



BALUCHISTAN's

Renewable Energy Assessment Study

Journey Towards Making Accessible, Affordable,
and Sustainable Power in the Province

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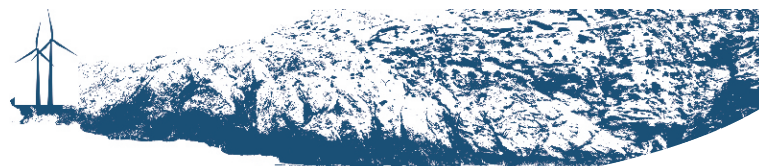


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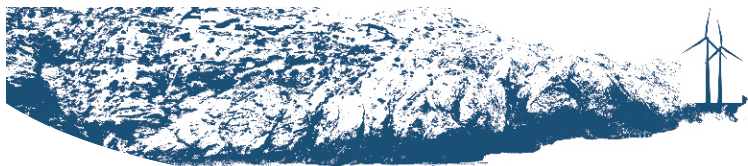
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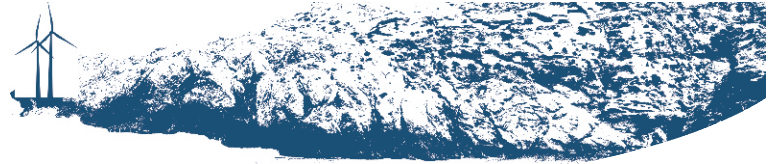


FOREWORD

Balochistan is almost half of Pakistan in terms of land mass. Nearly two-thirds of the population is yet to be connected to the national grid and the areas connected are supplied power for only a few hours a day; sans provincial capital. The rising cost of energy has drawn our attention towards renewable sources of energy. Nature has bestowed the province with excellent solar and wind resources which would prove a game changer.

The Government of Balochistan has decided to formulate an energy policy that would not only provide affordable energy to the masses but would also contribute to the economic growth of the province and new job creation for the educated and skilled youth. IDSP has collaborated with the Government of Balochistan and has carried out a study that provides in-depth insight towards formulating a new energy policy with a special focus on the renewable resources of the province. I appreciate the efforts put into this study by the IDSP research associates Zubair Khan, Muhammad Awais, Mamoon Nabi, and Rabia, who remained in touch with the Energy Department during the course of their research and hope that their hard work would be of great help towards achieving the objective of presenting Balochistan as the Renewable Powerhouse of Pakistan.

Muhammad Ayub
Additional Secretary
Energy Department



It is a pleasure and with gratitude that I write this note on the amazing research carried out by the IDSP's young researchers, who are graduates of the Renewable Energy Department at the University of Balochistan. For one year, the four researchers at IDSP have been engaged in policy research on Renewable Energy (RE). The present report is the first document on RE that brings out the detailed views of stakeholders, ranging from the communities in the selected districts, to understand the positions taken by the Federal Government, Provincial Government, and electric power suppliers, QESCO.

Upon reading the report, one will notice some very interesting views on QESCO vs FARMERS OF BALOCHISTAN. There are great guidelines, insights, and excellent advice that the farmers' community has provided. While the QESCO staff in the districts were found to be insecure about the researchers.

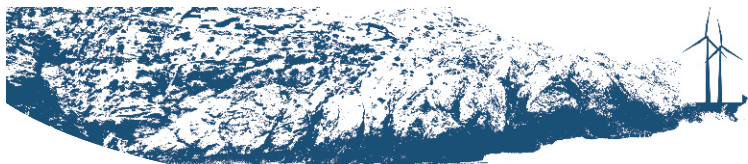
If only the Government of Balochistan could seriously review these recommendations and stand for the right and just solution, only then the report do its job very well. The IDSP's research team was very professional and supported by some of the officials in the Government of Balochistan; generally, all DCS of districts the team visited were supportive and helpful.

It is TARA who provided this excellent opportunity to initiate the research on Renewable Energy. IDSP was technically assisted by their team too. The research team is all graduates of the University of Balochistan, from the Department of Renewable Energy, an exceptionally committed team led by IDSP's Co-director, who is an unconditional, committed professional of sustainable living and the creator of the eco-friendly campus of IDSP's University of Community Development, where we all live and practice learning and living with the environment and nature.

Once again, I would like to reinforce that the Balochistan Government has to take a clear, defined position based on facts and figures, thus ensuring the rights it has according to the 18th Amendment.

With gratitude and respect,

Dr. Quratul Ain Bakhteari
Founding Director
IDSP - Pakistan



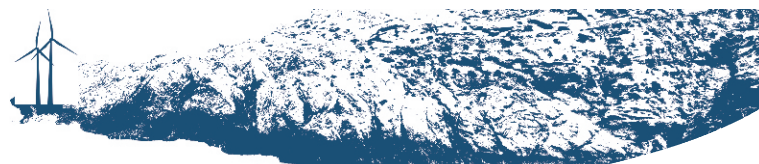
QESCO is the major licensee for Power Distribution in Balochistan with the exception of Dureji in the Lasbela Division. Despite having an installed capacity of 3500 MW, major areas of Balochistan remain un-electrified. The demography is sparse and lengthy lines are a challenge for QESCO to provide quality supply to its customers. The poor socio-economic condition of the people is the main factor in poor recoveries; with continuous rise in tariffs conventional electricity has become unaffordable for them.

QESCO is promoting a campaign for efficient usage of electricity in collaboration with Balochistan University of Information Technology, Engineering and Management Sciences (BUITEMS) for the modernization of consumer end generation preferably renewable energy to offset costly capacity charges of IPPs. QESCO has requested the Government of Balochistan (GoB) to rely on renewable energy sources for future village electrification.

The Research Associates of IDSP namely Zubair Khan, Muhammad Awais, Mamoon Nabi, and Rabia are viewed as the pioneers working in the same direction of QESCO for the future of Balochistan. Their strenuous efforts were diligently supported in technical as well as professional aspects of the research by QESCO. QESCO considers them as local assets and believes that their research work will provide a direction for policymakers in their vision for the future of Balochistan.

I personally am very impressed with the IDSP faculty for their selfless work and dedication to the development of a less privileged society of Balochistan. Their dedication is reflected in their graduates and the quartet mentioned above is a living example. It will be most unfortunate to neglect the research work in future Public Sector Development Programs (PSDP) of Balochistan.

Engr Yousuf Shah Khan
Chief Engineer QESCO



I am thrilled to announce the successful launch of the "Renewable Energy Assessment Study," a significant milestone in Balochistan's renewable energy sector, led by IDSP under the guidance of the Energy Department of the Government of Balochistan.

Our project aimed to draft a Renewable Energy Policy for the Government of Balochistan. With the invaluable support of TARA, we set out to overcome the lack of local perspective in the research and policy field for Balochistan. IDSP placed its trust in our local talent, particularly recent graduates from the Renewable Energy Department at the University of Balochistan.

Our team, comprising fresh graduates from the University of Balochistan's Renewable Energy Department, along with technical support and guidance from Mr. Basit from Renewable First and Ms. Zukhruf Amjad (Project manager / Consultant), showcased exceptional leadership in drafting the Renewable Energy Assessment Study, which is now set to be launched.

This achievement marks a pivotal moment in our quest to develop a Draft Renewable Energy Policy. The team's engagement with stakeholders has enabled fruitful consultations and discussions, shedding light on the potential of renewable energy in Balochistan and the challenges it faces.

I extend heartfelt gratitude, on behalf of the Institute of Development Studies and Practices (IDSP - Pakistan), to the Secretary of Renewable Energy, Government of Balochistan, for entrusting Balochistan's youth with this important initiative. I also express gratitude to the Renewable Energy Department, University of Balochistan, for spearheading the renewable energy course in the region. Finally, Heartfelt thanks to all stakeholders for their unwavering support and assistance throughout this study.

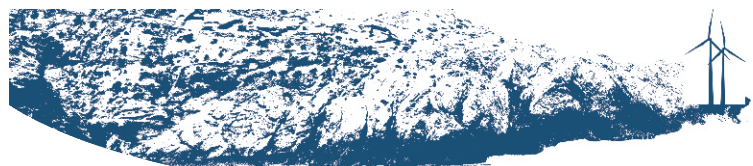
A special congratulations to Ms. Rabia Marri, Ms. Mamoona Nabi, Mr. Mohammad Awais, and Mr. Zubair Khan for their outstanding leadership. Despite their limited experience, they persevered and successfully developed a competitive report: "The Renewable Assessment Study."

Warm regards,

Malik Safdar Hussain

Co-Director

Institute of Development Studies and Practices (IDSP - Pakistan)

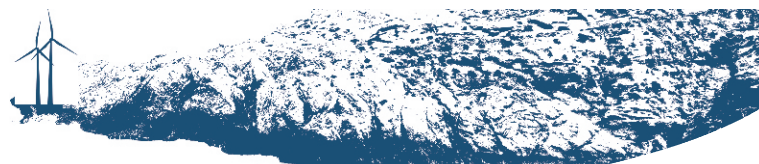


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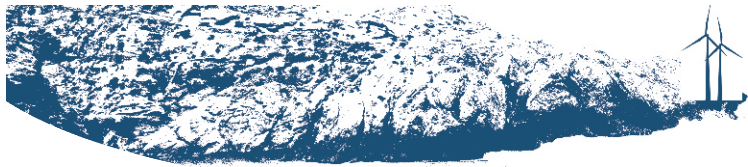
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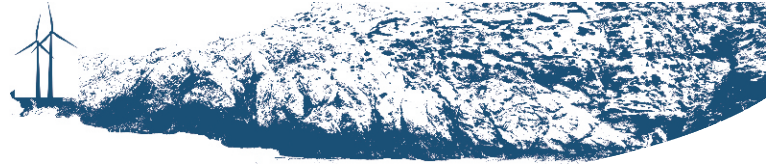


Abbreviations and Acronyms

AEDB	Alternative Energy Development Board
ARE Policy 2019	Alternative & Renewable Energy Policy
BECL	Balochistan Energy Company Limited
BED	Balochistan Energy Department
BOOT	Build Own Operate and Transfer
BPCs	Bulk Power Consumers
CCI	Council of Common Interests
CCOE	Cabinet Committee on Energy
CPDI	Centre for Peace and Development Initiatives
CPEC	China - Pakistan Economic Corridor
CPPA	Central Power Purchasing Agency
CPPA / CPPA-G	Central Power Purchasing Agency-Guarantee
CSP	Concentrated Solar Power.
CTBCM	The Competitive Trading and Bilateral Contracts Market
DISCOs	Distribution Company
EDFCC	Environmental Defence Fund Climate Corp
FY	Fiscal Year
G2G	Government to Government
GDP	Government of Pakistan
GENCO	Government Owned Generation Company
GW	Gigawatt
GWh	Gigawatt hour
HEIS	High-Efficiency Irrigation Systems
HVAC	Heating, ventilation, and air conditioning
HVDC	High-Voltage Direct Current
IDSP	Institute for Development Studies and Practices
IGCEP	Indicative Generation Capacity Expansion Plan
IPPs	Independent Power Producer
KE	Karachi Electric
kV	Kilovolt
kWh	Kilowatt Hour
LOIs	Letter of Intent
LOS	Letter of Support
MW	Megawatt
MWh	Megawatt Hours
NEP	National Electricity Policy
NEPRA	National Electric Power Regulatory Authority



NESPAK	National Engineering Services Pakistan
NGOs	Non-governmental Organization
NREL	National Renewable Energy Laboratory
NTDC	National Transmission and Dispatch Company
PPIB	Private Power and Infrastructure Board
PV	Photovoltaic
QESCO	Quetta Electric Supply Company
RE	Renewable Energy
SHS	Solar Home System
T&D	Transmission and Distribution
TPS	Thermal Power Station
TSEP	Transmission system Expansion plan
UNDP	United Nations Development Programme
VRE	Variable Renewable Energy
WAPDA	Water & Power Development Authority



Executive Summary

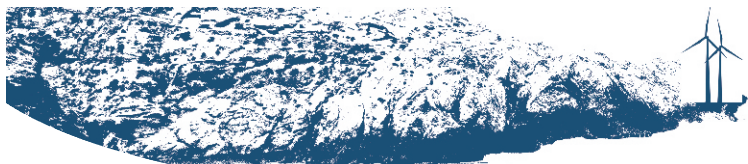
This summary summarizes the results of a study that focuses on the potential for energy in Balochistan and the complex challenges that hinder its progress. Balochistan, which covers a part of Pakistan's land area holds promise in terms of renewable energy, especially solar and wind power. The region's plentiful sunshine and clear skies make it an excellent candidate for harnessing sustainable sources of energy. However, there are obstacles to overcome to fully utilize this potential, many of which are closely tied to the policies governing the energy sector.

A major concern highlighted by the study is that an astonishing 73% of electricity consumption in Balochistan can be attributed to tubewells. These tubewells, vital for sustaining the agricultural sector, receive subsidies resulting in a significant financial burden on both the federal and provincial governments. Despite these subsidies, 15% of payments from agricultural consumers are recovered, emphasizing how urgent it is to address this issue and develop more sustainable energy policies.

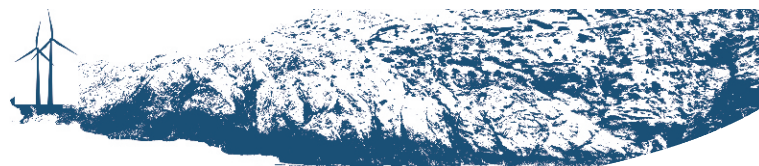
Moreover, the demographic distribution in Balochistan is characterized by scattered populations residing in remote areas far from the central grid. This geographic dispersal presents a formidable challenge when it comes to extending the grid to these households. The study highlights the associated financial infeasibility and complex technical requirements in connecting these isolated communities to the energy grid. The lack of adequate infrastructure and the considerable distance from power plants further compound these challenges, necessitating innovative solutions for energy distribution.

The study reveals significant insights into Balochistan's energy landscape, shedding light on issues within the Quetta Electric Supply Company (QESCO), existing policies, and the dynamics of power generation and demand. Beyond the challenges, however, the region presents promising opportunities for renewable energy development. Notable projects, such as Reko Diq and the rapid developments in Gwadar, GW parks, and the burgeoning mining sector, hold the potential to reshape Balochistan's energy future.

Governance-related challenges also come to the fore, encompassing issues of stable leadership, policy consistency, capacity building, and the imperative need for effective community engagement. Meanwhile, infrastructure and financial challenges pose critical hurdles, encompassing transmission constraints, security payments within tariff structures, low bill recovery, and the strain on an overburdened infrastructure.



In conclusion, this executive summary offers a comprehensive glimpse into the study's findings on Balochistan's renewable energy landscape, showcasing both the challenges that need to be addressed and the opportunities that await. Recommendations stemming from these insights span a range of solutions, from policy enhancements to infrastructure investments and proactive community involvement, all aimed at collectively addressing the pressing energy-related issues in Balochistan. Balochistan's untapped potential in renewable energy can be harnessed through a strategic and holistic approach to policy and infrastructure development.

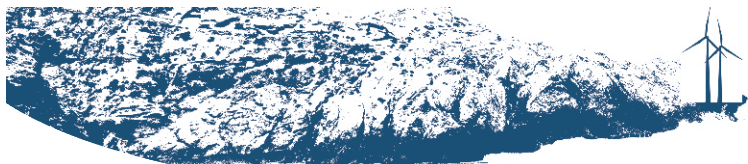


About IDSP

Institute for Development Studies and Practices (IDSP) is a national-level institute that has been at the forefront of creating leadership in community development since 1998. IDSP primarily focuses on creating safe spaces for young people, through its Open Learning Spaces program, and empowers youth with critical thinking, leadership, and professional skills, promoting human rights, gender equality, and global citizenship. It works directly with communities in Balochistan to adopt sustainable practices, boost local economies, and improve living standards. The organization also works closely with the Government of Balochistan to enhance capacities for public health, community development, and education.

IDSP has recently embarked on a program to develop a Renewable Energy Policy for Balochistan, which is housed under their "Sustainable Living" Theme. The organization's strong ties with both communities and the government place it perfectly to understand local grievances in the provision of affordable and sustainable electricity and bring those to the government in the form of a policy. This project aims to identify barriers to integrating renewables in Balochistan and facilitate their adoption at the grid, mini-grid, and off-grid levels to support national targets of achieving a 30% share of renewables in the national energy mix by 2030. Additionally, the project also focuses on a strategic pathway for the solarization of tube wells, rural electrification, and an emphasis on energy justice and fairness.

Perhaps what is most incredible about this project is how it is led primarily by researchers who belong to Balochistan. The project is focused on bringing local voices to the limelight and developing the capacity of Balochistan's youth to lead the efforts to develop the province through energy transition. Not only does this bring forward a clear picture of the on-ground challenges faced by RE deployment in the province, but it also provides space for local solutions that take local communities into confidence and have a greater chance of success.

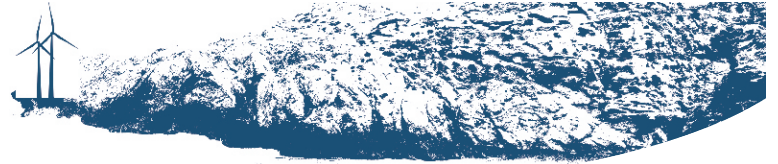


Disclaimer

The report (herein referred to as "Balochistan Renewable Energy Assessment study") has been prepared by the IDSP research Associate team on the RE Policy draft. The information incorporated in this study stems from extensive stakeholder engagements, publicly available resources such as the State of Industry Report 2021-2022, official documents, and third-party research. While our team exercised utmost caution during data collection and analysis, it is crucial to note that the views presented herein represent the collated perspectives derived from consultations.

Despite our concerted efforts to consult with a diverse range of stakeholders, the time constraints inherent in this study may have limited the inclusion of some relevant perspectives. Therefore, we acknowledge that certain stakeholder views might not be fully reflected in the study.

The IDSP and its affiliates or sponsors do not assume any liability or responsibility for financial or other losses resulting from the use of the data and results presented in this report. The opinions expressed by the authors are their own and do not necessarily reflect the views of IDSP or any of its affiliates or sponsors.



About the Authors



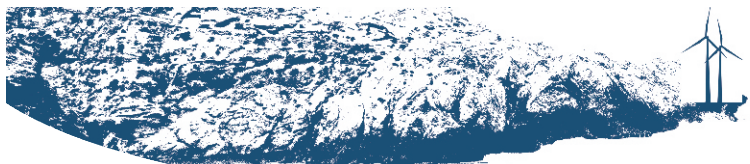
Zubair Khan is primarily from Quetta, Balochistan, and holds an undergraduate degree in Renewable Energy from the University of Balochistan and is currently working as a Research Associate at IDSP. Before working at IDSP, he accumulated experience by serving as a visiting lecturer at the University of Balochistan, Department of Renewable Energy (2022) and interning as an Assistant Energy Analyst with UNDP. Zubair is passionate about using energy transition as a means for equitable development in Balochistan. His role involves collaborating with the government, political, academia, private sector, investors, community, and industrial stakeholders and identifying solutions to overcome obstacles in Balochistan's Renewable Energy sector.



Muhammad Awais, a Research Associate at IDSP from Killa Abdullah, Balochistan, after completing his studies in Renewable Energy at the University of Balochistan in 2022 focused on developing a water purification plant. Before joining IDSP he gained experience as a training assistant and Area field officer at Apex. I also worked as a budget data analyst at CPDI. His passion lies in energy and climate justice particularly exploring the potential of Variable Renewable Energy in Balochistan. He has actively collaborated with academia, government entities, the private sector, investors, and local communities to make this project successful. His goal is to become an expert in renewables leading the way for energy development in Balochistan, through grid integration and innovative off-grid solutions.



Mamoonah Nabi hails from the Nushki district of Balochistan and has an undergraduate degree in Renewable Energy from the University of Balochistan. Her primary objective is to promote solar energy for rural electrification, tapping into the province's abundant potential. Additionally, she leads awareness campaigns covering water resource management, energy-efficient practices, engagement with Zamindar Action Committee representatives in the region, and social challenges related to renewable energy development, all aimed at advancing sustainable and inclusive energy solutions in Balochistan.



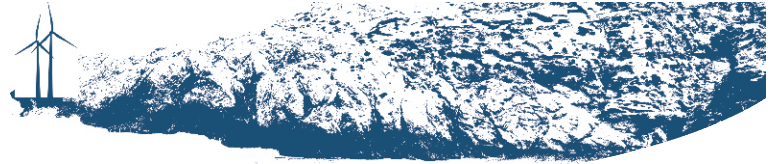
Rabia is primarily from Quetta, Balochistan working as a Research Associate at IDSP, and holds a bachelor's degree in Renewable Energy from the University of Balochistan (2022). She is a data enthusiast and enjoys deriving insights through analysis. Additionally, Rabia's unique proficiency in local languages enables effective grassroots awareness sessions, particularly for initiatives such as solarizing tube wells and water conversion, fostering sustainable energy solutions, and community involvement in Balochistan's energy development.



Zukhruf Amjad is a Program Manager at IDSP and works in the field of power system planning, energy transition, and climate change policies. She also works with the World Bank's Global Energy Unit where she conducts grid-level power system analysis for Climate Country Development Reports. Zukhruf is a Fulbright scholar and received her master's from Duke University in Environmental Management with a focus on Energy Systems.



Muhammad Basit Ghauri is a Sr. Program Associate at Renewables First - Islamabad-based think tank on Energy and Environment. Working in the advancement of Renewable Energy deployment, he is also an Environmental Defense Fund Climate Corp (EDFCC) fellow focusing on making an impact at the global level. He has a strong focus on addressing key policy and regulatory barriers in Pakistan that hinder renewable energy deployment.



Purpose of the Study

This study is part of a broader project to develop a Renewable Energy Policy for Balochistan and focus on the urgent need to address energy challenges in the region. As a first step, this study provides an in-depth assessment and analysis of the current state of electricity and paves the way for a pragmatic and sustainable policy for accelerated deployment of Renewable Energy in the region.

Balochistan faces significant issues in energy generation, transmission, distribution, and consumption which is resulting in prolonged periods of power outages. Approximately 64% of the Balochistan area and 40% population¹ lack access to electricity, posing a direct threat to the province's economy and overall development. All this while the province has incredible solar and wind resources potential for power generation.

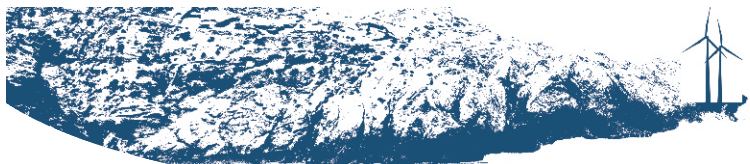
This report was put together through an extensive literature review and detailed stakeholder consultations with private sector companies, NGOs, and government officials at both the provincial and federal levels. The goal was to understand challenges faced in Balochistan for renewable energy deployment and provide a holistic representation of relevant issues through this assessment, areas of opportunities in the short, medium, and long term for renewable energy policy have been identified. The policy's primary objective will be to deploy renewable energy projects in the province instead of the challenges identified in this study.

The study will serve as a roadmap for targeted interventions in priority areas, with a particular focus on relieving the heavy burden caused by agricultural demands as well as off-grid and mini-grid electrification in the province. Beyond immediate economic concerns, the policy aligns with broader environmental and sustainability goals, including the development of Human Resources.

Balochistan boasts rich mineral and renewable energy resources, offering the potential not only to meet Pakistan's energy demands but also to export surplus energy to neighboring countries and become the powerhouse of the country. A key target is to achieve a 30% share of renewable energy in the energy mix by 2030, benefitting both Balochistan and Pakistan's economic landscape.

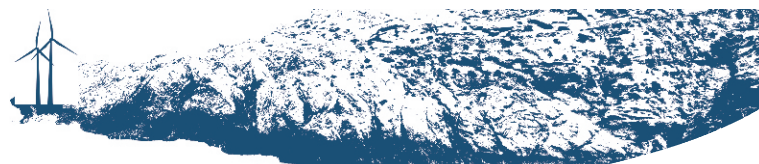
Perhaps the most crucial aspect of this study is that it reflects the voices of researchers native to Balochistan who understand the unique challenges and opportunities the

¹Govt. of Balochistan energy department comments on IGCEP-22



province presents. Through this, the team seeks to ensure that Balochistan's development is not relegated to the background but takes center stage.

The team is also very grateful to Renewables First who have been instrumental in providing us with the technical expertise and assistance in putting together this report. Additionally, our collaborations with various stakeholders, including the Government of Balochistan's Energy Department, QESCO, and Balochistan Energy Company Limited (BECL) demonstrate a collective commitment to bringing this policy to fruition for the betterment of Balochistan's people and its distinctive environment.



Energy Landscape

Geographic and Macro Economic Indicators

Balochistan is Pakistan's largest province in terms of territory, but it's also the least developed. It makes up about 44% of Pakistan's total land area and 6% of the total population, making it the largest and most sparsely populated province in the country.² The province is divided into 36 districts and 8 administrative divisions; Quetta, Zhob, Sibi, Nasirabad, Kalat, Rakhshan, Loralai, and Makran. Most of the area in Balochistan is considered inter-mountainous with the remaining 20% characterized as flood plains and coastal plains.

Balochistan has a population density of 35 persons per km², which is lower than the national average of 236 persons per km². Overall, 27.6% of the population lives in urban areas, with the remaining 72.4% making up the rural population. Most of these communities live below the poverty line in tough conditions. Additionally, the 2017 Census revealed that Balochistan's literacy rate is under 43.58%, lower than the nationwide rate of 58%.³

The province has valuable resources and minerals such as sulfur, chromite, iron ore, and limestone. Additionally, it is blessed with some of the world's largest reserves of copper and gold. The province is particularly rich in renewable energy sources for power generation, including solar and wind resources, including high irradiation levels, wind corridors, and ocean/tidal wave energy which can be explored for the development of clean energy projects.⁴

The province's economy is mostly centered on the extraction of minerals, agriculture, fisheries, livestock, tourism, and other industries which are the main sectors for investment in Balochistan. Nearly 30% of Pakistan's total fish for commercial use is caught in Balochistan. One of the province's primary fish harbors is Gwadar. However, due to the lack of industries in the province, it has accounted for only 4 percent of the country's GDP in the past 15 years.⁵

Balochistan's Gwadar Port is a crucial part of the China-Pakistan Economic Corridor (CPEC) and is on track to become a leading trade and economic center in the region. Its strategic location provides access to some of the most important trade routes across the globe. CPEC includes 21 energy projects, most of which are in the regions of Sindh and Punjab while Balochistan only has two projects. Hub, Balochistan (Imported Coal) with an installed capacity of 1320 MW, and the prospective Gwadar (Imported Coal) with 300 MW. There are no renewable energy projects in the CPEC pipeline for Balochistan currently.⁶

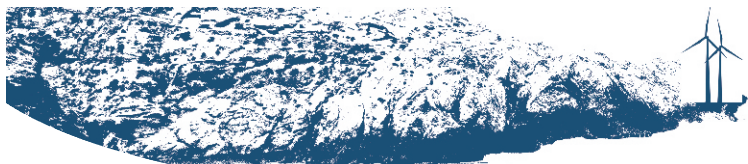
²https://www.pbs.gov.pk/sites/default/files/population/census_reports/pcr_Balochistan.pdf

³<https://www.macrotrends.net/countries/PAK/pakistan/literacy-rate#:~:text=Pakistan%20literacy%20rate%20for%202019,a%201.38%25%20increase%20from%202013.>

⁴https://www.pbs.gov.pk/sites/default/files/population/census_reports/pcr_Balochistan.pdf

⁵https://www.pbs.gov.pk/sites/default/files/population/census_reports/pcr_Balochistan.pdf

⁶<https://nepra.org.pk/Admission%20Notices/2017/Mach%2017/list%20of%20cpec%20projects.pdf>



The province is advancing its renewable energy sector with 15 projects in the pipeline, all of which have received Letters of Intent (LOIs) from the Balochistan Energy Company Limited (BECL). However, all the candidate renewable energy projects from Balochistan were placed in category-all as per the CCoE decision and currently await the auctions to take place as per ARE Policy 2019. To date, no auctions have been announced for Category III projects, bringing uncertainty in the future of these projects.

One of the key significances of the province is its potential to spur the mining industry. The Reko Diq area of Balochistan has one of the largest copper and gold reserves in the world and mining in the region is expected to begin in 2028.⁷ 25% of the project is owned by the Federal Government, 50% by Barrick Gold, and is expected to employ 7500 people, with priority given to locals. The region of Chagai, where this project will be set up, has great solar and wind potential and illustrates the potential for deployment of renewable energy to meet the demand of mining activity. As the national grid does not extend to the region, on-site renewable energy power plants can also provide electricity to the locals living in the area.

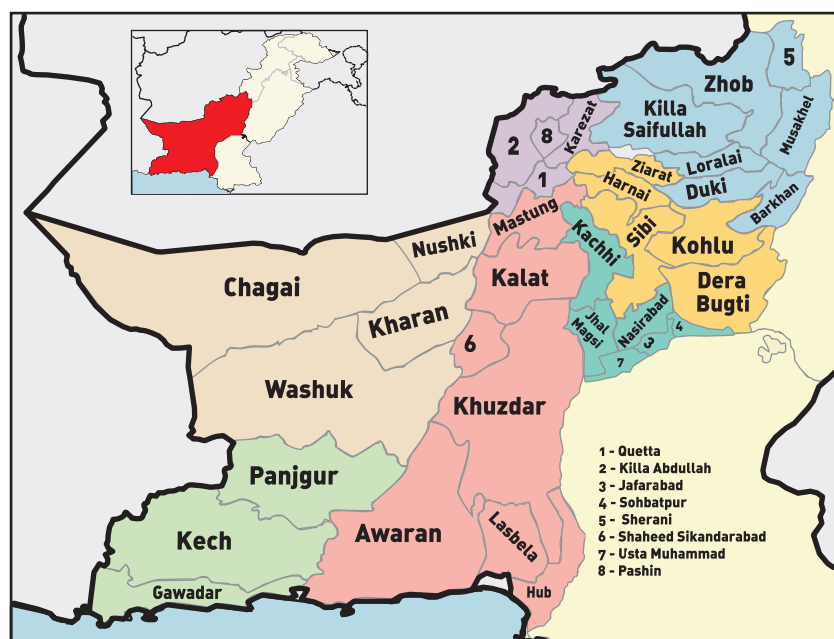


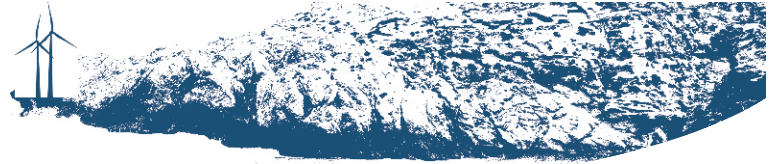
Figure 1- Map of Balochistan

Electricity Regulatory System

Outlook of Pakistan's Electricity System

The Power Sector in Pakistan falls under the Ministry of Energy (Power Division) which is responsible for crafting and implementing power sector policies. The Water and Power Development Authority (WAPDA) manages hydropower generation, and the Private Power

⁷<https://www.barrick.com/English/operations/reko-diq/default.aspx>



and Infrastructure Board (PPIB) oversees other IPPs. Country-wide transmission is managed by the National Transmission and Dispatch Company (NTDC), which feeds the 11 distribution companies (DISCOs) spread across the country. K-Electric is a private utility that serves the Karachi, Sindh region, and Lasbela district in Balochistan. The sector is regulated by the National Electric Power Regulatory Authority (NEPRA), which sets tariffs and safeguards consumer interests

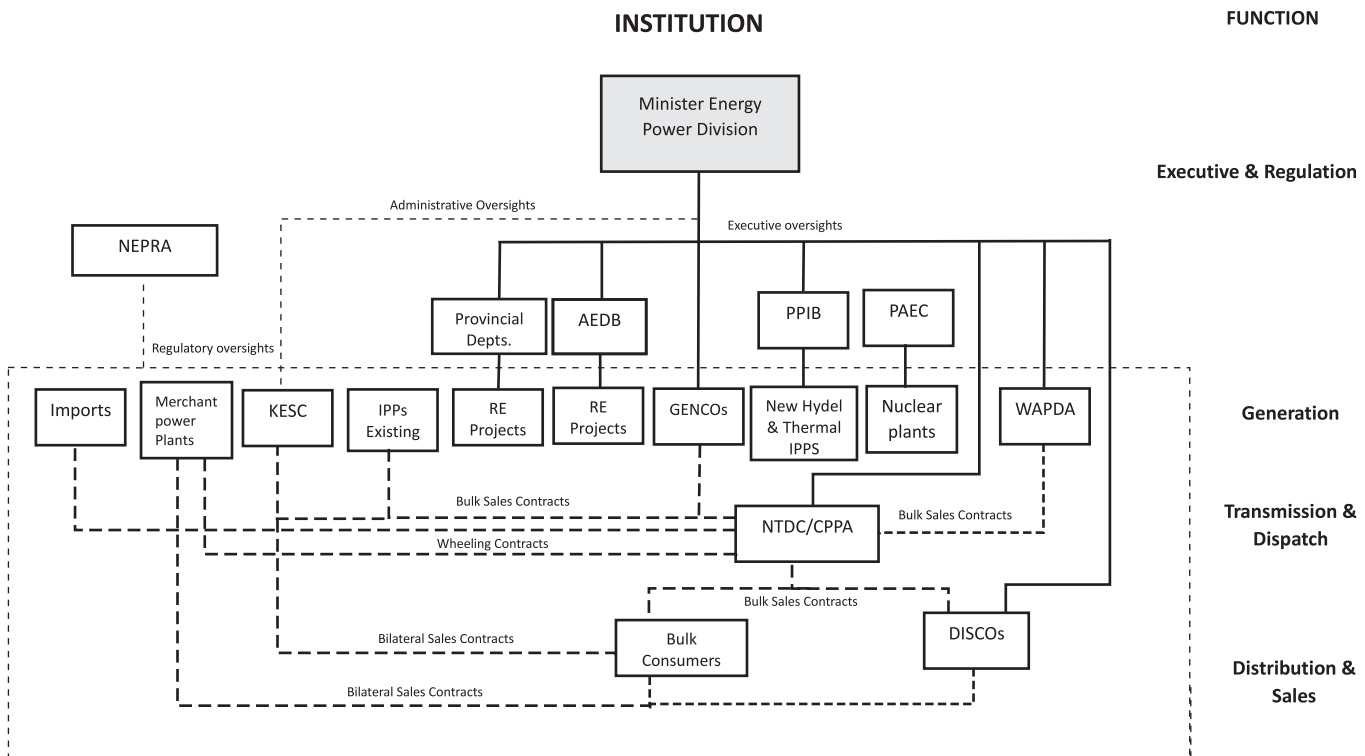
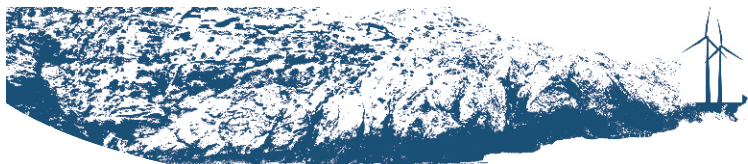


Figure 2-Electricity System of Pakistan

In Balochistan, the electricity sector is managed by the Department of Energy, and the distribution network by Quetta Electric Supply Company (QESCO). There are 6 generation units located in the province and about 200 MW of electricity is imported from Iran⁸. Balochistan Energy Company Limited (BECL) is responsible for the feasibility studies and technical analysis for proposed generation plants.

After the 18th Amendment, Article 157 of Pakistan's Constitution gave provinces authority over generation, transmission, and tariff design if it is in the boundary of the province. While the provincial power sector is given more autonomy over its energy sector, the interconnected nature of electricity tends to confuse the exact roles of the provincial vs federal government. Provinces do have the authority to develop the generation, transmission, and distribution infrastructure within their physical jurisdiction and have the option to connect to the national grid after approval from NTDC and within the plan of IGCEP.

⁸According to BED and QESCO



Key Stakeholders

The findings of this study were developed in collaboration with key stakeholders in public and private offices, at both the provincial and federal levels. These stakeholders were requested to provide insights on the challenges faced by renewable energy deployment today supplemented by data to help highlight these issues.

- **The Energy Department-Government of Balochistan** is the authority on provincial energy matters in Balochistan. It is responsible for the formulation of policies on energy that fall under the provincial mandate after the 18th Amendment. This includes generation, transmission, and distribution happening within the boundary of the province. The department is dedicated to enhancing the province's energy capacity for economic growth and aims to meet energy demands sustainably and affordably.⁹
- **BECL (Balochistan Energy Company Limited)** is a venture of the Government of Balochistan and is responsible for the promotion of generation activities in the province and coordinating with the private sector in the development of projects. The organization's core focus is on planning, promoting, and implementing programs for exploring and developing oil, gas, renewable, and alternate energy resources in Balochistan.¹⁰
- **National Transmission and Dispatch Company's** main role is to link power generation units with load centers nationwide, managing one of Pakistan's largest interconnected transmission networks. It provides Pakistan with a reliable, efficient, and stable transmission network while adopting sustainable practices and maximizing stakeholder return.¹¹
- **Quetta Electric Supply Company (QESCO)** is one of the 11 distribution companies in Pakistan, and it is responsible for the supply of electricity to most of the province.

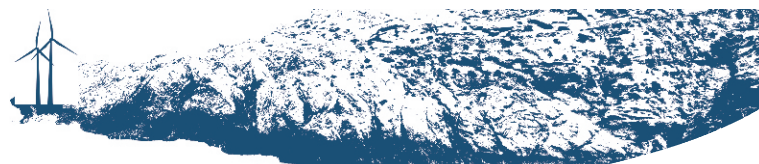
Key Policies and Plans

A list of key federal and provincial policies that impact the deployment of renewable energy policy in Balochistan is discussed below:

⁹<https://energy.Balochistan.gov.pk/about-us-2/>

¹⁰<https://becl.com.pk/>

¹¹<https://ntdc.gov.pk/about>



National Policies

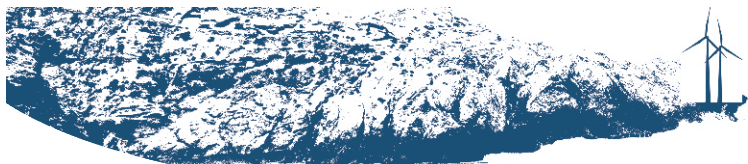
Alternate Renewable Energy Policy 2019's main target is to achieve 30% of the renewables share in the electricity mix by 2030. To meet this goal, it has proposed three mechanisms. The first is a G2G approach through which governments can directly engage in RE generation. This approach is especially helpful for Balochistan where the private sector participation is in a nascent stage. The second is for unsolicited projects that are designed for new technologies and will have to go through a specific feasibility stage overseen by AEDB. Lastly, the most common approach is open and transparent competitive bidding. For this approach, AEDB will announce a volume-based auction based on IGCEP and geographic diversity, which will be open to bidding. The Government of Pakistan has also unveiled a Solar Fast Track program in September 2022 which aims to add 10,000 MW of solar projects, 6000 MW of utility-scale solar, and 4000 MW of existing solar feeders and the solarization of government buildings. 6000 MW of utility-scale solar will be procured under competitive bidding on a Build, Own, Operate, and Transfer (BOOT) basis.

The Indicative Generation Capacity Expansion Plan (IGCEP 2022-2031) is Pakistan's 10-year electricity expansion plan designed using the least cost optimization model to forecast the capacity requirements of the country. It guides the generation capacity additions based on the least cost, including renewables, to ensure a reliable power supply that meets future reliability efficiently. In the latest report of IGCEP (2022 - 2031), __ 6,508 MW of renewable generation is optimized in the next 10 years. However, no projects from Balochistan are included as part of the "candidate" or "committed" category.

The Competitive Trading and Bilateral Contracts Market (CTBCM) is a step towards transitioning Pakistan's electricity sector into a wholesale electricity market. This will encourage increased competition in the market. In the first stage of this initiative, the scheme will be accessible to Bulk Power Consumers (BPCs) with a capacity of 1 MW and above, while the residential sector will continue to purchase electricity through Distribution Companies (DISCOs). Under this new arrangement, any BPC will have the opportunity to procure power directly from generators. This shift is expected to introduce greater efficiency, flexibility, and transparency in the power market, benefiting both consumers and market participants.

National Electricity Policy (NEP 2021) is the guiding policy document for the development of the electricity sector in the country.¹² It has three basic goals: I) Supplying reliable, secure, efficient, and affordable electricity to the country II) Maintaining a constant power supply

¹²<https://nepra.org.pk/Policies/National%20Electricity%20Policy%202021.pdf>



via the use of various energy sources and solid infrastructure, III) Fostering sustainable growth through the reduction of environmental impact and resolution of financial difficulties. These goals are met through focused intervention in generation, transmission, and distribution. The policy highlights the need to shift from imported fuels to local generation, the role of provincial governments in the construction of grid stations and laying transmission lines within their jurisdiction, and the option to connect to the national grid under TSEP. Lastly, the role of the provincial government in assisting distribution companies with recoveries, theft detection, and legal procedures.¹³

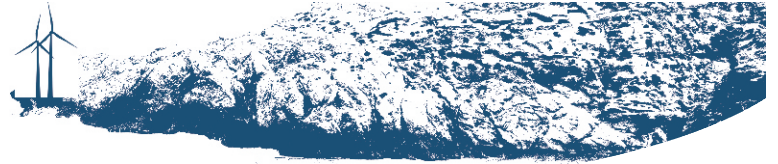
Balochistan Power Generation Policy 2007

In 2007, the Balochistan provincial government introduced the Balochistan Power Generation Policy, aimed at fostering project development through renewable and indigenous coal resources. Central to this initiative was the establishment of the Balochistan Power Development Board (BPDB), serving as a one-stop facilitator to encourage private sector investments, particularly in the expansive realm of solar and wind energy. Drawing inspiration from the federal Policy for Power Generation Projects 2002, the provincial policy sought to leverage Balochistan's abundant natural resources to address power shortages. The BPDB plays a pivotal role in granting permissions for power projects within the province, with a specific focus on projects not exceeding 50 megawatts in capacity. Despite these efforts, the challenging terrain and considerable distances from grid networks have posed obstacles, hindering the board's ability to mobilize private investments effectively in renewable energy projects. The policy underscores the utilization of diverse resources, including coal, canal water, and local fuels like oil and gas, while also exploring the viability of wind and solar energy where feasible.

Provincial Policies

Balochistan currently does not have a formal electricity policy, the provincial government is looking to formalize the Balochistan Energy Sector Plan 2020-2025. This plan discusses a pathway for renewable energy in Balochistan, connecting it to national development goals and regulations. It focuses on strengthening the transmission network to support future power generation. The federal power sector regulations are being improved to attract private investment, and Balochistan should engage with relevant agencies to secure its interests. It emphasizes a regulatory and legislative changes in the energy sector, such as land allocation mechanisms and power management.

¹³<https://www.ppib.gov.pk/policies/National%20Electricity%20Policy%202021.pdf>



Balochistan's Electricity System and Access

Electricity Access and Reliability

Balochistan is the largest province in terms of area, yet 40% of the population does not have access to electricity.¹⁴ According to the 2023 digital census, the population in the province has increased to 14.9 million from 12.3 million within five years (2017-2023). About 72.4% of this population lives in rural areas and must deal with severe energy shortages. The vast land area of the province does not make it easy to provide access to electricity since it is impractical to extend transmission infrastructure to these regions. This energy deficiency hinders growth and quality of life for the people of Balochistan, impacting various aspects of their daily lives and hampering overall development efforts.¹⁵ According to the Balochistan Energy Department, about 19,000 Solar Home Systems (SHS) have been installed in the province in remote areas without electricity.

The map below shows the unelectrified villages per district in Balochistan. From the districts for which data was available, the highest percentage of unelectrified villages is in Nushki and Kalat Districts.

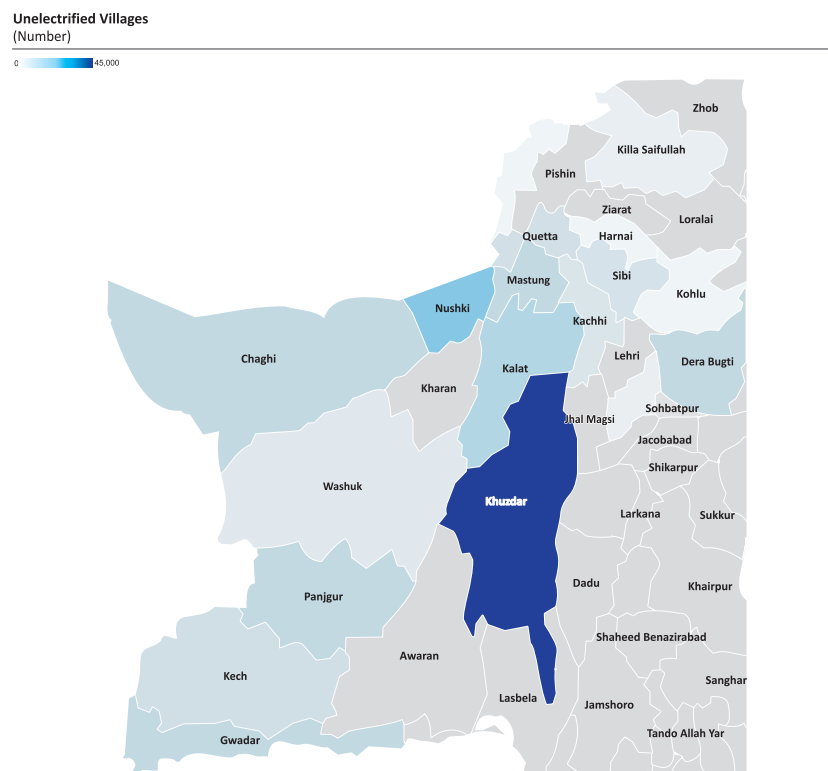
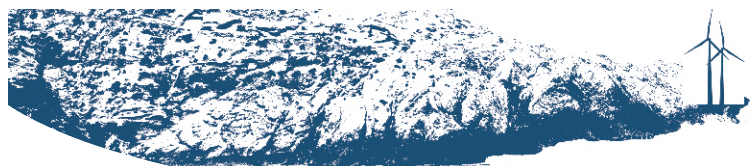


Figure 3- Unelectrified villages of Balochistan

¹⁴ Govt. of Balochistan Energy Department comments on IGCEP-22

¹⁵ <https://strafasia.com/energy-poverty-in-Balochistan/#:~:text=According%20to%20a%20document%20submitted,impossible%20to%20ring%20electricity%20there>



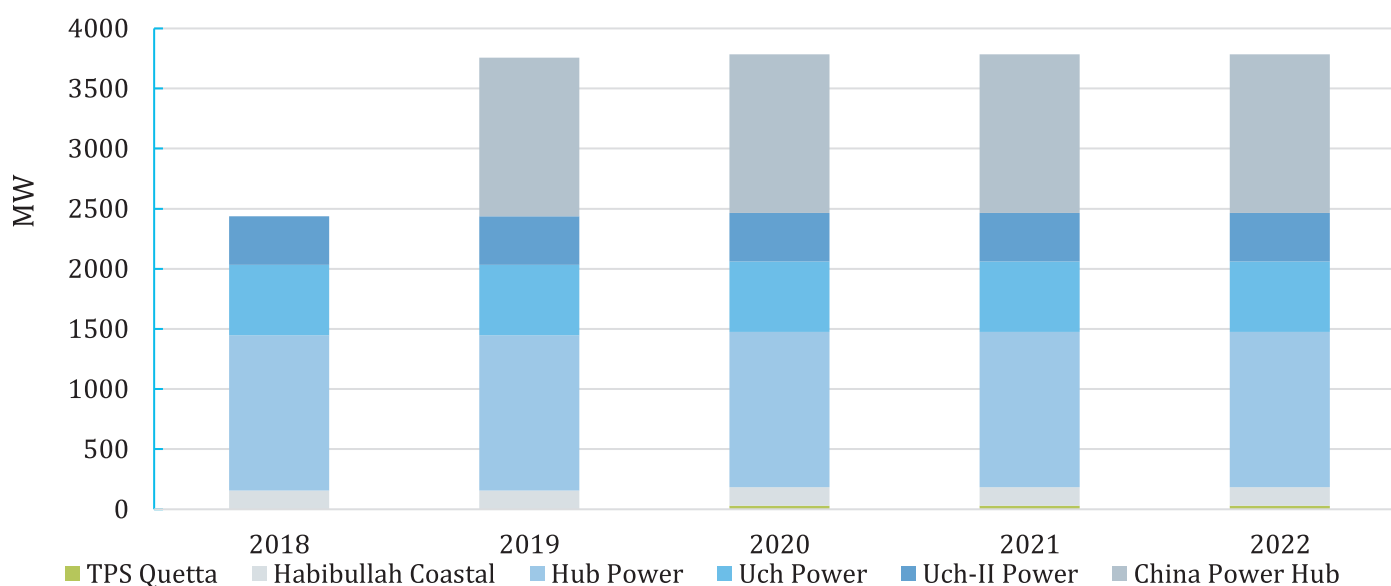
Supply and Demand

Quetta Electricity Supply Company (QESCO) is the primary power distribution company operating in Balochistan. Among the 11 distribution companies in Pakistan, QESCO holds the mandate to provide reliable electricity to the largest land area in the country - about 44%.¹⁶

According to the State of Industry Report 2021-2022, there are currently six power plants operating in Balochistan. Uch 1, Uch 2, TPS Quetta, Hubco, China Hub, and Habibullah Coastal Power Station, all of which rely on conventional, fossil-based sources of energy. TPS Quetta and Habibullah Coastal Power Station are currently not operational, the latter due to an expired gas agreement. Uch 1 and 2 mainly provide electricity to the province, particularly Quetta. A list of power plants operating in Balochistan and their installed capacity available on the grid is shown in Figure 4. Most of this is exported out of the province since the demand of the province is less than 1500 MW.¹⁷ However, only 600 MW is dispatched, resulting in a 900 MW shortfall. The province also imports 514 GWh from the Iran border to fulfill its energy demand. Additionally, from KE (Karachi Electric), only 55 MW out of 90 MW is supplied, resulting in a 35 MW shortfall. This shortfall leads to 8-12 hours of load shedding faced by the people of Balochistan.

The primary reason behind this low demand is the inability of QESCO to generate sufficient revenue from the area, leading to a financially unviable sector.

Installed Capacity in Balochistan



¹⁶https://www.pbs.gov.pk/sites/default/files/population/census_reports/pcr_Balochistan.pdf

¹⁷<https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202022.pdf>

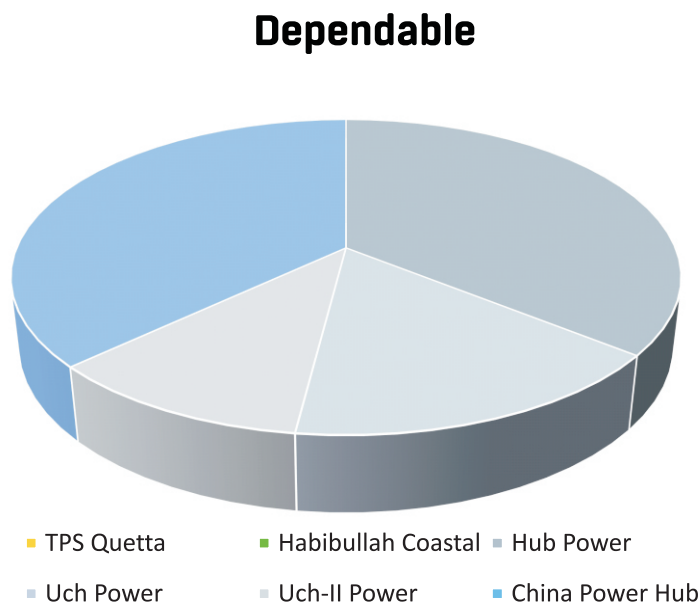
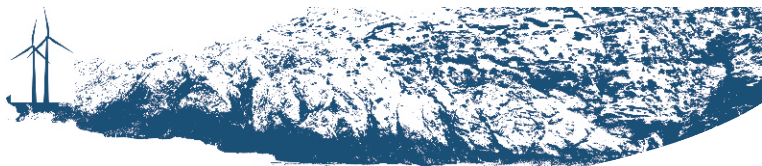


Figure 5 - Dependable installed capacity in Balochistan

Transmission and Distribution

The Distribution Network Map of QESCO, shown in Figure 6 illustrates the electrical infrastructure and the layout of the power distribution network in Balochistan. The map represents both the existing and proposed distribution network of QESCO during the period from 2014 to 2025.

Balochistan has five 220kV grid substations, located in Quetta, Sibi, Loralai, Dera Murad Jamali, and Khuzdar, and no 500kV grid station. Apart from QESCO, some areas in Balochistan receive electricity from other utilities. K-Electric provides electricity to locations like Bela, through 66kV grids. Additionally, electricity is imported from Iran to the Mand, Tump, Turbat, and Hoshab regions.¹⁸

¹⁸<https://www.ntdc.gov.pk/ntdc/public/uploads/services/planning/pms%20load%20forecasts%202014/qesco.pdf>

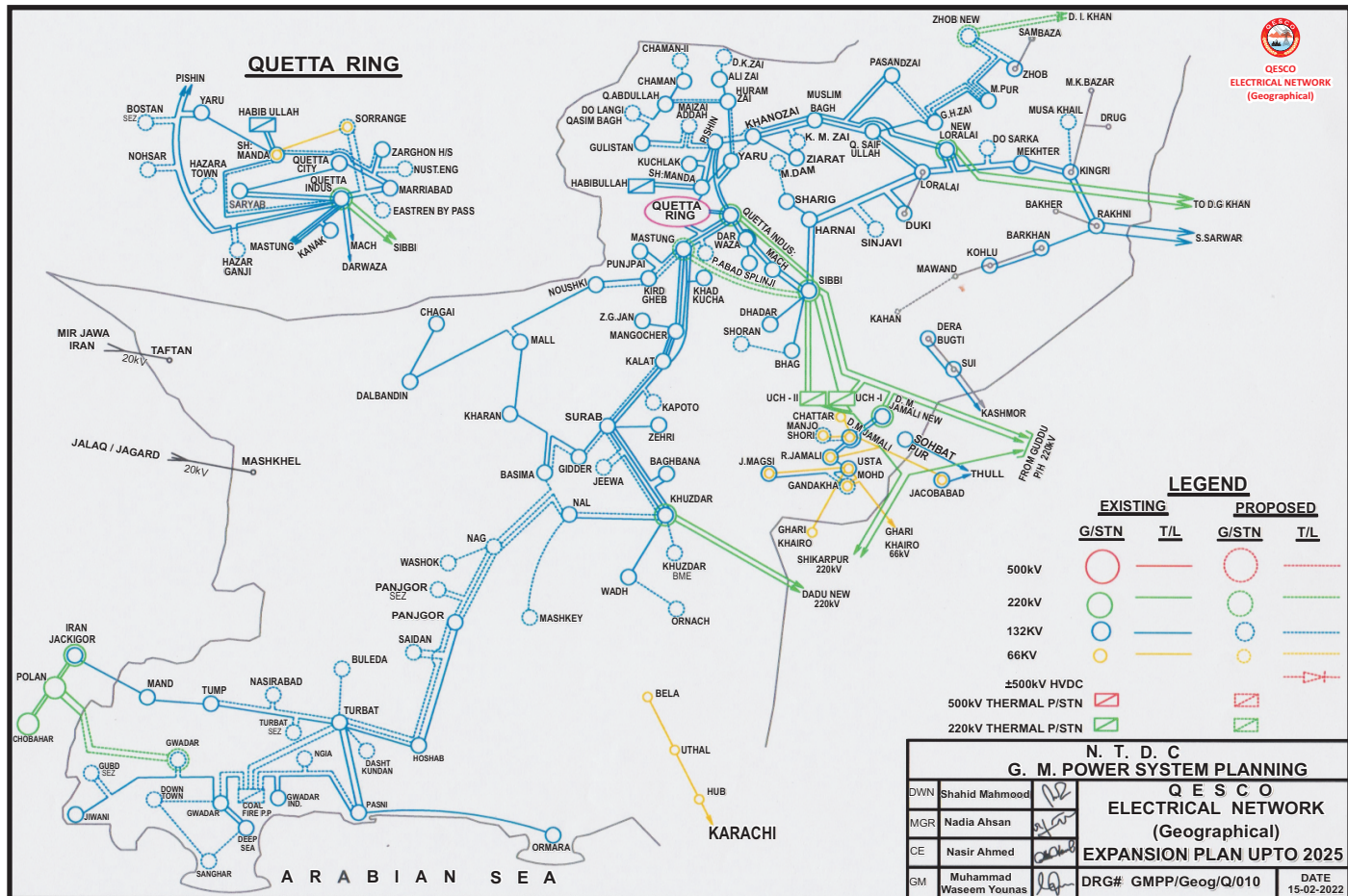
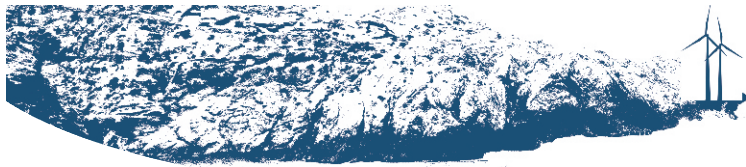


Figure 6 - QESCO NTDC 132,220, and 66 KV transmission lines

Consumer Outlook

According to reports published by QESCO, the consumer base for electricity in Balochistan is very different from what we see in other provinces. While the number of domestic consumers accounts for a major share across the country, the agriculture sector accounts for 73% of the energy consumption. The agriculture load is mostly tube wells for irrigation purposes. One reason for the high consumption rate could be the subsidy provided jointly by the provincial and federal governments. Based on this subsidy, about ~80-90% of the electricity bill of these farmers is paid by the government. While this is important to promote agriculture, an important economic activity in the region, it does lead to inefficient use of electricity and environmental concerns. The historical record of the number of consumers within QESCO jurisdiction is given below in Figure 7.

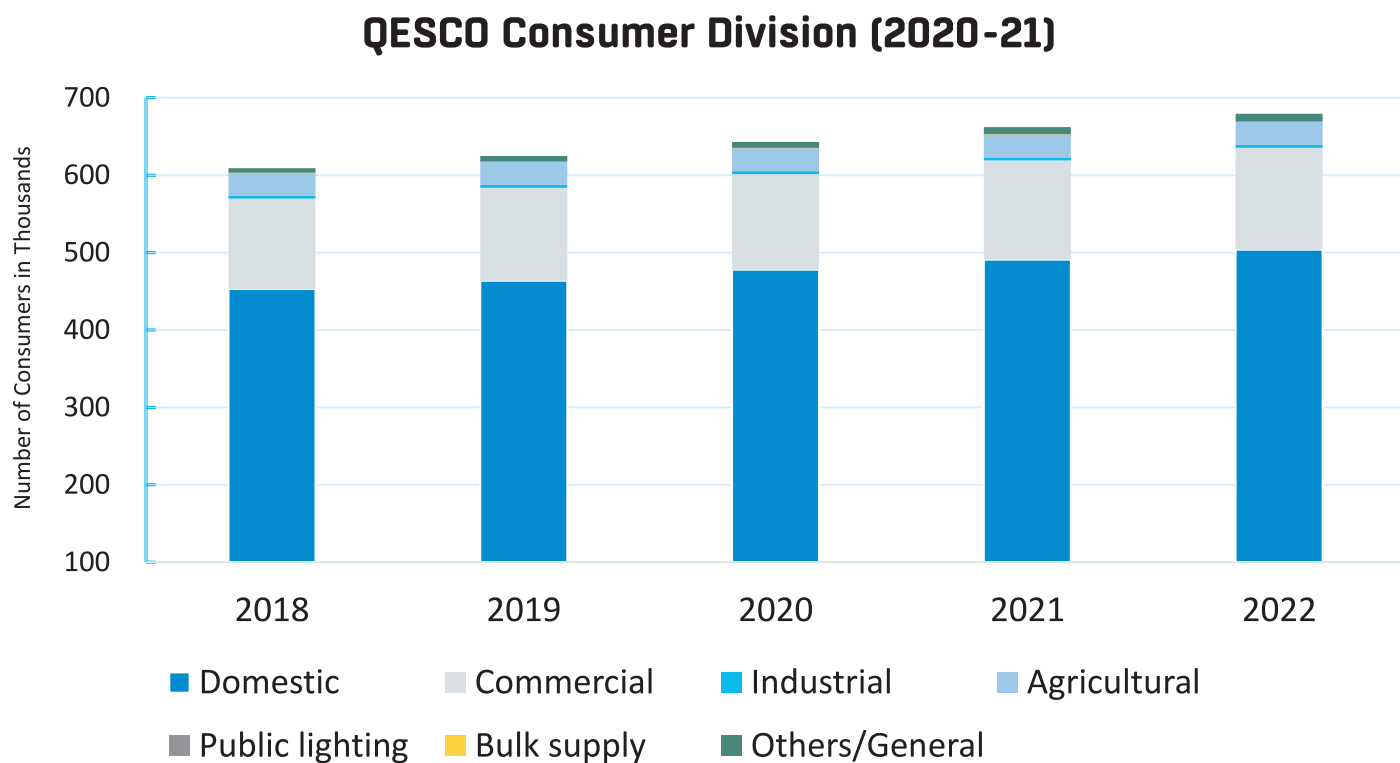
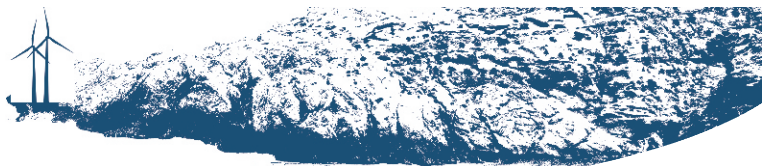
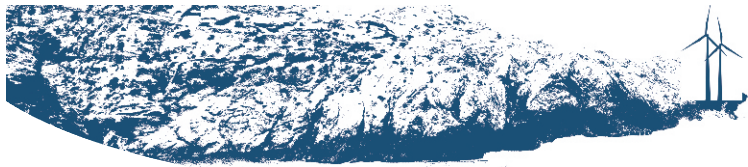


Figure 7 -QESCO consumer Division data for 2020-2021.

Another interesting takeaway from the consumer and energy use breakdown from QESCO is the lack of commercial and industrial load on the system in Balochistan. The dearth of industries can have an adverse effect on the province, including slow economic growth, higher unemployment rates, increased poverty levels, and reduced government revenue. Additionally, the big gap between the number of domestic consumers and their share in actual energy consumed illustrates the unreliability of the system and how the domestic consumer cannot fully utilize this resource due to load shedding.



Consumption Percentage

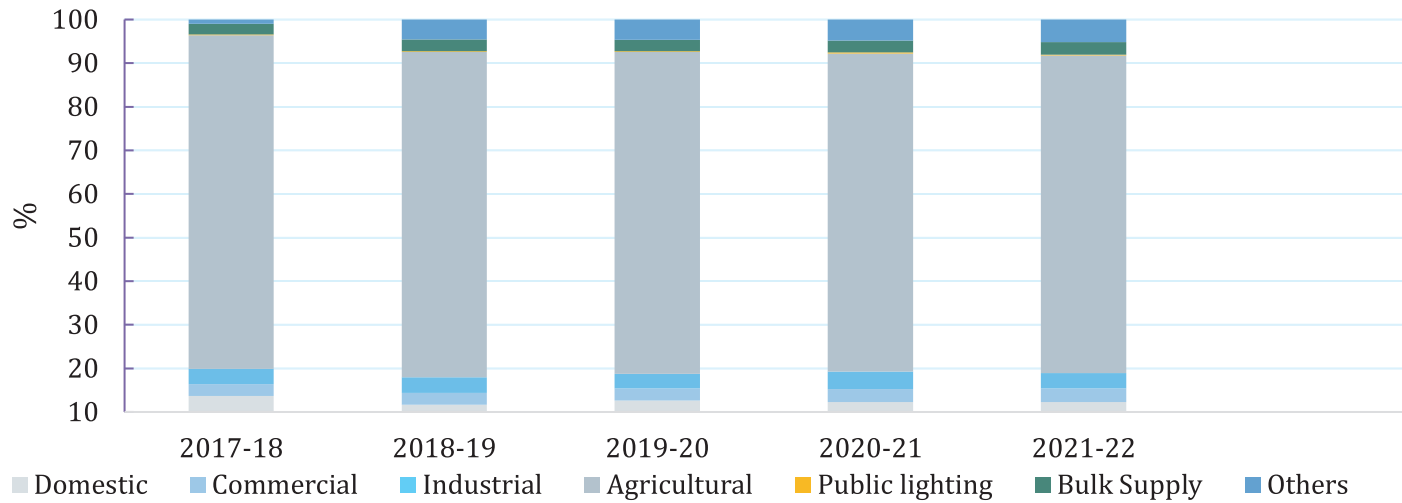


Figure 8 - Consumption Percentage

In terms of sanctioned load, agriculture has the highest sanctioned load followed by domestic and commercial load.

Category-wise Sanctioned Load of QESCO in (MW)

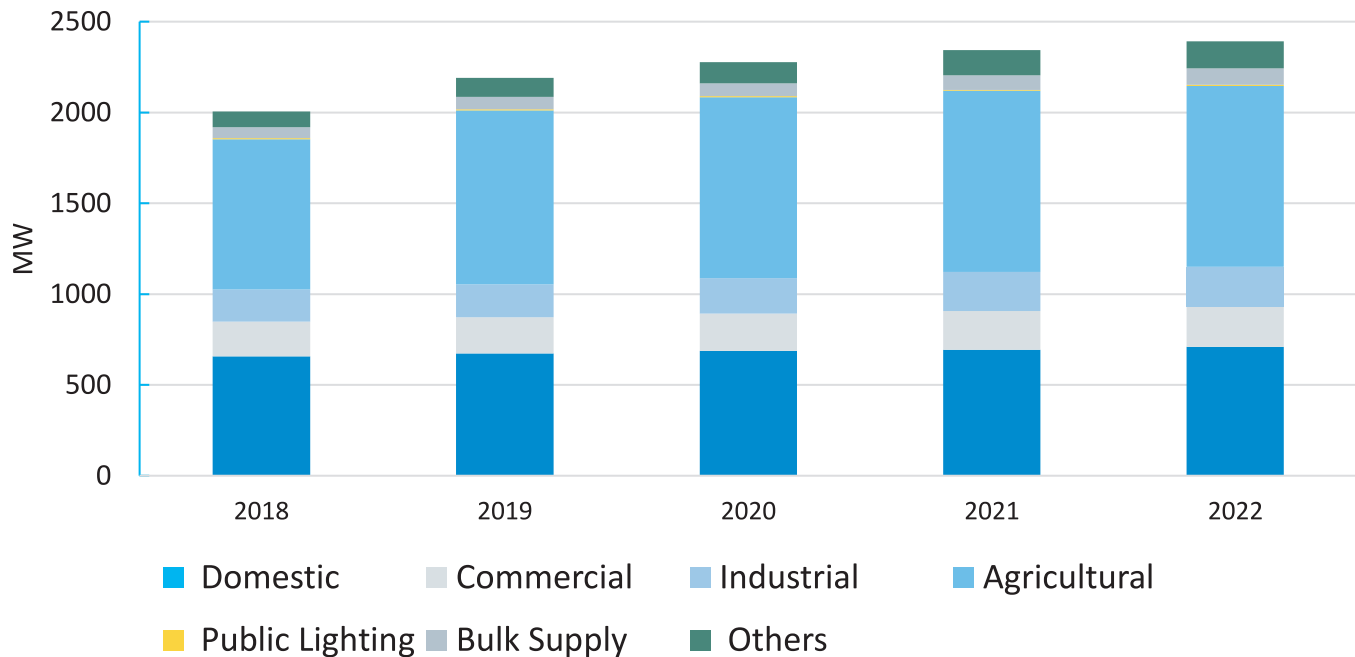
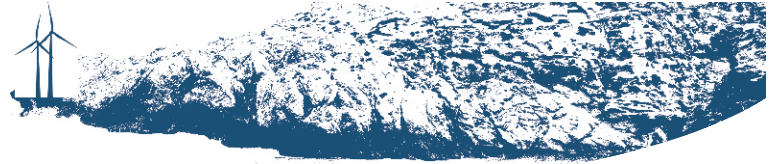


Figure 9 - Sanctioned Load of QESCO



The actual peak demand for QESCO is around 1500 MW, much lower than what was forecasted through their planning division. The peak demand has decreased from 1800 MW to 1500 MW between 2017 - 2022, even though the sanctioned load for the province has increased over these years (Figure 10).¹⁹ This could be because the planned increase in demand from activities like village electrification and increased industrial load did not plan out as forecasted leading to an increase in sanctioned demand but a drop in actual demand (Figure 10). The forecast report assumes the peak load in Balochistan will go up to 2255 MW by 2022, higher than what it is currently.²⁰ This could be due to the lack of planned development of commercial and industrial activities in the province, a lack of expansion of transmission lines to reach more domestic consumers, non-practical growth assumptions, or a mixture of all three.

Actual vs Forecasted Demand 2017-2022

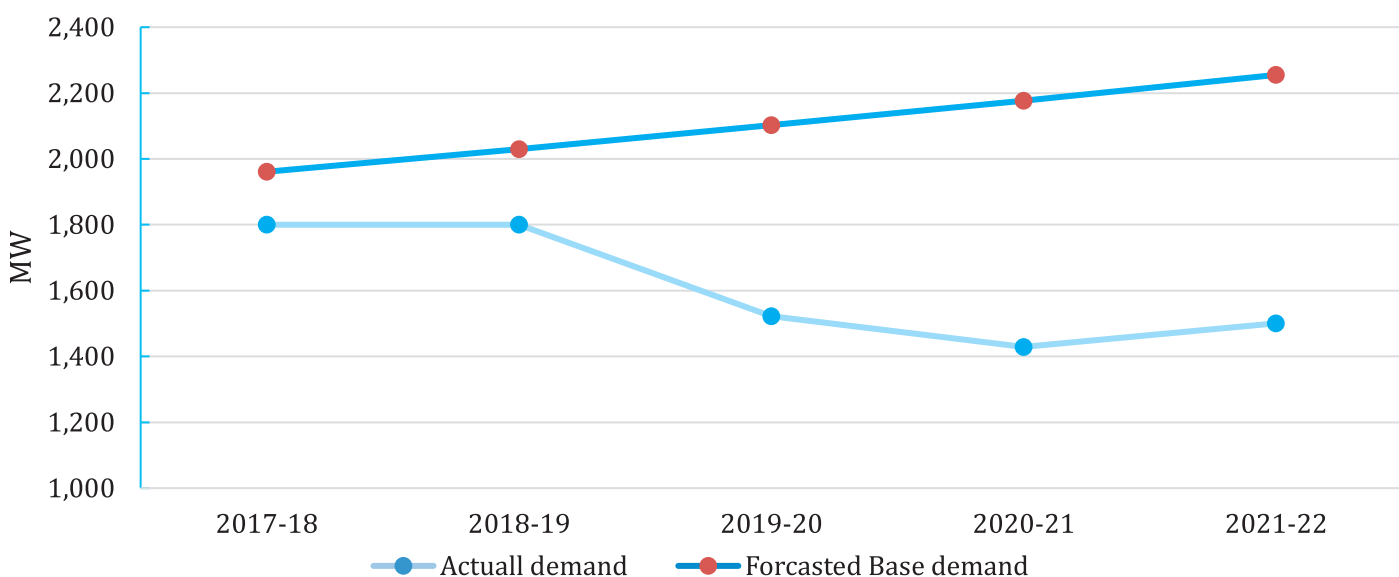
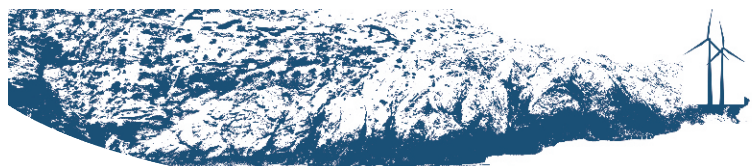


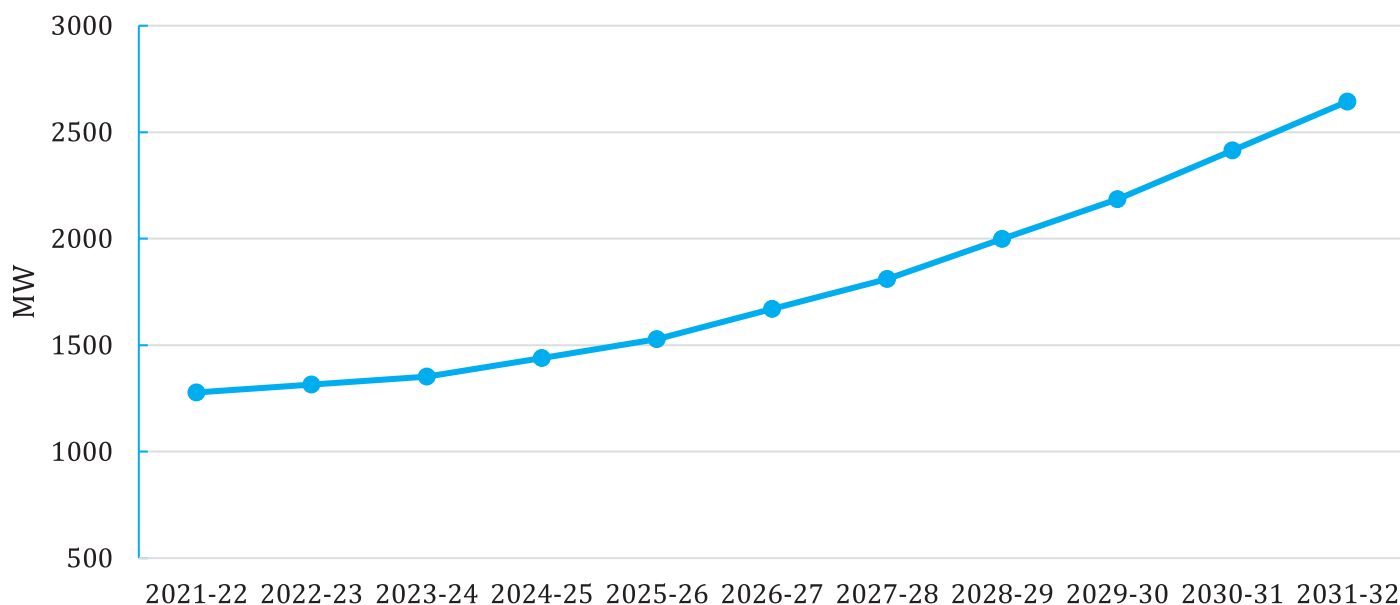
Figure 10 - Actual vs Forecasted Demand

¹⁹<https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202022.pdf>

²⁰<https://www.ntdc.gov.pk/ntdc/public/uploads/services/planning/pms%20load%20forecasts%202014/qesco.pdf>



Computed Peak (MW) 2021-32



²¹Figure 11 - Computed Peak of QESCO

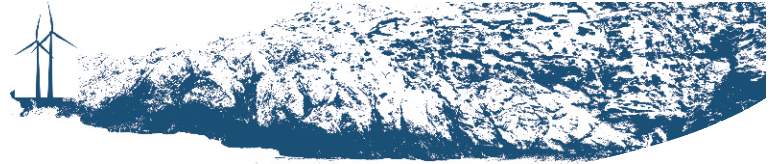
The situation raises questions about the effectiveness of QESCO's expansion plan, which aimed to electrify villages and increase the number of consumers. The expectation was that an increase in consumers would lead to a rise in electricity demand. However, the actual scenario in Balochistan seems to show otherwise.

Subsidy for Agricultural Tube wells

Agriculture is a key economic activity in Balochistan, and the diverse climate allows a variety of crops and fruits to be available across the year. Tube wells are primarily used for irrigation purposes in these farmlands, and to promote agricultural practices in the region, a subsidy is provided on tube well electricity use by the government to registered farmers. This subsidy directly impacts the financial sustainability of the overall power sector, keeping in view the overall share of these tube wells in the overall demand of the province. Both the federal and provincial governments contribute to the subsidies, 40% from the federal government and 60% from the provincial.²² These subsidies are paid directly to the Quetta Electric Supply Company (QESCO) on behalf of the farmers, and farmers only need to pay a nominal amount of "PKR" 10,000/- per month for their electricity bills. This applies to a bill that is up to PKR 75,000 and anything above this amount is paid by the farmer.

²¹QESCO Medium Term Load Forecasting , based on power Market survey, (2031-32)

²²ECC Cabinet Meeting Number 103/21/2018



According to Balochistan's Department of Agriculture and QESCO, there are a total of 76,666 tube wells in the province, with 38,052 getting electricity directly from the grid and paying bills themselves. There are currently 29,522 registered and subsidized Tube Wells. However, there are 9092 unregistered tube wells as per a joint survey of GoB and QESCO in 2019.

Tubewells by Division (QESCO)

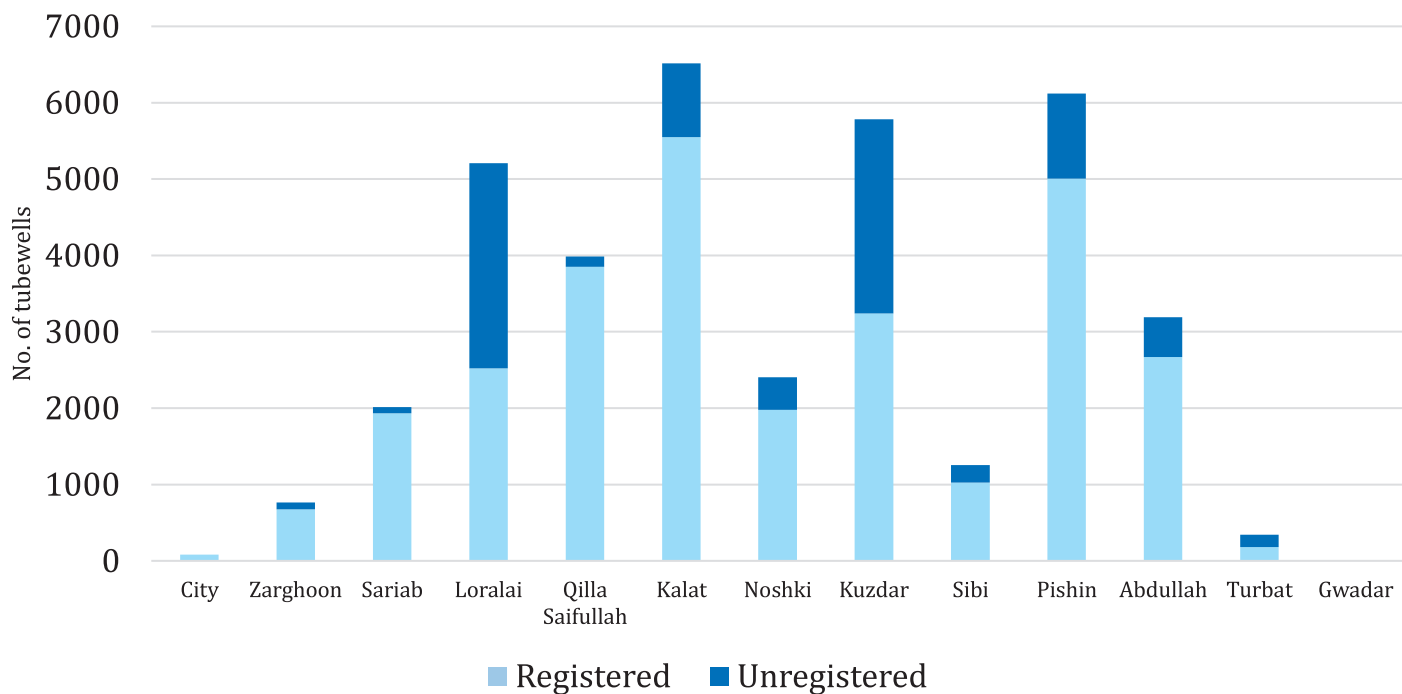


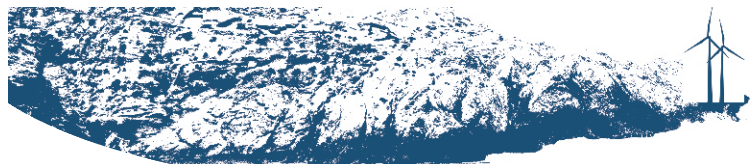
Figure 12 - Tubewells by division

This significant financial support enables farmers to access affordable electricity, which is crucial for running their tube wells and irrigation systems. By offering these subsidies, the government aims to promote sustainable agricultural practices, boost rural economies, and support the livelihoods of farmers. This initiative contributes to the overall prosperity of farming communities and fosters sustainable growth in the agricultural sector.

Currently, there is a movement to solarize these tube wells led by the Department of Agriculture in Balochistan.²³ Solarization of tube wells can reduce the burden of subsidies on the governments and make use of the immense solar potential in the province. This drive also helps eliminate the burden of payment on QESCO of unregistered tube wells. These unregistered tube wells are not billed, and consume electricity, leading to a strain on the power system and overall, 18.5 billion PKR financial losses burdens for QESCO.²⁴ This in

²³https://pdf.usaid.gov/pdf_docs/PA00XG1M.pdf

²⁴FY 2021-2022



turn leads to QESCO executing severe load shedding leading to very high line losses and low voltages once the lines are open. Additionally, due to low voltages, the wear and tear of pump motors is very high, and efficiency remains very low. The transition to solar-powered tube wells aligns with efforts to promote renewable energy adoption and decrease dependence on conventional electricity sources.

The solarization of tube wells presents both challenges and benefits, shaping the landscape of sustainable energy adoption in the agricultural sector. A big challenge, one that has led to pushback from environment-focused groups in the province is the misuse of groundwater. The shift to solar-powered tube wells may lead to the mismanagement and overexploitation of groundwater resources. This is due to the minimal or negligible operating cost of the solar tubewells. To overcome this issue, smart meters can be installed on pumps against subsidizing or incentivizing solarization of tubewell.

Renewable Energy Potential in Balochistan:

Balochistan accounts for about 40% of the primary energy production of Pakistan and houses 33% of natural gas reserves, 9% of coal, and 2% of probable oil reserves. Balochistan's energy use consists mostly of biomass-energy firewood and dung cakes.²⁵ This is because most of the natural resources from the province are exported to other parts of the country. The province has immense potential for renewable generation, particularly wind and solar. This immense resource potential can fulfill the substantial demand of the province as well as the rest of the country. It is anticipated that the exploitation of these opportunities will result in an annual increase of around \$3 billion in Balochistan's GDP, representing a 30% rise compared to the current situation. Furthermore, this growth will lead to the creation of over 25,000 permanent jobs, contributing to the establishment of a robust industrial base.²⁶

Studies by 8.2 Renewable Experts / NESPAK and the World Bank deep dive into site-specific analysis of medium- and long-term renewable deployment opportunities in Balochistan. The report looks at potential in the existing grid, particularly 11kV feeders that can support the addition of solar and in the long run, extend the grid to meet solar and wind targets set up by IGCEP. Reports like these project important starting points to develop a renewable adoption strategy for the province.

²⁵<https://www.cscce.org.pk/attachments/news-bulletin/Balochistan%20Implementation%20Framework.pdf>

²⁶Balochistan Renewable Energy Development Study by the World Bank

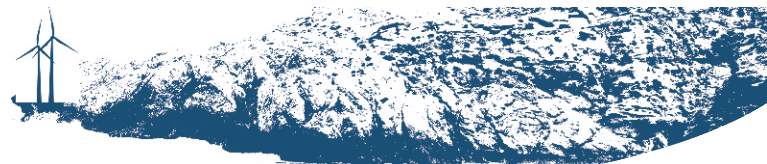
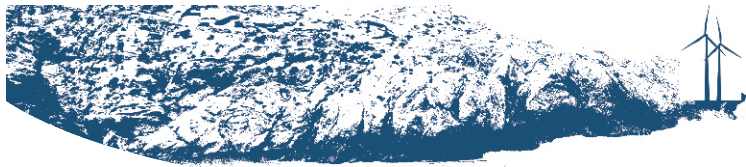


Table 1-Renewable Deployment Opportunities and Agricultural Pump Replacement

The specific cost of replacement of agricultural tube-well pumps through energy-efficient new models	16,250 PKR per kW
Total cost of replacement for 10,000 locations at 45 kW on average	7.31 billion PKR
Annual savings in energy for 10,000 sites	340 GWh
Savings in energy over 10 years for 10,000 sites	3,400 GWh resulting in a 2.1 PKR / kWh cost of saved energy without the cost of finance.

In the surveyed 261 farms with 556 tube wells in Balochistan, it was found that power requirements and pump sizes for agriculture are notably higher than in other Pakistani provinces due to deeper groundwater levels. The limited availability of electricity prompts farmers to install unregistered pumps, causing significant losses in the distribution system and inefficient on-site pump operations. Additionally, the study highlights a seasonal disparity, with farmers pumping excessive water during the off-season, leading to insufficient water availability during the critical summer months. These findings underscore the urgent need for improved water management strategies and more reliable power supply in Balochistan's agricultural sector.

Combine solar power and High-Efficiency Irrigation Systems (HEIS) for cost-effective, efficient farming. Benefits: 63% cost reduction in 10 years, grid reliability, and increased crop yield. Key: Emphasize energy value among farmers, incentivize savings, and consider a cooperative or individual solar systems with net metering.



Solar Potential:

Balochistan's area houses some of the highest photovoltaic power potential in the country. About 40% of the province's land area receives direct solar insolation with an energy potential of more than 6 kWh per sq.meter, while the rest of the province receives direct solar radiation with an energy potential of 4.5 kWh per square meter per day. A World Bank study calculated that this amount of solar resource can result in 1.2 million MW of solar potential in the province.²⁷ The province has a cleaner sky, higher days of sunlight, and the highest DNI compared to the other provinces of Pakistan.

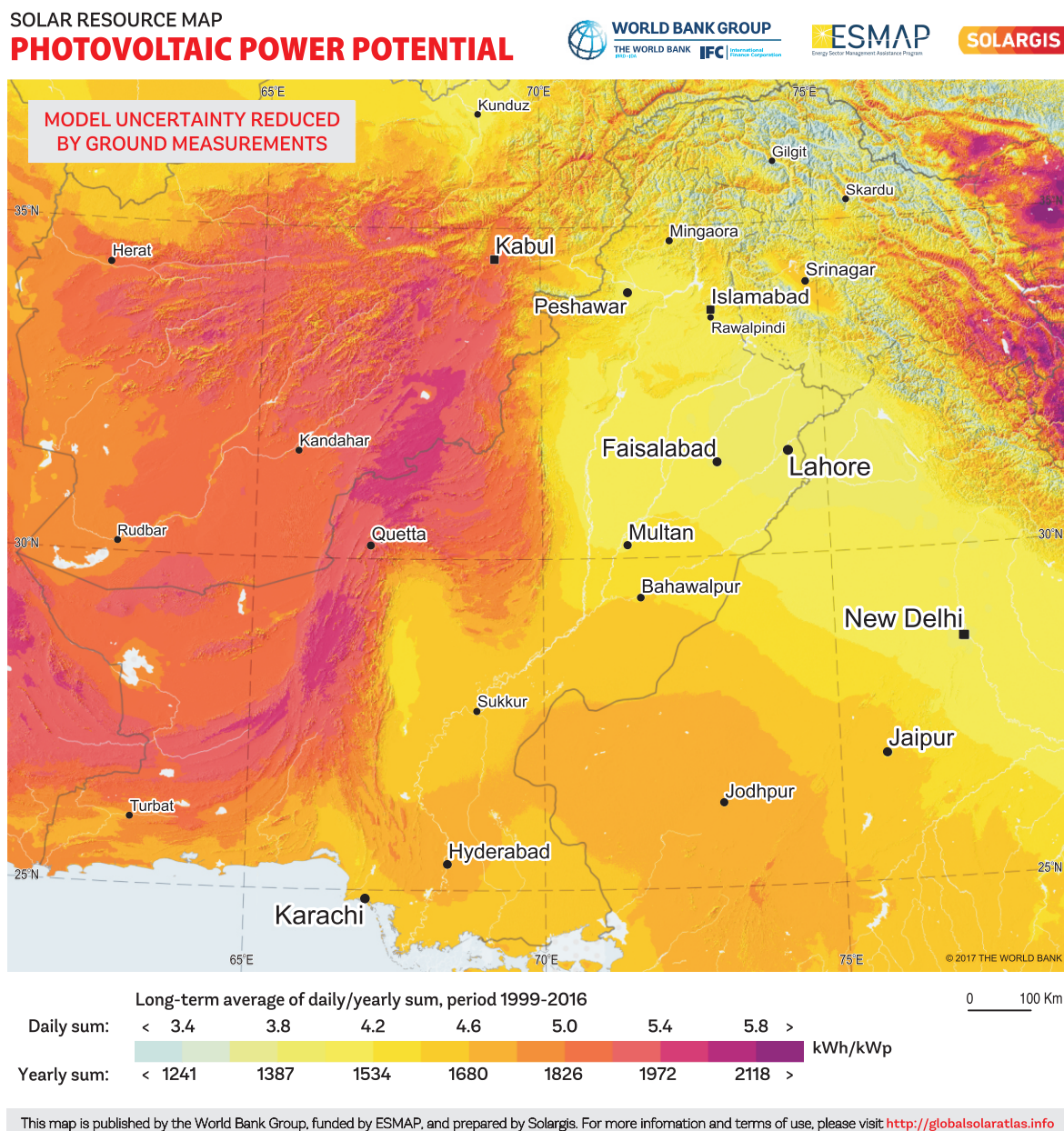
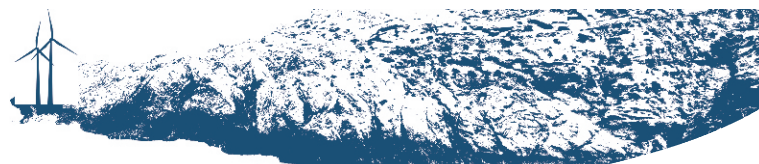


Figure 13 - Photovoltaic Potential in Pakistan

²⁷<https://documents1.worldbank.org/curated/zh/352401468145176136/pdf/ACS22580WP0v500art020Energy0Sector.pdf>



Wind Potential:

Like solar, Balochistan has immense wind potential, particularly in the south and western regions of the province. A wind resource assessment study by NREL estimated about 20,000 MW of wind potential in the province, particularly in the Nokkundi and Chagai regions.²⁸ To develop large-scale wind resources substantial financial investments in the transmission system will be required since the areas with high wind potential are far from the national grid. The private sector can play a huge role in using this potential, particularly around prospective mining regions that are far away from the national grid and have high energy demand.

- Reko Diq copper-gold mine and Gwadar City projects are anticipated to become the province's primary load centers within the next five years.
- Exploiting the region's abundant renewable potential provides a cost-effective means to supply power to these load centers, eliminating the need for substantial transmission investments.
- In the initial stages, the Reko diq project could operate independently in an island mode, leveraging local wind and solar resources along with a few Gensets to establish a mini-grid, ensuring voltage and frequency support.
- Similar to Reko Diq, a mini-grid could be implemented for Gwadar, utilizing the local renewable potential to meet its power requirements.
- Exploring grid connection options is crucial for enhancing reliability in these critical areas. A High Voltage Direct Current (HVDC) link from Multan to Panjgur, coupled with a High Voltage Alternating Current (HVAC) network extending to Chaghi and Gwadar presents viable solutions.
- The HVAC network, tapped at different locations, allows for the seamless integration of renewable generation along the way, contributing to a sustainable energy mix.
- The same HVDC link can be utilized to export surplus power to other parts of the country, maximizing the benefits of renewable energy generation in the region.

²⁸https://www.researchgate.net/publication/227284314_Solar_and_Wind_Resource_Assessments_for_Afghanistan_and_Pakistan

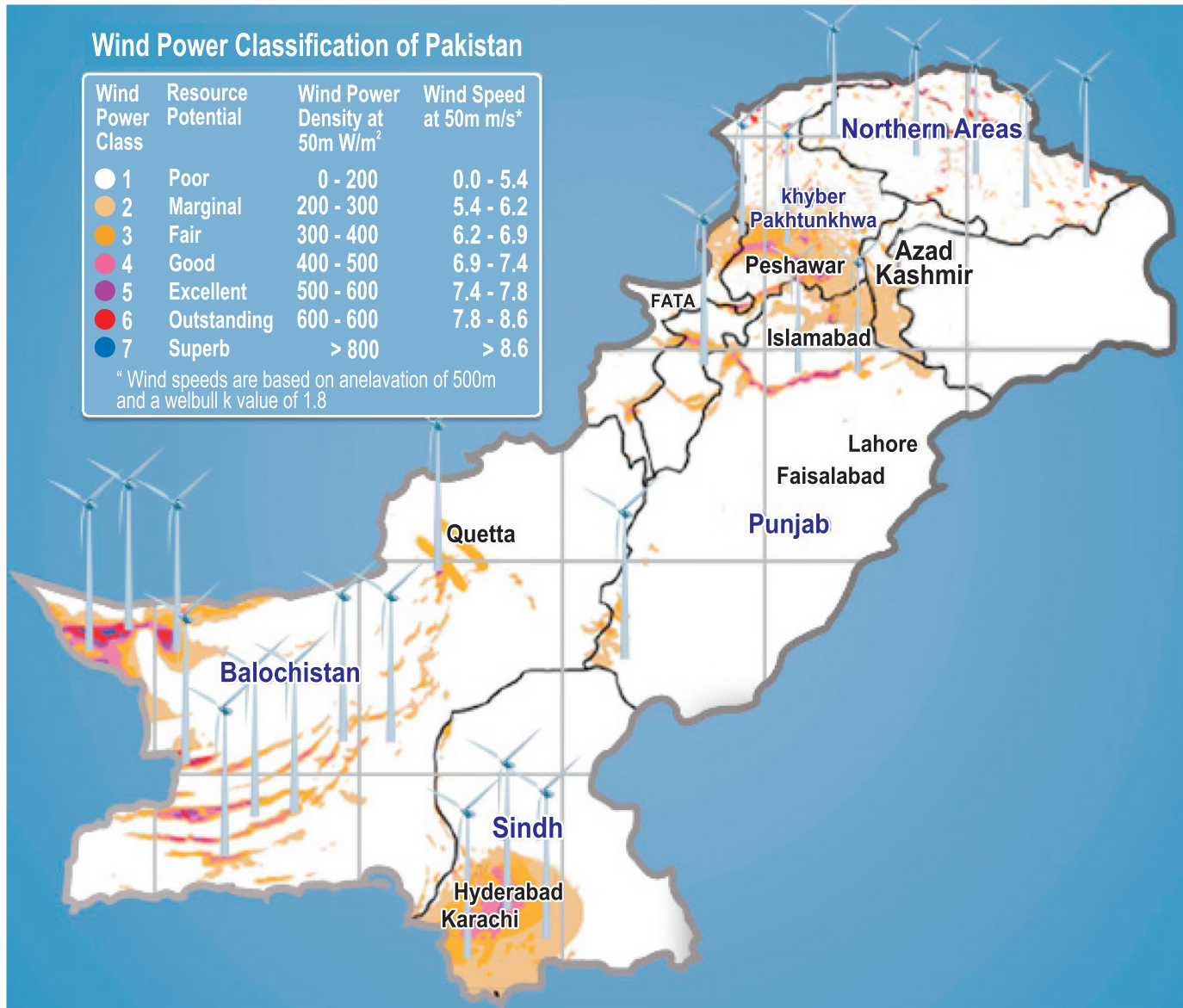
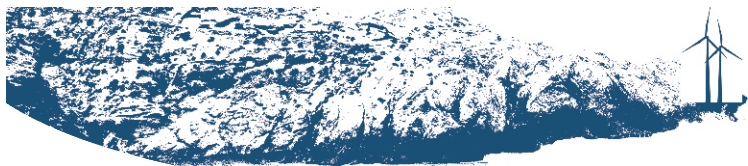
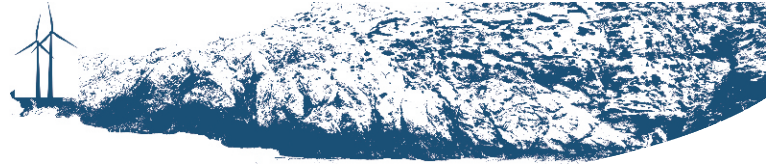


Figure -14 Wind Potential in Pakistan

Other Renewable Sources:

There are other renewable resources that can also be explored, including offshore wind and CSP. There has also been discussion on the potential of geothermal and tidal energy in the province. While these technologies are less renowned and used globally as compared to solar and wind, there could be significant potential to explore their feasibility keeping in mind the specific geographic and population density situation in Balochistan. However, the discussion on these technologies is limited and no comprehensive feasibility studies have been conducted to understand the full potential of these sources.



Challenges to Renewables Deployment in Balochistan

Balochistan, despite having immense potential in Renewable Energy, lacks in the overall development of Renewable Energy in the country. This could be pegged to multiple challenges that constrain and hinder the growth of the Renewable Energy ecosystem in the province. The wide variety of challenges pertain to the overall governance of the sector, the technical constraints of the system, financial health, and social issues.

Governance Challenges

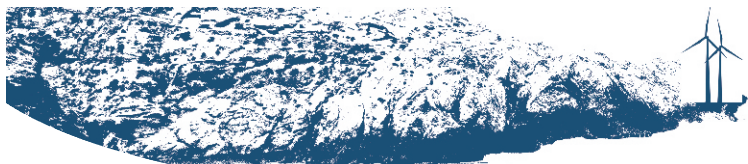
Lack of Stable Leadership and Consistent Policies

Balochistan occasionally experiences transitions in key government positions, with individuals sometimes concluding their roles before their expected term. This flux in leadership can lead to breaks in continuity, potentially affecting the steady advancement of long-term objectives in the province's energy landscape, such as delays in RE projects.

There is also a lack of a comprehensive strategy for harnessing the potential of renewable resources which hinders their effective utilisation. The 2007 Balochistan Power Generation Policy defines regulation for energy-related endeavors in the province but does not highlight renewable energy specifically. Hence, there is currently no provincial-level energy policy for renewables which leads to uncertainty in the implementation of energy-related projects in the province. Similarly, the current policies and plans are updated according to the energy dynamics of the province. For instance, the tubewell subsidy remains one of the critical factors impacting the financial sustainability of the whole sector, but current policies and plans fail to address these critical issues.

Limited Vision of Policy Makers on Renewables

Balochistan has the potential to benefit greatly from diversifying its energy mix beyond fossil fuels. While there is an abundance of fossil fuel sources available in the province, there isn't equal focus, in terms of policy, on renewable resources like solar, wind, biomass, geothermal, and tidal/wave energy. These sources can all be crucial in ensuring a sustainable, reliable, and secure energy future. A major reason for the lack of vision and political will is the lack of interest in renewable transition and access to electricity in the general population of the province. There is no discussion on cheap electricity, or electricity access in the political mandate. While most of the focus is on the solarization of tube wells and solar streetlights, other avenues of energy transition such as electrification of off-grid communities or distributed solar generation at the domestic consumer level are not highlighted.



Capacity Building and Training

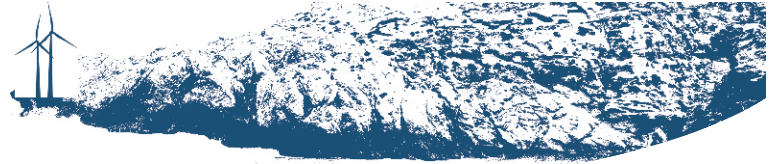
One of the key issues in the province is the lack of prudent capacity to undertake policy decisions based on sound data and analysis. This is evident during national meetings, policy designs, and planning processes when subject matter experts with local context are not available for consultation on key issues. The human resource of Balochistan faces difficulties in effectively participating in discussions, sharing ideas, communicating with federal entities, and demanding rights in the power sector from the national committee. This lack of engagement hinders their ability to contribute meaningfully to the development and formulation of energy policies at the national level.

Community Engagement and Local Perspectives

Balochistan's local dynamics are complex due to historical, social, and economic factors which makes it difficult to engage in meaningful consultation. The province has a distinct cultural identity and a history of grievances related to resource exploitation. In the absence of a proper strategy to consult with communities, policymakers lack effective mechanisms to engage with them, especially in energy-related decision-making processes. The absence of community participation had led to the neglect of local perspectives, empowerment, participation, needs, and concerns, which resulted in unsustainable energy projects and potential conflicts between communities and project developers. For example, the Govt. of Balochistan allotted a contested land in the Kuchlak area to a developer for a solar plant which resulted in litigation proceedings between the community and the developer. There is a considerable communication gap between the government and communities that hinders progress in improving the renewable outlook in the province.

Limited Use of Technology and Systems for Governance

The lack of technology and systems in governance poses significant challenges to project developers. For instance, allotment of land rights for large-scale renewable projects often takes years due to the absence of digitized land records. This creates issues, as for any project, the developer has to put in considerable resources in terms of time to identify landowners for the project. This becomes a tedious process for RE developers who want to develop projects in the province. Additionally, the Energy Department and related provincial organizations face hurdles due to the limited technological infrastructure and access to digital resources like energy data, future forecasts, and monitoring of the current energy system of Balochistan. Similarly, QESCO is still operating on archaic manual governing systems. Digital governance and operation have the potential to revolutionize energy management by integrating technology and digital tools to streamline project development processes.



Security, Law, and Order

The insurgency in the province has only increased in the past decade. These conflicts have led to violence, attacks on infrastructure, and disruption of public services including Energy (Gas) supply. Security concerns have deterred domestic and foreign investors from participating in energy projects in Balochistan. Investors are likely to be cautious about committing funds to projects in areas with a history of instability and security threats. Additionally, the additional cost for security arrangements of the personnel increased the overall cost of the project as well.

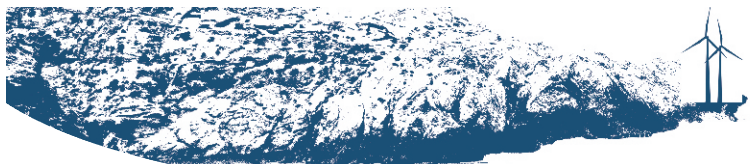
These security challenges demand careful planning and coordination between the government, security agencies, and project developers to ensure the safety and continuity of development projects in Balochistan. One example of this is attaining land rights, a lack of law-and-order situation may impede the entry of new developers, particularly international organizations. Even if it proceeds with the projects, the developers may only invest with accompanying security assurances by the Government. For instance, there are no-go areas in the province which renders many potential projects unviable due to accompanying security risks.

Limited Coordination with Federal Entities

Balochistan's power sector coordination among the stakeholders (Academia, Industry, Govt, communities, and private investors) remains a prominent challenge. Poor coordination is observed among various stakeholders, including the provincial government, federal authorities, power generation companies, distribution companies, and regulatory bodies. This lack of synchronization and collaboration hampers the efficient functioning of the energy sector, leading to delays in decision-making processes, issues conflicts in policy implementation, and overall inefficiencies.

There is a general perspective within the province that its needs and priorities are often overlooked or underrepresented in national-level energy policy and decision-making processes. On the other hand, federal stakeholders point out the inability of the provincial stakeholders to participate and communicate effectively along with their lack of representation on key issues concerning the province. This lack of coordination derails the process of securing support, funding, and resources from federal institutions for local energy projects.

Another key issue regarding the Indicative Generation Capacity Expansion Plan (IGCEP) is the lack of engagement of Balochistan's stakeholders in its formulation. This is particularly significant as the overarching capacity to understand and influence IGCEP is lacking in the



province. IDSP is currently working in this regard to enhance the capacity of the public institutions as well as other organizations/experts of the province to take part in such conversations.

Transmission Constraints

Balochistan has vast rugged terrain and a population that is scattered which makes it difficult to establish infrastructure for energy generation, transmission, and distribution. Not only is the cost of building transmission lines to these areas extremely high, but the long transmission lines also mean high technical losses. The average distance of distribution lines in Balochistan is about 56 km, Zarocha area situated in Noshki has a 90 km length of 11 kv lines. compared to their rated length of 25-30 km which leads to high transmission and distribution losses. To fulfill transmission needs requires considerable investment in the expansion of the grid network.

Decentralized systems such as off-grid and mini-grid solutions are more feasible keeping the population density in mind.

As per a World Bank study, an assessment has established the viability of roughly 5 gigawatts (GW) of short-term potential distributed among 25 distinct Balochistan, all of which can be utilized by the existing grid infrastructure. Using this potential lines up with goals for sustainability, leading us to a future where clean energy thrives.

The figures below are part of the World Bank's VRE Locational Study and show that the areas near the existing grid infrastructure are not only more economical to develop but also can be developed faster.²⁹ As the maps show, the national grid in Balochistan is significantly less dense but also hosts the highest wind and solar potential in the country. A lack of grid access is a huge reason for why renewable exploration in Balochistan has been hindered and will require a strategic roadmap if all this potential is to be tapped into.

²⁹<https://documents1.worldbank.org/curated/en/883241610741226840/pdf/Main-Report.pdf>

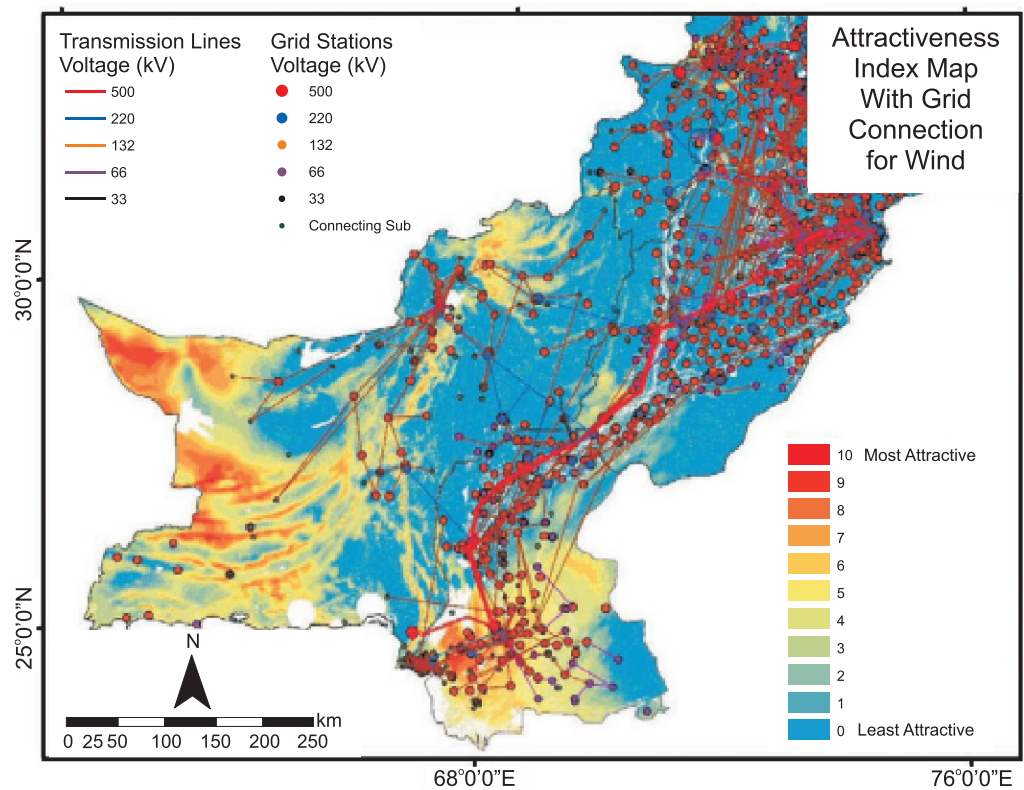
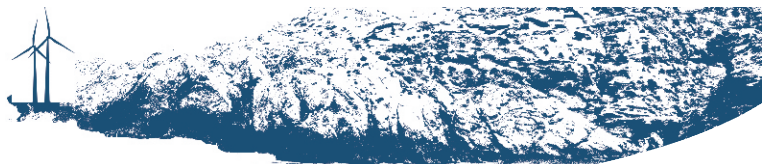


Figure 15- Map with Grid connection for Solar

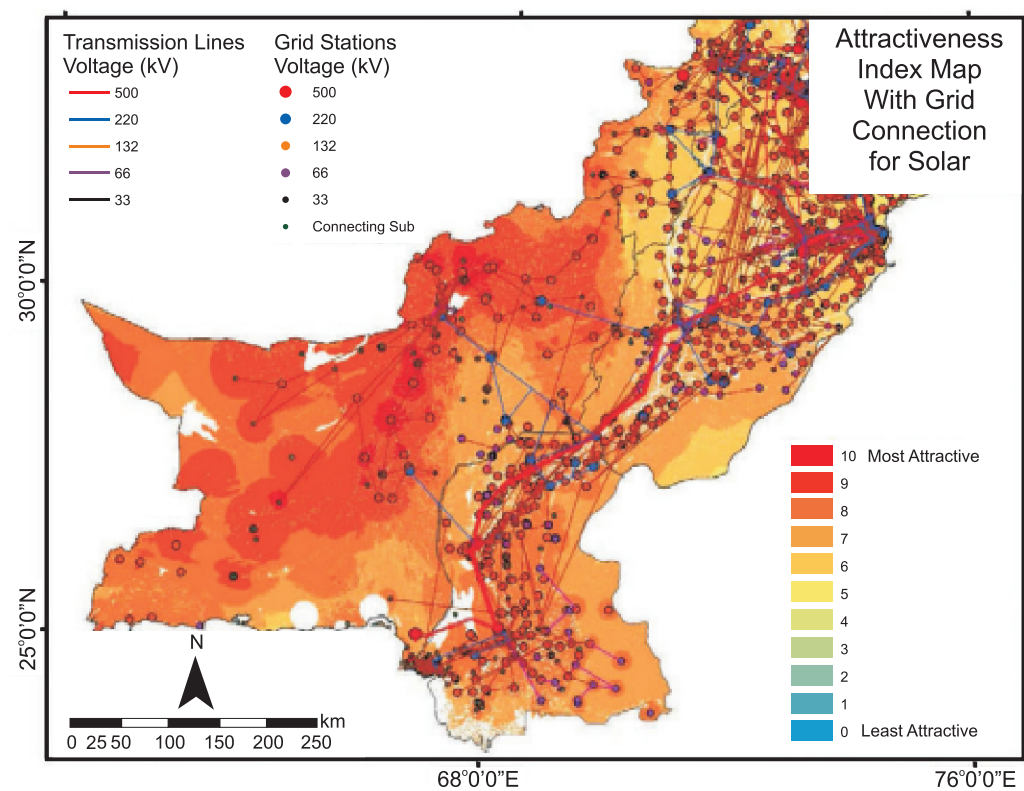
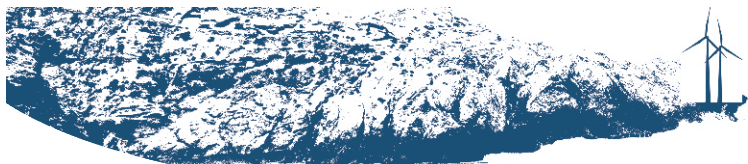


Figure 16 Map with Grid Connection for Wind



Financial Challenges.

High-Security Payments in Tariff Design:

Balochistan faces a unique situation where additional security payment needs to be considered due to the law-and-order situation in the country. This addition directly raises the overall project cost, making Balochistan-specific projects un-competitive at national level auctions set to happen under ARE policy 2019. In this context, Balochistan might face challenges in qualifying for the lowest bidding, as the circumstances differ from other regions. The comparatively high-security payment further influences the cost dynamics, potentially impacting Balochistan's competitiveness in bidding processes.³⁰

Low Recovery of Bills:

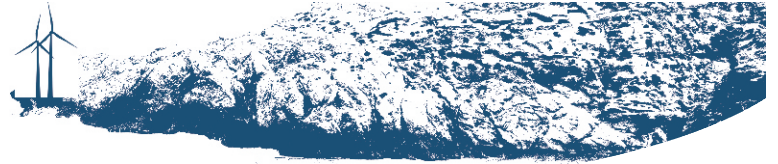
The billed amount against electricity is not recovered from a large share of domestic and agricultural consumers. This is mainly due to the amount of electricity theft and illegal connections that exist in the electricity system in Balochistan. Many consumers have unmetered connections due to political and social reasons, so there is no way for QESCO to monitor and collect bills from such consumers. Meterman and other field staff are unable to visit certain areas due to security reasons and long distances.

The non-payment of bills results in a meager 35% recovery for QESCO in FY 2022, while the remaining 65% is lost, placing a significant burden on the financial health of the electricity sector. These losses accumulate monthly and yearly, reaching almost PKR 96,523 million in 2022. To offset these losses, the unit prices are adjusted in the annual tariff revisions, further exacerbating the financial strain.³¹

In terms of the consumer category, the lowest return comes from agriculture consumers due to a large number of unregistered tube wells and high subsidies for the sector. On the contrary, industrial consumers, which make up a small percentage of consumers, have a recovery percentage of almost 100%. Domestic consumers have a 64% recovery rate, and this can be attested to the high load shedding and illegal connections.

³⁰No. NEPRA/R/SA(Tariff)/TRF-462/EBSP-2019/14275-14277 (Jun 4, 2020)

³¹<https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202022.pdf>



Recovery of Bills in QESCO (2020 -2021)

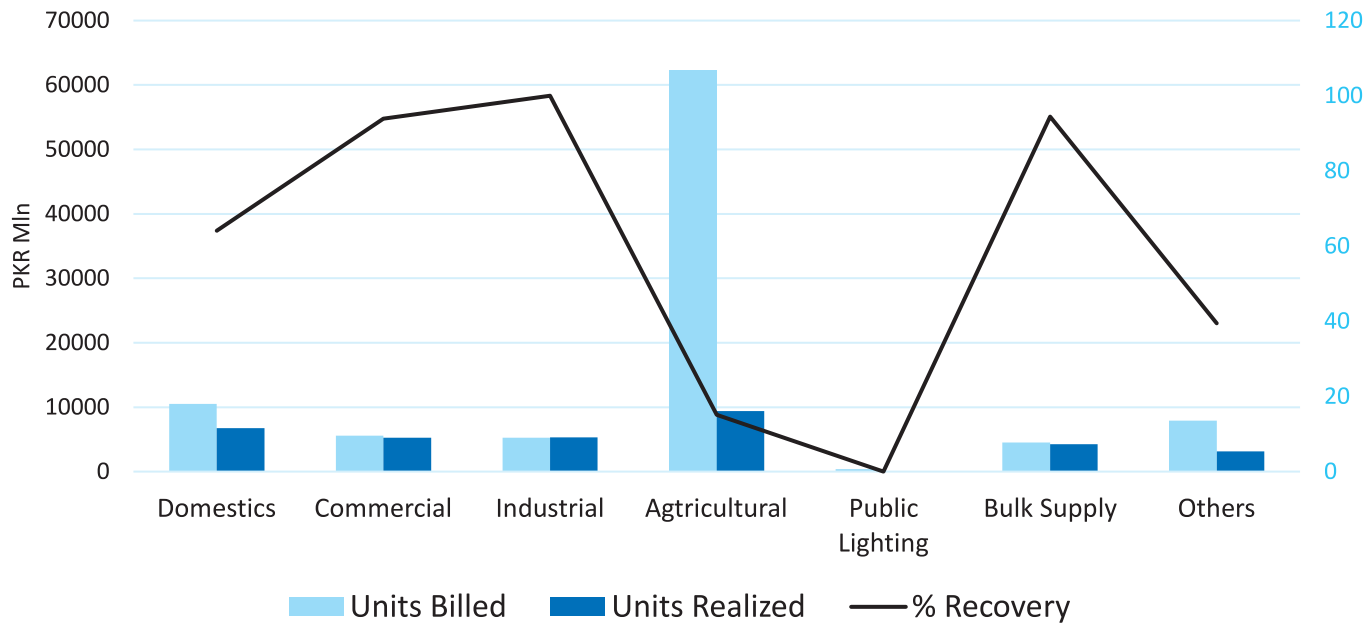


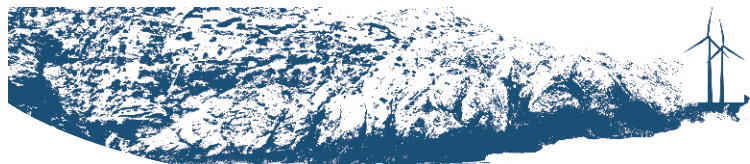
Figure -17 Overall recovery of QESCO 2020-2021

Tubewell subsidy and inefficiencies in the billing remain the major reasons for low recoveries from Agricultural consumers. According to the subsidy program, PKR 75,000/- is paid by the government and the remaining bill is covered by the consumer for agricultural tubewells. The subsidy program is targeted at tube well motors with certain technical specifications. However, due to a high amount of load shedding in the electricity system, consumers tend to use higher-capacity motors for longer periods to meet their load. There are also situations where more than one motor is installed to make most of the time when electricity is available. This coupled with the lack of payment required by the consumers as per the subsidy design only exacerbates the low recoveries issue.

A key conundrum for the recovery issue is the circular nature of the problem. From the perspective of the communities, the low quality of power supply and high load shedding of more than 6-8 hours per day impedes the consumers from becoming a paying customers. On the other hand, utility remains unable to improve the distribution infrastructure, unless the recoveries are considerably improved. The issue is circular since consumers then resort to inefficient methods to use electricity during the hours that it is available, increasing the burden on the system further.

Aging and Overburdened Infrastructure

The existing electricity network of QESCO is unreliable with several hours of load shedding a day, whereby 40% of the province does not have access to electricity. This is mainly due to the technical condition of the existing lines and the weakening financial health of the



distribution system. Due to the long distances between villages, 11 kV distribution lines are generally more than 56 km long as opposed to the standard maximum length of 25-30 km distance. These practices have resulted in high T&D losses for QESCO, which were about 28% in FY 2022, which is significantly higher than the approved T&D loss value of 14.49%. QESCO ranks as the fourth worst DISCO in Pakistan in terms of T&D losses, after PESCO, SEPCO, and HEPC³². Additionally, the aging electricity infrastructure is also used to its maximum capacity. Transformers are often overloaded above their rated capacity. In 2022, about 5000 transformers accounting for 7.6% of the total transformers in QESCO jurisdiction were overloaded. Additionally remarkable progress in 2022 as QESCO, which experienced 100% overload on an 11 kV feeder in 2021, successfully reduced it to 41%.

QESCO Overloaded 11 kV Feeder 2021 -22

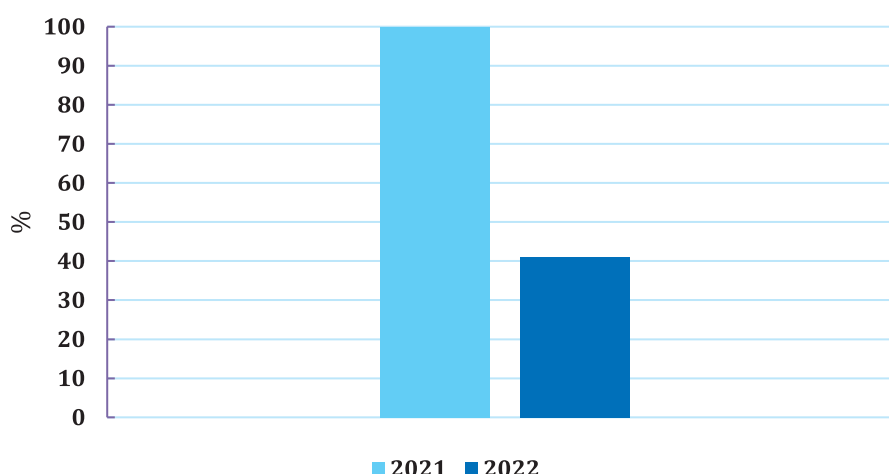


Figure -18 Overloaded 11 KV Feeders

Overloaded Transformers 2022

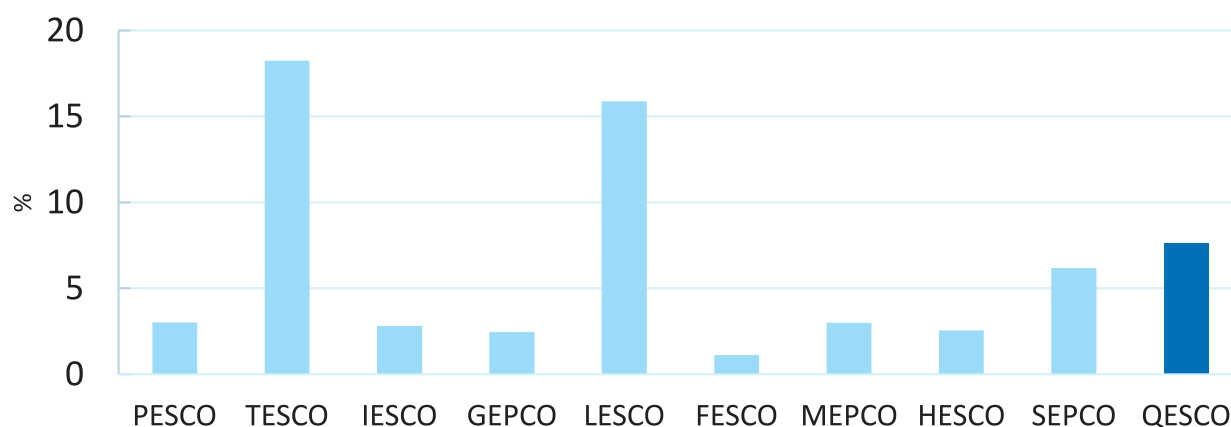
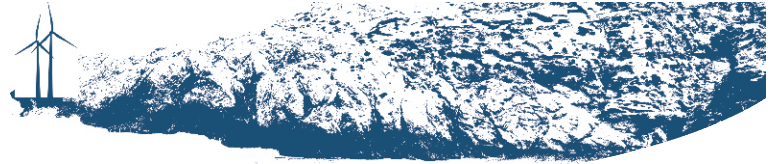


Figure -19 Overloaded Transformers of Discos-2022

³²<https://www.nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202022.pdf>



The financial constraints are a big reason for the utility's inability to upgrade its archaic infrastructure. With infrastructure that is outdated and inadequately maintained, there is a heightened risk of frequent breakdowns, prolonged outage periods, and escalated maintenance expenses. This situation not only impacts the reliability of service delivery but also strains the financial resources required for upkeep. There is also a need for more long-term planning to prepare for these maintenance activities beforehand instead of going into firefighting mode when breakdowns happen.

Limited staffing in Utilities:

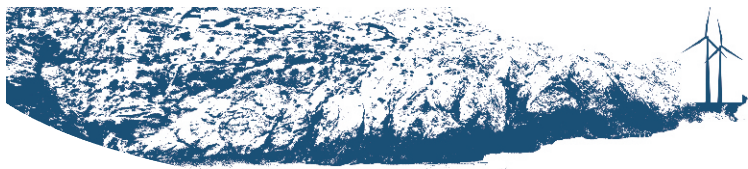
The shortage of skilled technical personnel, encompassing engineers and technicians, poses a considerable obstacle to QESCO's competence in efficiently managing and maintaining its electricity distribution network. Because of the limited number of staff, the company faces service delays, struggling to respond promptly to customer queries, address technical issues, and provide new connections. This delay, in turn, leads to customer dissatisfaction and negatively impacts QESCO's reputation.

Skilled employees in the organization have quick turnover times and are often opting for opportunities outside of the province once a certain skill set is built. The absence of enough skilled personnel makes it difficult for QESCO to initiate and implement new initiatives, such as establishing individual cells or specialized units within the organization. This limitation hinders the progress and improvement of various aspects of the company's operations.

The lack of human resources and the burden of recovery has not allowed QESCO to focus on developing a long-term strategy for some key areas of development in the province. This includes policies to reduce the burden on the grid such as net metering but also expansion of the current system such as village electrification.

Limited Net Metering Uptake in Balochistan:

QESCO is the limited adoption of net metering connections, despite the immense potential in Balochistan. This stems from a lack of awareness and understanding about net metering among the public. Net metering allows consumers to generate their electricity from renewable sources like solar panels and feed any excess energy back into the grid, potentially reducing their electricity bills. However, due to insufficient knowledge about this opportunity, many people in Balochistan are not taking advantage of net metering, even though the region holds significant untapped solar energy potential.



Limited Demand of the Province

The national focus of renewable energy in Pakistan has historically been on hydropower, which makes up 25% of the generation capacity for the country³³. This has led to minimal focus on developing solar and wind resources across the country, with only 5% of the capacity mix for the country coming from wind and less than 2% from solar. The national appetite for hydro can prove to be a hindrance in the development of solar and wind in Balochistan and will need to be addressed at a faster pace if these resources are to be developed. Effects further at the provincial level.

Additionally, QESCO is a single utility in Balochistan with a peak demand of 1500MW, while Punjab six, KPK two, and Sindh have two DISCOs with a peak demand of 20109 MW, 4560 MW, and 2540 MW respectively. The demand itself represents that QESCO contributes only 5% for the whole of Balochistan which is very low as compared to other provinces and makes it difficult to focus on solar and wind park development the reason may be less industrial sector and low capital demand as compared to average is too low.

PEAK DEMAND OF DISCOS (MW) IN 2021-22

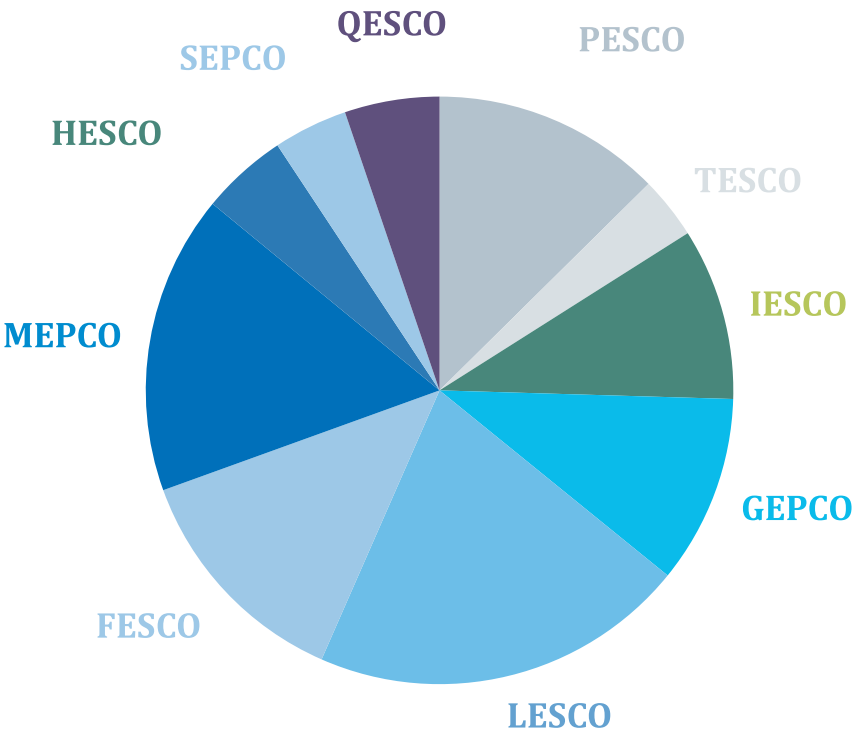
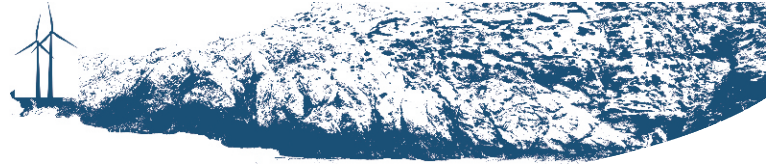


Figure -20 Peak Demand of DISCOs (MW) 2021-22

³³<https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202022.pdf>



Looking Ahead - Solution Spaces for Renewable Energy Deployment

With the backdrop of this report, the challenges faced by Balochistan to increase renewable energy generation and ensure its population receives affordable and sustainable electricity are multifaceted. These challenges are not limited to a particular area and hence require an all-hands-on-deck approach to solve. With IDSP's position and presence within both the local communities and government organizations, it is well suited to providing a way forward in the form of a renewable energy policy for Balochistan.

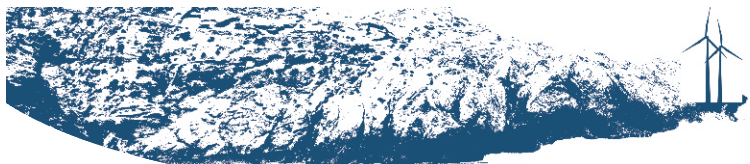
As a starting point, below are 4 solutions spaces that the policy may directly focus on. These solution spaces were designed keeping in mind the biggest challenges to RE deployment in the province and the recommendations of various stakeholders that have partnered with IDSP to assist in developing this policy. The policy will focus on increasing RE deployment in the province, increasing access to electricity to communities not living within grid access, and ensuring the indigenous resources of the province are used for the development and betterment of its people.

Utility Scale Renewable Projects

Balochistan has the potential to become the powerhouse of the country and through renewables, reduce the growing financial burden of the electricity sector in the country. The province hosts some of the highest potential of wind and solar in Pakistan and with the right policy environment, can attract both national and international investors. With AEDB announcing auctions for category 3 projects in 2024, low-cost renewable projects in Balochistan will start to come online and improve the reliability and economic conditions for the province.

Apart from the umbrella of the ARE Policy 2019, the policy will highlight ways Balochistan can focus on projects that generate and supply electricity only to consumers within the province. While many projects are still waiting to be auctioned under ARE 2019, there is an option to explore projects that are solely to be used within the province. With large-scale development projects coming online, such as Rekodiq and Gwadar in the next 5-10 years, along with the multiple mining activities, there is potential for the Government of Balochistan to partner with these organizations to push their renewable agenda and subsequently provide electricity to communities in the project's vicinity as well.

Ultimately, the policy will focus on providing routes to the market for investors of all levels, whether that is through a provincial-level contract, under the ARE policy, or additional opportunities. For each of these routes, the policy will highlight the responsibilities of different government stakeholders to streamline the process, what the ideal timelines for each of these procedures should be, and how different institutions within the province can



work together to meet this goal.

Additionally, Balochistan's interests must be safeguarded in power auctions, ensuring its weak transmission doesn't disadvantage the province. Suggestions include letting provinces acquire equity per land lease costs, involving them in feasibility studies, keeping PPP options open for projects of different scales, considering local content in selection, and incentivizing new technologies. This approach becomes vital as Power Exchanges emerge and provinces gain power-related prominence. Organizing visits and training for stakeholders enhances understanding, especially with DISCOS becoming off-takers. These steps ensure a fair policy implementation, benefiting all.

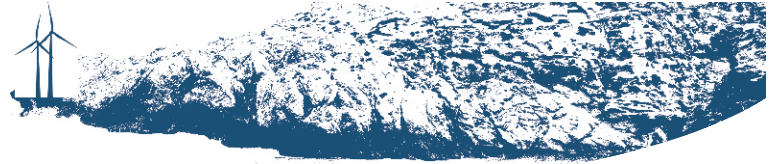
Development of distributed energy projects

The vast area and low population density of the province make grid extension financially infeasible. However, electricity access is a basic right and many critical buildings such as schools and hospitals rely on electricity for their operation. The policy will be designed to help the Government of Balochistan reach these far-off communities and aim to reach 100% electricity access in the province.

Compared to other provinces in the country, access efforts have been limited in Balochistan for multiple reasons. This includes the security situation in the province which hinders access to many areas as well as the lack of information available to investors on demographic and demand data for these regions. Additionally, the buy-in and ownership from communities are also missing, which is critical to the success of these projects. The Government of Balochistan is currently working on pilot studies for micro-grid sites but expansion of these efforts will require a holistic approach that focuses on a profitable business plan for both investors and the community.

A provincial-level policy shall provide the framework for a more structured approach to meeting the goal of 100% electricity access in Balochistan. This will include the lessons learned from ongoing studies such as those by the World Bank on the identification of least-cost electrification options by site across the province. The policy will also provide new innovative solutions for community-based models, such as those developed by SRSP in KPK and GB. The policy will focus on clarifying the roles of different stakeholders in developing these solutions.

Beyond the operational and community-focused framework, the policy will also provide recommendations for various government organizations on how to develop the market of off-grid and mini-grid projects. These will focus on creating business models that can be adopted by national and international investors in this space and the corresponding regulations to support these developments. The goal of this section of the policy will be to provide a structured approach to increasing last-mile electrification efforts in the province and bring together the development work currently happening in silos.



Resolving the Tubewells conundrum through solarization

As discussed in this assessment study, agriculture consumers make up 73% of the consumer base for the province. They are also provided with a joint subsidy from the federal and provincial governments to encourage more agriculture practices in the province, however, inefficient practices have led to high technical and commercial losses in agriculture feeders that need to be addressed through policy change.

One solution that is being put forward is the solarization of tube wells to reduce the financial burden on the Provincial and federal governments and QESCO, the distribution company that manages the subsidy currently. With the immense potential of solar and land availability for farmers, this sounds like a great solution. However, there are concerns that uninterrupted use of tube wells can have devastating environmental effects due to a lowering water table. Recommendations on how to move forward will require an area-by-area solution based on the status of the water table. The recent flooding in the province led to a rising water table and hence, solarization could be a great solution.

Additionally, the policy recommendation will also need to focus on direct collaboration with communities. Farmers who have been used to nearly free electricity for years will now have to be told about the upfront costs that come with a solar system and why that could be beneficial for them in the long run. This is also necessary to ensure sustainable water conservation practices by the farmers.

Supporting Resources and Infrastructure

As with any development effort, it is important that the Balochistan government has the right resources available to take on projects that focus on renewable deployment in the province. This includes capacity building, institutional development, streamlining of processes, and division of responsibilities. This section of the policy document can focus on recommendations for institutional capacity building to meet the overall policy's targets. This can include mobilizing technical assistance programs through MDBs to streamline processes and bring reforms to key organizations.

This section can also include being ready for upcoming changes in Pakistan's energy sector so Balochistan can be ahead of the curve and ensure a sustainable transition. Examples of this include the upcoming CTBCM framework and the provincialisation of DISCOs. Additionally, the policy can investigate the development of a Balochistan Transmission and Distribution Company as a long-term vision for the province that allows the province to be self-sufficient when it comes to the electricity sector.

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