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Sustainable Cities: (6B) Future challenges in the urban transition

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Presentation Title: An Analysis of Challenges & Potentials in Urban Renewable Energy Transition

Research Focus: Suggestions for Green/Renewable Energy Transition for Sustainable Cities in LDC

Introduction: As the world's population increasingly gravitates towards cities, these urban centers emerge as pivotal economic hubs consuming a substantial portion of our energy resources. The transformative shift towards renewable energy is critical not only for the energy sector but also for shaping transportation, buildings, industries, and other vital aspects of cities. In the context of Least Developed Countries (LDCs), such a change is imperative to achieve Sustainable Development Goal 7 (SDG 7) and establish sustainable cities. The scope and objectives of this research paper is to study the challenges and potentials of urban renewable energy transition in Least Developed Countries (LDCs), with a special focus on sustainable cities. It also discusses the potentials of a Clean Energy Project in Pakistan.

1. The Need for Transformative Change in Least Developed Countries (LDCs):

Access to affordable, reliable, sustainable, and modern energy poses significant challenges for LDCs. Shockingly, a third of the global population without access to clean cooking and two-thirds without access to electricity are concentrated in these countries. Furthermore, disparities in energy access persist, particularly between urban and rural areas. On average, 78% of urban populations in LDCs have electricity access, compared to only 44% of rural populations.

Renewable Energy Progress in LDCs: The transition to modern renewable energy in LDCs, Landlocked Developing Countries (LLDCs), and Small Island Developing States (SIDS) has

been sluggish, with modern renewable accounting for only 12%, 10%, and 8% of Total Final Energy Consumption (TFEC) in these regions, respectively. Fossil fuels still meet a considerable share of the energy demand in LDCs.

Addressing Investment Gaps: A review of investment needs at the midpoint of the 2030 Agenda for Sustainable Development shows that the investment gap in developing countries across all SDG-relevant sectors has increased from $2.5 trillion in 2015 to more than $4 trillion per year today. The largest gaps are in energy, water, and transport infrastructure.

While renewable energy investments have seen growth since the Paris Agreement, most of the funding has flowed to developed nations. Developing countries require approximately $1.7 trillion annually for renewable energy investments, but in 2022, they attracted only $544 billion. Many developing countries still lack significant international investment projects in renewable energy. Support for clean energy in LDCs has been inadequate, leading to a vicious cycle where these countries pay more for electricity, struggle to afford the high upfront costs of clean energy, and find themselves locked into fossil fuel projects. This energy trap exacerbates poverty and climate challenges.

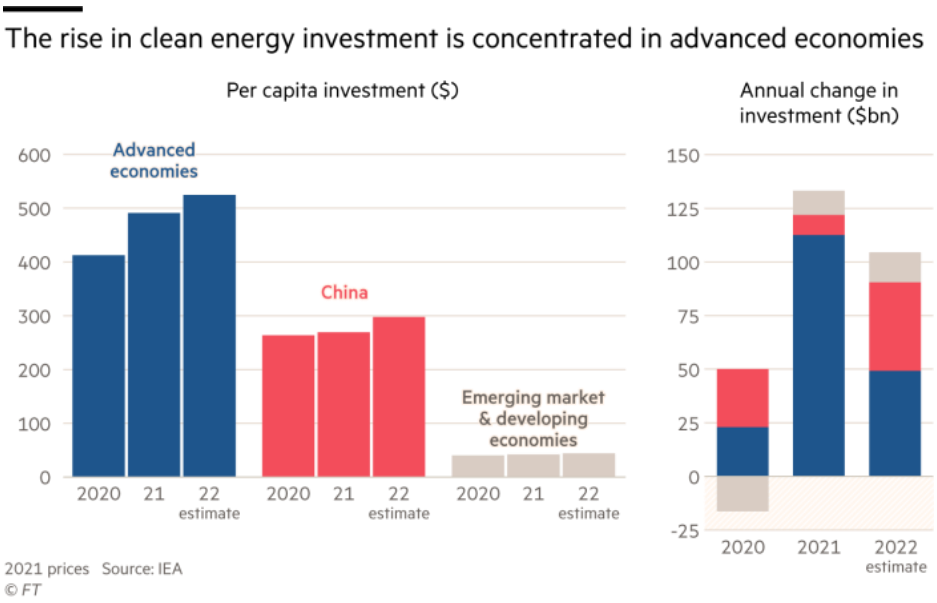

Figure 1 showing the Clean Energy Investment gaps in developed and developing Economies

Role of International Investors: The cost of capital presents a significant barrier to energy investment in the Least Developing Countries, perceived as riskier endeavors. Collaborations between international investors, the public sector, and multilateral financial institutions can significantly reduce this cost of capital. Such partnerships can yield an 8% decrease in debt finance spreads when international investors are involved, while the addition of multilateral development banks (MDBs) further reduces it by 10%. Public-private partnerships with governments can lead to a substantial 40% reduction in the cost of capital.

De-risking Support and Expanding Technical Assistance: Vastly expanding de-risking

support is crucial to lowering the cost of capital for energy transition investments in developing countries. Additionally, increased technical assistance should be made available for investment planning and project preparation. Reforms in International Investment Agreements (IIAs) are essential to enhance policy space for climate action and strengthen promotion and facilitation provisions.

Beyond Renewable Energy Generation: While renewable energy generation has seen substantial investments, other sectors crucial for the energy transition, such as energy infrastructure, still face lower involvement by international investors. Investment requirements extend to energy efficiency in buildings, industries, and transportation, energy infrastructure, clean and low-emission fuels, renewable supply chains, and carbon capture and storage.

International Investment's Role in Energy Transition: In the context of total energy transition investment, foreign direct investment (FDI) plays a significant role. International project finance accounts for 55% of global project finance values in the renewable energy sector. This share rises to over 75% in LDCs, underscoring the significance of international investment in shaping the renewable energy landscape.

2. Pakistan as a Case Study Country:

"Pakistan, being a case study country, faces higher-than-average warming in the South Asian region, as stated in the IPCC's Fifth Assessment Report (AR5). This vulnerability is attributed to demographic trends, socioeconomic factors, agricultural dependence, and slow adaptation to climate change impacts. Glacier melt, changing weather pattern, and alterations in the monsoon's strength and timing are expected consequences, affecting the energy systems as well.

Pakistan's energy sector is the largest producer of GHG emissions in the country. Despite efforts to increase power generation capacity from various sources to meet rising electricity demand, the sector remains a significant obstacle to economic growth due to expensive fuel sources, import reliance, gas shortages, debt, and outdated infrastructure. Weak governance and policymaking further worsen the situation. Although international assistance has provided some support, major reforms are necessary for a sustainable energy future. Presently, 63% of energy comes from thermal sources, 25% from hydro, and 5.4% from renewable. In the current scenario, renewable energy (RE) resources can play an important role in closing the deficit. With current government’s tilt towards renewable energy, Ministry of Energy revised the current Renewable Energy (RE) Policy 2019 recently. The government aims to shift to 60% renewable energy, including hydro, by 2030 to reduce import dependence."

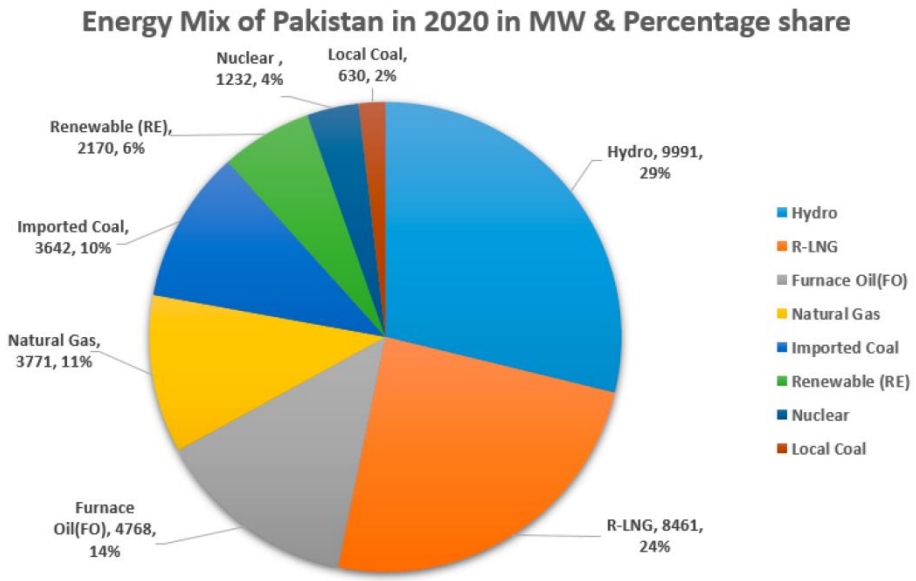

Figure 2 showing the Energy Mix of Pakistan

Case Study: Virtual Pipeline Project for Meeting Pakistan's Rising Gas Demand

Introduction: This case study explores a significant project in Pakistan aimed at addressing the country's urgent and increasing demand for natural gas. The project proposes to import Liquefied Natural Gas (LNG) from the Gulf region and distribute it to consumers using a virtual pipeline infrastructure. By surpassing conventional pipelines and adopting ISO Tanks for LNG supply, the project offers a flexible and efficient solution for meeting the gas requirements of various industries and remote areas.

Project Description: The project's primary objective is to ensure a stable and sufficient supply of LNG to meet the growing gas demand in Pakistan. It plans to import LNG from Qatar, Oman, and Abu Dhabi, storing it in a permanently berthed Floating Storage Unit (FSU) at Gwadar Port. The FSU will be replenished by a second FSU, facilitating continuous supply. The project aims to provide approximately 300 MMCFD of LNG within three years of commissioning, contributing significantly to the country's energy requirements.

Virtual Pipeline Structure and Supply Chain: The project envisions a virtual pipeline network connecting consumers to various gas sources beyond traditional pipelines. The process involves the following key steps:

1. A Floating Storage Unit (FSU) will be permanently berthed at Berth 3 of Gwadar Port.
2. LNG carriers from Qatar, Abu Dhabi, and Oman will serve as supply sources due to their proximity to Gwadar.
3. LNG will be transferred from the FSU into ISO containers for subsequent deliveries to consumers in Hyderabad, Gwadar, Karachi, and other locations.

4. ISO tankers will ensure uninterrupted LNG supply to customer locations, where LNG vaporizers will be installed for re-gasification.
5. The project aims to make approximately 2.25 million tons per year (MTPA) or 300 MMCFD of LNG accessible to consumers.

Technical Codes, Standards, and Quality: Adherence to technical codes and standards is a top priority for the project. During construction and operation, all relevant guidelines and standards, including the LNG Policy 2011, will be strictly followed. The project will comply with international standards such as ASME, DOT, and Pakistan's regulatory requirements. The terminal will also meet international safety standards and codes while operating under the supervision of the Pakistani Regulator. The LNG and RLNG supplied to end consumers will meet the quality parameters set by the OGRA.

Market Analysis and Economic Impact: The market analysis reveals a significant gas shortfall in Pakistan, both in winter and summer seasons, projected to exceed 5,000 MMCFD by 2024. The virtual pipeline project, with an estimated supply of 300 MMCFD within three years, will play a vital role in bridging this gap. As a result, industries like steel mills, steel furnaces, petrochemical, and textile units will have a stable supply of gas, promoting economic growth. Additionally, the project is expected to support the export of Pakistani products to Central Asia and China, further enhancing the country's economic prospects.

Project Cost Estimations and Investment: The total investment for the project amounts to over US$ 113.17 million, with 80% of the capital allocated to leasing LNG Equipment. The project's capital structure comprises 70% debt and 30% equity. Local companies will provide the equity portion from their own resources, while national and international commercial/developmental banks will arrange the debt financing. The project is also anticipated to attract approximately 60 million US$ in Foreign Direct Investment (FDI), contributing to the national economy.

Conclusion: The proposed virtual pipeline project represents a significant step forward in meeting Pakistan's rising energy demand. By leveraging LNG supply through ISO containers and a flexible virtual pipeline infrastructure, the project ensures the efficient and reliable delivery of gas to industries and remote areas. With its potential to address the country's energy challenges, foster economic growth, and support exports, the virtual pipeline project stands as a critical initiative in Pakistan's pursuit of sustainable development, clean energy and energy security.

Recent Update for Energy Transition in Pakistan:

Pakistan and the United States (US) have agreed to advance transition to renewable energy as both the government committed to work together to help Pakistan reach its goal of 60 percent renewable by 2030. The Green Alliance framework will help the United States and Pakistan jointly face climate, environmental, and economic needs, especially through partnership on renewable, sustainable, and clean energy.

3. Empowering Cities to Accelerate the Transition to Renewable Energy

Municipal Authority as a Catalyst:

This research explores how municipal authorities can drive the adoption of renewable energy in cities. While renewable energy uptake has surged primarily in electricity generation, cities have played a crucial role in accelerating the shift towards renewable sources. Municipal authorities can influence energy supply through clean energy guidelines, targets, and labeling schemes. Several case studies and examples illustrate how cities are successfully embracing renewable energy in various sectors, such as street lighting, waste-to-energy, net metering, and community empowerment.

Accelerating Renewable Energy in Street Lighting: Street lighting constitutes a substantial portion of a city's energy budget. Traditional lights are inefficient and costly to maintain. To address this, cities are turning to solar-powered LED lights, which offer energy and cost savings of over 50% and greater durability with life spans of up to 20 years. Implementing smart grid technologies further enhances the benefits of solar LED lights.

Case Study: Dubai, United Arab Emirates: The Shams Dubai program, adopted by the Dubai Electricity and Water Authority, installed 30–40 megawatts (MW) of solar capacity on the premises of the Dubai Ports Authority. Dubai's ambitious strategy aims to derive 25% of its total power output from clean energy by 2030 and 75% by 2050.

Waste-to-Energy: Capturing Methane and Utilizing Food Waste Urban waste generation has become a growing problem worldwide. To address this issue, many cities are capturing landfill methane to produce biogas for power generation as part of their waste-to-energy strategy. According to the United Nations, the global population is expected to surpass 9 billion by 2050 and over 11 billion by 2100. Therefore, the wastes accumulation is expected to rise exponentially in the upcoming future. The rising carbon emission and air pollution are negatively impacting the environment. The rising government initiatives to commercialize alternate energy sources due to the depleting conventional sources of energy are driving the growth of the waste to energy market across the globe.

Figure 3 showing the waste to energy market size, 2022 to 2032

Case Study: United States; The US Environmental Protection Agency reports that as of August 2020, there were 565 operational landfill gas energy projects using methane captured from waste, and 475 "candidate" sites with the potential to generate electricity or produce fuel from captured methane. However, it is essential to balance waste-to-energy strategies with waste reduction efforts like recycling and composting.

Net Metering and Net Billing: Encouraging Solar PV Deployment Net metering and net billing policies enable households and businesses to feed surplus electricity back into the grid, transforming them into "pro-sumers."

Case Study: **Pakistan**; Pakistan expanded net metering from a few cities to the entire country, with plans to reach 1,000 MW of solar installations by 2021 and 4,500 MW by 2025. While these policies offer benefits, policymakers must ensure accessibility for all, including lower-income households.

Case Study: Africa; In South Africa**,** Cape Town's net metering program does not offer payment for excess generation but rather provides credits to offset later consumption. The city is one of only a few municipalities in the country that support feed-in, i.e., the export of excess electricity generation by private users to the grid.

Empowering Communities and People in Renewable Energy: Public ownership and community engagement are effective drivers of local energy transitions. Several countries have established city-run companies to generate renewable power, promoting citizen participation in renewable energy projects.

Case Study: Bristol, United Kingdom; Bristol Energy was the first municipal energy company in the UK, providing local, low-cost, and low-carbon energy to residents while improving building energy efficiency. Additionally, the Bristol Energy Co-operative encourages citizen investment in local energy production units, enhancing community involvement.

Community Renewable: Community energy involves the economic and operational participation and ownership by citizens in renewable energy projects. Various ownership models exist, including co-operatives, non-profits, community trusts, partnerships, and corporations.

Policy Support: Local authorities can offer financial support through grants, loans, and tax incentives to accelerate community renewable energy development. Creating transparent administrative structures can reduce burdens and increase efficiency. Policymakers must ensure that waste reduction objectives are not compromised and that renewable energy solutions remain accessible to all members of the community.

Enhancing Urban Resilience: Collaborative Initiatives and Global Networks for Sustainable Development and Climate Action in Cities:

Cities can derive significant benefits from collaborating and exchanging experiences with

partner cities worldwide, especially due to the common opportunities and challenges they face. Several collaborative networks have emerged, each with a unique focus on promoting sustainability and addressing climate-related issues. Notable examples of such initiatives include:

C40 Cities: This network comprises 97 cities globally, representing a quarter of the world's gross domestic product and 1 in 12 people on the planet. C40 Cities primarily focuses on addressing climate change issues in megacities.

Cities Climate Finance Leadership Alliance (CCFLA): As of 2021, CCFLA consists of 64 organizations, including United Nations (UN) agencies, multilateral development banks, governments, donor agencies, banks, financial institutions, non-governmental organizations, and academic institutions. It assists sub-national governments and stakeholders in identifying project preparation facilities to develop green and resilient infrastructure. This includes initiatives such as implementing energy-efficient heating and cooling systems, deploying renewable energy, establishing sustainable transit, and climate-proofing resilient infrastructure.

Global Covenant of Mayors for Climate & Energy (2016): This alliance unites approximately 10,600 cities across 138 countries on all continents, representing a staggering one billion people. The covenant undertakes various initiatives aimed at increasing public and private sector investment in urban climate change mitigation and resilience projects. It also collects data to measure and manage cities' climate ambition and progress.

Conclusion: It is evident that such collaboration has significant potential to foster positive change and drive progress, not only in developed regions but also in the Least Developed Countries (LDCs). By establishing international initiatives specifically tailored to support collaboration in LDCs, we can create opportunities for these nations to learn from the experiences of more developed cities and benefit from shared knowledge and expertise.

International organizations, governments, non-governmental entities, and academic institutions should come together to facilitate the establishment and funding of such initiatives. By doing so, we can foster a global network of collaboration that includes all cities, regardless of their level of development, and collectively work towards a more sustainable and resilient future for our planet.

Empowering Tomorrow’s World: Unleashing the power of Sustainable Energy:

UNCTAD's Action Compact for Investment in Sustainable Energy for All is a comprehensive framework that addresses the three crucial objectives of the energy transition: meeting climate goals, providing affordable energy for all, and ensuring energy security. It comprises six action packages focusing on various aspects of investment policymaking, partnerships, financing mechanisms, and sustainable finance markets.

For least developed countries (LDCs), some key elements of the Action Compact are particularly significant:

National & International Investment Policy: The aim is to strengthen investment promotion institutions' capacity to attract energy transition investments, leverage Special Economic Zones as energy transition models, and integrate sustainable development as a core objective of

international investment agreements (IIAs).

Global & Regional Partnership: The promotion of partnerships is emphasized, especially to support vulnerable economies like LDCs and small island developing states in their energy transition needs.

Financing Mechanism and Tools: The focus is on maximizing the role of development finance institutions (DFIs) in catalyzing energy transition investments and their support in countries with limited access to electricity.

The urgency of the energy transition is underscored by the fact that a significant amount of investment is required to stay on the 1.5°C pathway. The world needs to invest over USD 35 trillion in transition technologies by 2030, with efficiency, electrification, grid expansion, and flexibility as priorities. To achieve this, a redirection of planned fossil fuel investments towards transition technologies is essential.

For LDCs, a structural transformation is crucial to address institutional and capacity constraints and to ensure resilience against climate change and external shocks. International cooperation, involving both public and private investment, is vital in this endeavor, with a focus on inclusivity, particularly for women, youth, and vulnerable groups. Multilateral financial institutions must direct more funds, at better terms, towards energy transition projects and the development of a new energy system.

As we move forward, let us heed the call of IRENA's Director-General Francesco La Camera and rewrite the way international cooperation works. By prioritizing energy access and climate adaptation, we can work together to realize the goals of sustainable energy for all and a just transition to a low-carbon economy.

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