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Working Paper: Perception of Barriers to Renewable Energy in Southern Africa

Growth in renewable energy in Southern Africa has significantly lagged behind the ambitions and potential in the region, with wind and solar comprising less than 5% of total generation across the 12 mainland countries. In this study, the authors aim to understand the barriers to scaling up renewable energy in Southern Africa through surveys, focus groups, and interviews with energy planners, regulators, utilities, financiers, and project developers.

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Perceptions of Barriers to Renewable Energy in Southern Africa (Working Paper)

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Abstract

Renewable energy technologies—especially wind and solar—are well positioned to meet Africa's anticipated huge growth in electricity demand while reducing carbon emissions. However, the growth in renewable energy generation capacity has significantly lagged behind ambitions and potential in the region, with wind and solar comprising less than 5% of total generation across the 12 countries with South Africa accounting for the largest contribution. To understand the barriers to scaling up renewable energy, we conducted surveys, focus groups, and interviews with energy planning experts in the Southern Africa region. As a grouping, financial and economic barriers-including high costs of renewable and transmission projects and cost of capital-had the highest level of agreement across respondents for being an important barrier. Focus groups and open-ended survey responses identified the additional importance of the need for higher tariffs. Across the other barrier groupings,

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respondents identified lack of experience—either in the form of skilled labor or institutional implementation of renewable projects—as important barriers. There is significant disagreement that availability of suitable locations, government selected sites, and profitability are important barriers. Regulators, utilities, and government agencies were the most concerned about social, financial, and technical barriers while development banks and researchers identified institutional and technical barriers as being the most significant. Focus group themes largely reflected survey results, with particular concerns like the need for integrated resource planning, highlighted. Addressing these barriers will require significant policy interventions, both from national governments and the international community, especially to reduce the cost of renewable energy and transmission infrastructure through access to technologies, low-cost capital, and subsidies as well as to create a skilled workforce through training at all levels of the renewable energy industry.

1. Introduction

Electricity demand in the Southern African Power Pool (SAPP), which consists of 12 member countries, is expected to double by 2040 [1]. Non-hydro renewable energy resources (henceforth, RE) along with battery technologies with their rapidly declining costs can cost-effectively meet this growing electricity demand in the region. The region has large resources of both wind and solar, at least one or two orders of magnitude greater than future expected demand in most member countries [2]. Scaling up electricity generation from RE resources will also be an important strategy to meet climate goals. In 2021, at the Conference of Parties (COP) 26, two SAPP member countries pledged to quit coal, and a large majority (three-fourths) of the countries have a net zero target by 2050. Currently, the region's electricity system is dominated by coal and large hydropower. RE comprises less than 3% of electricity generation. Pursuing high RE targets within the next two decades will require addressing the barriers to electricity infrastructure generally and RE development specifically in the region [3].

In this study, we assess the perceptions of barriers to renewable energy in the Southern African region. We deploy surveys, focus groups, and interviews to identify barriers and their relative importance.

2. Methods

We employ a complementary suite of approaches—survey, modified focus groups, and interviews—for capturing the range of possible barriers to renewable energy development, identifying themes and trends, and comparing the relative importance of barriers in a systematic way.

2.1. Surveys

To quantitatively determine the relative importance of the various barriers, we deployed a Likert survey to energy experts and professionals across 11 SAPP countries (Angola, Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Tanzania, Zambia, Zimbabwe). We invited 92 experts to take the survey and we received 44 completed responses. Half of the respondents were participants who took the survey during a workshop on decision-support tools for planning renewable energy held in Johannesburg, South Africa in November 2019. Respondents were presented with statements about potential barriers to renewable energy development and asked to select among the following Likert answers: strongly disagree, disagree, somewhat disagree, neither agree nor disagree, somewhat agree, agree, and strongly agree.

We developed survey questions after conducting a thorough literature review of barriers to RE development generally and in other developing countries [4, 5, 6, 7, 8, 9], and in sub-Saharan Africa and the countries within SAPP specifically [3, 10, 11, 12]. Using the thematic framework originally presented in Painuly [4] and other more recent studies [8, 11], we grouped barriers into five categories–institutional, financial and economic, technical, social, and environmental. See Fig. 1 for the list of barriers as stated in the survey.

We calculated normalized Likert scale scores [13] for each of the barrier categories for each respondent by (1) assigning each of the Likert-type item responses (ordinal data) to numeric values (interval data) where "strongly disagree" was assigned a value of 1 and "strongly agree" was assigned a value of 7, (2) multiplying the number of Likert-type items within the category by 7 since that is the highest possible value, and (3) dividing the summed Likert interval data across all Likert-type items by this summed maximum value. Average normalized Likert scale scores were calculated for each type of organization for each category.

To determine if any Likert-type item responses or normalized Likert scale scores significantly differed between different groups of respondents (i.e., country, type of organization), we performed nonparametric Kruskal-Wallis Tests (i.e., a one-way ANOVA on ranks), given the low sample size within each of the groups, followed by the Dunn test if the Kruskal-Wallis test was significant.

In addition to asking multiple choice survey questions to gauge opinions on common barriers, respondents were given the opportunity to share what they considered to be the most hindering barriers to renewable energy development. The question they were asked was, "In your opinion, what are the top three barriers to renewable energy development in your country or region? You may list barriers mentioned in the above questions or additional ones you propose. Please list them below in order of their importance."

These user generated responses were initially categorized into the general barrier categories of financial/economic, institutional, social, environmental, and technical. They were then further categorized into subcategories. Any subcategory with 5 or more responses was kept as a subcategory. The rest were grouped together under the broad category name. There were not enough responses from the Multilateral Development Banks or Project Developers/Renewable Energy Companies, so these were grouped into one organization group labeled "Other (Bank/Project Developer).

2.2. Focus groups

Focus groups are a form of social science research in which participants discuss topics of questions to elicit hidden "norms, beliefs, values" shared across all participants that may otherwise not come to the fore through single interview or survey methods [14, 15, 16]. During the same decision-support workshop held in November 2019, we formed modified focus groups by organizing participants using the country within which they work or if the participant works for an international organization, the country that they are most knowledgeable about with respect to the energy sector. Utility, regulator, ministry of energy, academic, and industry representatives comprised each of the nine country focus groups (Angola did not have enough participants to form a group). Groups sizes ranged from two (Malawi) to six (Zambia). We modified the traditional focus group method, in which participants are interviewed within the focus group, to one in which each focus group was asked to discuss and answer the following question amongst themselves and then share the outcomes of the discussion with all participants

during the workshop: "What issues has your country or region encountered in developing more renewable energy and what are your ideas for how power sector planning processes and operations can be improved to address them?"

Responses were coded, categorized (as institutional, financial and economic, technical, social, or environmental), and either matched with a barrier within the survey or noted as not captured in the survey. Common barriers were quantified across countries.

2.3. Interviews

We conducted 25 individual semi-structured interviews with experts either in person during the decision-support workshop or via web conference calls from November 2019 through July 2020. The following two guiding questions were asked: 1) What are the top 3 challenges or barriers facing utility-scale wind and solar development in your country or region? What suggestions do you have for addressing these barriers? 2) In your opinion, what are some of your biggest concerns about wind and solar development in your country or region? Interviews were recorded and then transcribed. For coding the transcriptions, we conducted thematic content analysis to find patterns across the interviews. We also used a deductive coding approach by assigning coded barriers to the survey barrier categories and to the closest equivalent barrier in the survey.

3. Results and Discussion

3.1. Surveys

Responses to the surveys were categorized as predominant agreement and disagreement to barriers to RE are shown in Figure 1. The barriers are ordered by mean value for agreement and disagreement, starting from a high level of agreement to a high level of disagreement.

The most number of barriers that had significant agreement across survey respondents are in the Financial and Economic category. These barriers include inadequate government incentives, unfavorable terms of financing for RE projects including high cost of capital and shorter loan repayment times, high costs of RE technologies and transmission interconnections, difficulties in procurement of generation equipment compared to more developed RE markets, and delays in payments for RE by buyers. These barriers are all interrelated and highlight the need to reduce costs associated with RE project development and to provide adequate financial support for these projects.

Importantly, respondents disagreed that large-scale RE projects are not profitable.

In the Institutional category, important barriers cited by respondents include inexperience of public institutions in implementing RE, weak incentives for RE development in energy policies and regulations, and an inability or a lack of willingness to use capacity investment plans to inform renewable energy procurement or transmission upgrades for new RE development.

Key barriers cited in the Technical category are poor quality or unavailability of data or studies on specific country and regionally-relevant RE costs and project finances, as well as RE resources. But importantly, respondents disagreed that quality of RE resources in the region is poor. Further, delays in building and providing access to transmission interconnections is also an important barrier to RE development.

One of the most important barriers to RE development agreed by respondents is the lack of skilled labor required for designing, building, and operating RE projects. This barrier in the Social category highlights the importance of building training facilities and programs that help create a skilled workforce for the RE industry. Other barriers that had broad agreement in this category include limited local jobs or ownership opportunities in RE project areas and the potential relocation of communities for renewable energy deployment.

Lastly, wildlife and biodiversity impacts of RE are cited as an important barrier in the Environmental category. However, respondents largely disagreed that low-ecological impact or low-conflict areas were not available for RE development. They also disagreed that RE development resulted in negative impacts on ecotourism or natural habitat.

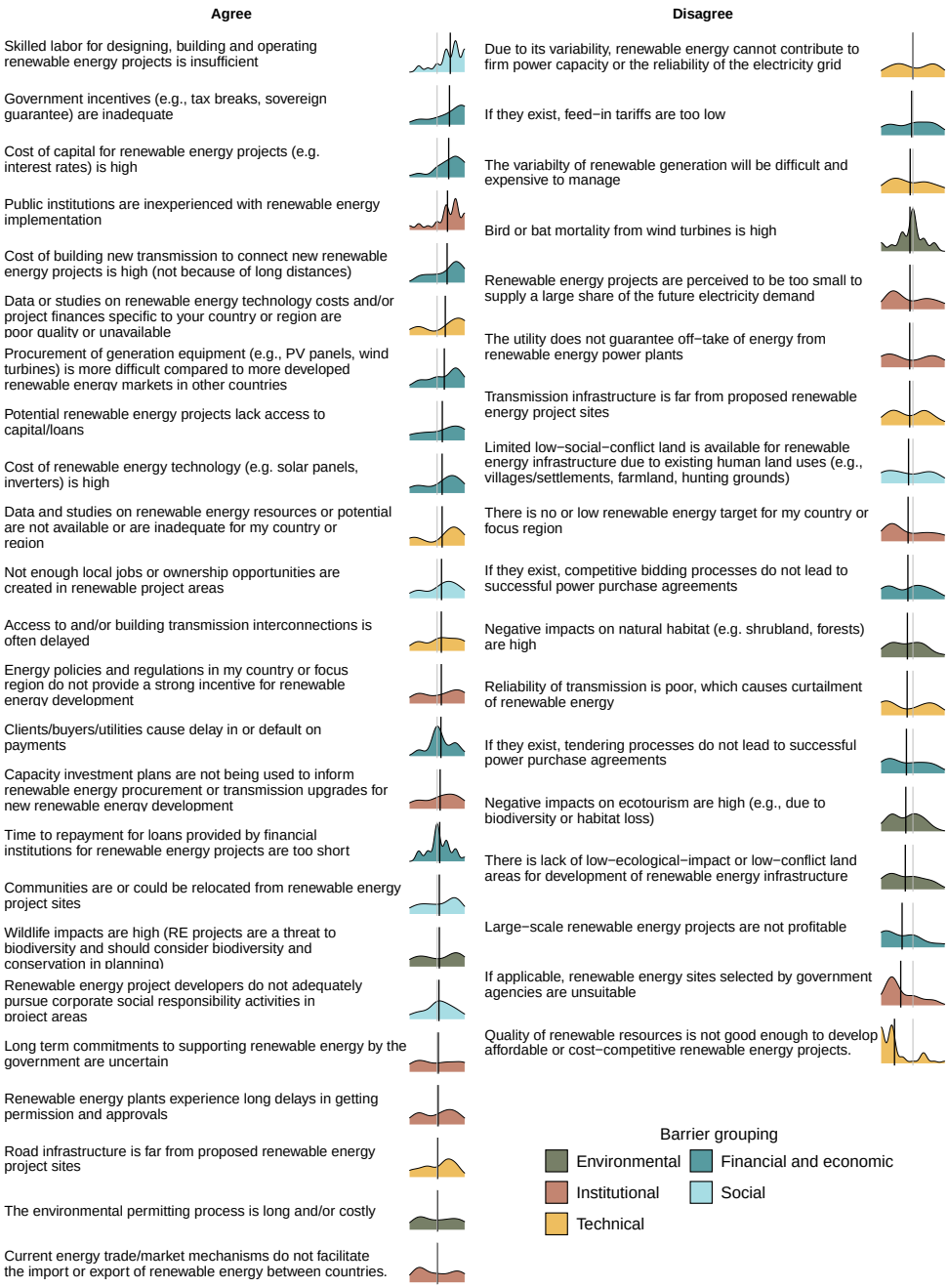

Figure 1: All barriers with mean values indicating predominant agreement (left) and disagreement (right), ordered from top to bottom by mean value. The kernel density plots show the distribution of survey responses. Curves leaning to the right of the mean indicate agreement whereas those leaning to the left indicate disagreement with the stated barriers.

Figure 2 shows the normalized Likert scale scores for each barrier category for each type of respondent (organization). Higher scores indicate greater agreement about barriers within the barrier categories. Respondents from regulatory organizations, utilities, government agencies, and regional inter-governmental organizations agreed most about barriers in the Social category, followed by the Financial and Economic category. Respondents from multi-lateral banks and academic research organizations agreed most about Institutional barriers. Respondents from regional inter-governmental organizations and multi-lateral banks also agreed that Technical barriers are critical. However, differences in perceptions of barriers between respondent groups are relatively small.

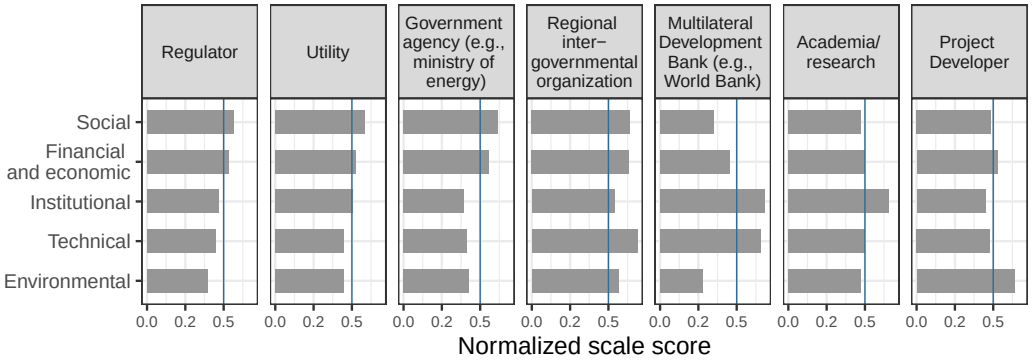

Figure 2: Average normalized Likert scale score for each organizational grouping.

Results of the non-parametric Kruskal-Wallis Tests to test whether any of the barriers were perceived differently between respondent organizations or countries were negative. Hence, we fail to reject the hypothesis that there is a difference in the perceptions of barriers across type of organizations or countries. The lack of significance may be driven by the low sample size within each respondent category.

There were 40 respondents who answered the question, "In your opinion, what are the top three barriers to renewable energy development in your country or region?" This generated 123 responses in total. Some respondents gave fewer than three responses, while some gave more.

Figure 3A shows a stacked bar graph with the totals of responses for each broad barrier category, by organization type. Economic barriers were the most frequently mentioned barrier. Government agencies are the most concerned about economic barriers. Many of these responses, from all or-

ganization types, referenced the high cost, the lack of incentives, and the lack of access to finance and funding for renewable energy. Technical and institutional barriers had the next highest frequency of responses. Utility companies had the highest number of responses in the technical category.

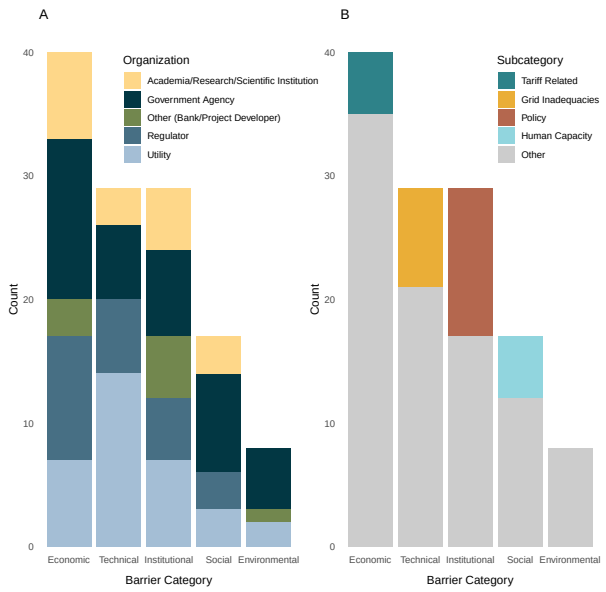

Figure 3: Total responses in each barrier category by organization (sub-figure A) and subcategory (sub-figure B).

Figure 3B shows the total number of responses and the subcategories within each category. For each category except one (environmental), there is one subcategory. The subcategories are included in the count of the total for that barrier because they fall under the umbrella of the general barrier. A large percentage of institutional barriers fall into the subcategory of policy. Respondents mention a lack of regulatory frameworks and an "absence of detailed policy, strategy and legislation to support the development of renewable energy policy." The subcategory of economic barriers is tariff related barriers. These responses include the lack of Renewable Energy Feed-in Tariff (REFIT) rules and appropriate tariffs. The subcategory of technical barriers included concerns about grid inadequacies, specifically regarding "weak network infrastructure", "interconnection of renewable energy sources to the national electricity network", and "power system reliability challenges limiting level of penetration." The subcategory of the social barrier is human

capacity. These barriers referenced the "lack of technical expertise" for the design and installation of renewable energy projects.

These responses also give insight into barriers that were not included in the survey. In the financial realm, these barriers include "developing funding mechanisms to develop skills development and local manufacturing", needing reasonable lending rates, attracting investors/developers, and the "lack of clear government support to finance renewable energy projects." Institutional barriers that were not covered by the survey mentioned the lack of regulatory frameworks and the lack of interest from utilities in renewable energy. Respondents also noted the lack of political will or understanding of the role the government could play in developing renewable energy. Similar to this is that "governments want to deliver a project for personal or political game rather than invest in a strong development or procurement process." Also noted was the "Weak legal framework for the implementation of renewable energies." Technical barriers that were not covered in the survey mentioned the difficulty in connecting to the grid, weak network infrastructure, and "ineffective/inadequate grid codes to ensure effective integration and associated connection requirements of renewable energy on the power system." The lack of storage systems was also not covered in the survey.

3.2. Focus group results

Results of focus group discussions are summarized in Table 1. The focus groups raised many of the barriers to renewable energy development captured in the surveys.

Similar to the survey results, in the Social category, lack of local capacity was cited as as major barrier. Likewise, in the Financial and Economic category, lack of incentives, adequate tariffs, and availability of loans to cover the perceived high costs of RE were cited as barriers. In addition, a need for competitive bidding was also mentioned within the focus groups. In the Institutional category, a need for an Integrated Resource Planning (IRP) process was strongly highlighted across country representatives to allow for diversification of energy generation. An IRP process is a stakeholder process, usually led by electric utilities, to comprehensively evaluate both supply-side and demand-side resources and create a plan for generation, storage, transmission, and demand-side investments to meet future electricity demand. In addition, focus groups cited a lack of coordination among stakeholders and division of responsibilities among ministries and agencies as barriers not specified in the surveys. Inadequate energy resource assessment studies and

transmission constraints were stated as barriers in the Technical category, similar to the survey results. Interestingly, no barriers in the Environmental category were mentioned in the focus groups other than land use prioritization.

Table 1: Focus group results

Category	**Captured in survey**	**Not captured in survey**	**Cross country themes**
Social	• Lack of adequate local technical capacity (**A1**)	• Lack of capacity building • Sparsely populated	• Lack of local capacity (n=3)
Financial & economic	• Lack of incentives (**A2**) • High cost and lack of access to capital (**A3**) • Need higher tariffs (**A2**) • Developers are unable to get loans (**A8**)	• Need competitive bidding for RE tenders	• Need more incentives, especially higher tariffs (n=5)
Institutional	• Procurement takes forever or never happens at all (**A21**) • Lack of licensing process and standardizing the documents needed for RE development (**A21**) • Lack of regulatory procurement framework (**A21**) • No generation and transmission investment plans (**A15**) • Lack of policies for RE (**A13**) • Lack of political will (**A20**)	• Lack of coordination among stakeholders and division of responsibilities among ministries or agencies • Lack of Integrated Resource Planning that allows diversification of energy generation	• Need IRP (n=5) • Need procurement framework (n=4) • Lack of coordination among stakeholders and division of responsibilities among ministries or agencies (n=3)
Technical	• Lack of resource assessment studies or inadequate studies (**A10**) • Lack of grid connection (**A5**, **D7**) • Inadequate transmission and distribution infrastructure (**A12**, **D12**) • Intermittency mitigation through storage systems (batteries) (**D2**) • Inadequate reserves to cover renewable energy variations (**D2**)	NA	• Lack of or inadequate resource assessment studies (n=3) • Transmission constraints (n=3)
Environmental	NA	Land use prioritization	NA

Codes A* and D* represent barriers in the Agree and Disagree categories in Figure 1.

4. Conclusions

Survey and focus group results as well as interviews revealed key barriers to renewable energy development in the Southern African region. As wind and solar PV equipment costs decline around the world, countries in the Southern African region need to ensure access to these technologies for project developers. Adequate financial incentives and better financing terms for RE project developers through international and regional financial institutions are critical to support the initial high costs of wind and solar PV technologies. With greater deployment, costs other than equipment costs will decline through economies of scale and help realize the gains of RE development experienced in other mature markets in the world. Similarly, building transmission, especially to interconnect renewable energy projects, is critical to provide access to the tremendous wind and solar resources found across the region. Capacity building, both technical and institutional will be key to scale up renewable energy development in the region. Importantly, results highlight the critical gap and importance of high-quality renewable resource assessment and integrated resource planning studies, as well as a broader integrated resource planning process. These results can help focus the efforts of various stakeholders to accelerate the development and deployment of renewable energy in the Southern African region.

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