to address these challenges by leveraging available opportunities. The study aims to achieve three objectives; conducting a situational analysis of wind energy investment in Sri Lanka, identifying key risk factors affecting investments that impact the growth and sustainability of the sector, and developing a framework for future investments of wind energy in Sri Lanka. By achieving these objectives, the study seeks to provide a comprehensive understanding of the current landscape and propose actionable strategies to enhance wind energy investments, thereby contributing to the country's sustainable energy goals.

To achieve the first two research objectives, the research follows a pragmatic approach, combining both primary (expert interviews) and secondary (government reports, industry publications, and literature reviews) data collection methods. Nine experienced wind energy industry professionals who represented important organizations including the Central Environmental Authority, Ceylon Electricity Board, and Sri Lanka Sustainable Energy Authority included in our expert interview sample. A set of questions covered a wide range of important topics guided the expert interviews, such as the current state of the Sri Lankan wind energy industry, upcoming and ongoing wind energy projects, financial feasibility, available financial instruments, risks and challenges related to the industry, environmental considerations, policy frameworks, and future trends. The information obtained from these experts' statements was insightful and helped to provide a comprehensive understanding present situation of the overall wind energy sector in Sri Lanka. As per the findings, key risk factors for wind energy investments were identified and narrowed down to six through peer debriefing—financial and economic risks, policy and regulatory risks, social risks, market risks, environmental risks, and technological risks—as visualized in Figure 2. Therefore, this study partially addressed the second ob-

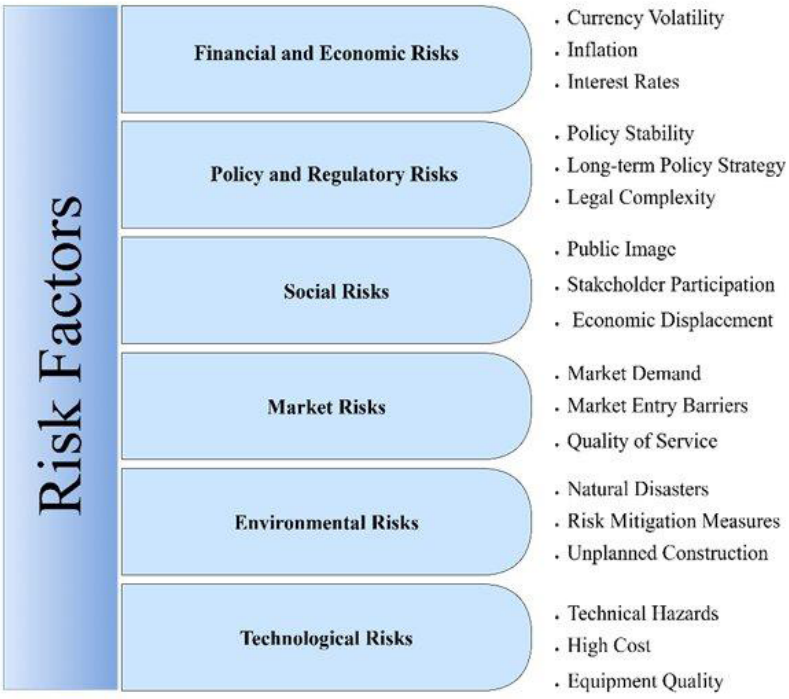

Figure 2: Risk Factors
(Source – Authors developed based on literature)

jective. As an ongoing study, to achieve the first objective and the remaining part of the second objective, interviewed data will be organized and analyzed using thematic analysis and NVIVO software. Further, using the Analytic Hierarchy Process—an analytical instrument that ranks the risks, the identified risk will be ranked. After ranking, we will develop a framework including targeted strategies to mitigate those risks based on the findings.

In summary, this study underscores the critical need for strategic investment in wind energy to unlock the full renewable energy potential of Sri Lanka. If these risks are mitigated and opportunities are harnessed within the industry, wind energy can enhance the country's energy security and facilitate suitable economic growth while contributing to global climate objectives. The comprehensive framework developed in this study will be an invaluable resource for investors and decision-makers, helping them to navigate the complexities of the wind energy market.

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