

EXPANSION OF SOLAR POWER TECHNOLOGY IN YEMEN

PROJECT CONCEPT PAPER

MINISTRY OF INDUSTRY AND TRADE (MoIT)

UNITED NATIONS DEVELOPMENT PROGRAM (UNDP)

REPUBLIC OF YEMEN

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I. INTRODUCTION

A major concern in the world today is achieving the Millennium Development Goals (MDGs) to contribute to the wellbeing of societies around the globe. One key approach to achieving those goals and reducing poverty is rural electrification and supply of sufficient energy sources.

Access to sufficient, reliable and cost-effective energy supply is vital for improving livelihoods and development in general. It is a major tool for poverty reduction, income generation, improved education, better health services and other development areas. More than 1.6 billion people, roughly a third of the world's population, live without access to electricity, with majority living in rural areas. The World Bank estimates 67 percent of rural population in developing countries live without electricity.

In Yemen, 75 percent of the population live in rural areas and only about 23 percent of the rural population have access to electricity. Yemen is the poorest country in the Middle East with the lowest electricity connection. Reports show that only 40 percent of the country's population has access to electricity compared to the regional average of 85 percent.

Despite the low access rate of electricity, only about one-half of those populations are connected to public grid and the other one-half gain access through other private sources including diesel generator which usually operate for few hours for lightening and less-intensive electric appliances. Alternative lighting devices are being used by non-grid electrified rural households includes kerosene Lamps (about 67 percent) and Lequified Petroleum Gas (LPG) Lamps (about 5 percent) which has serious environmental impacts. On the other hand, renewable energy share is estimated to be about 0.009 percent of the total energy mix.

التعليق [U1]: Addition from UNDP paper

In general, energy supply in Yemen is limited. Weak generation capacity, high electricity losses from the grid (about 30 percent of production capacity) and increasing demand are among the top sector challenges. The total generation capacity of the Yemeni electricity system is about 1.223 GW after accounting for the recently installed capacity of about 341 MW powered by Natural Gas Turbines (NGT), Phase I. The supply gap against demand is estimated to be about 500 MW in 2013. The latest Power Development Plan (2009-2020) forecasts a total capacity demand of 3,102 MW at an annual growth rate of 10 percent over the next decade. New capacity of 3,538 MW by 2020 will need to be added to the grid to replace the retiring units and to accommodate the growing demand with sufficient capacity. It worth mentioning that power demand of industrial development will require additional power supply beyond the aforementioned projections.

التعليق [U2]: Addition from UNDP paper

Today, Yemeni population having access to grid connected electricity suffer from long hours of electricity cuts due to occasional sabotage attacks on power supply lines and power stations. They depend mainly on diesel and petrol fueled generators to generate electricity. Those in rural areas resort to alternative energy sources such as charcoal, firewood, disposable batteries and kerosene to meet their energy needs. These alternative energy sources contradict another cross-cutting concern about global environment and climate change. Hence, there is a compelling need to invest in renewable, efficient and clean energy technologies.

Yemen needs an instrument for the promotion of renewable forms of energy, specifically solar energy, which will lead to its initiation and implementation in local and national projects. Solar energy is a growing investment opportunity worldwide and its use is expected to continue growing throughout the coming years. Using solar power will help to alleviate Yemen's power woes which, according to the ministry of electricity, 18,000 megawatts of solar power could eventually be produced in the country.

II. CONCEPT

The project aims at developing policy and implementation strategy for the government of Yemen to undertake the expansion of solar power technology in the country especially in government offices, agencies, schools, hospitals and in the agricultural sector.

It also proposes relevant policy instruments to catalyze expansion of solar energy investments in Yemen especially in improving the performance of SMEs and SSIs which promotes poverty reduction through generation of employment opportunities through creation of new green jobs in the economy. In addition, it explores the potential of solar energy alternative in boosting the performance of SMEs and small industries and improving livelihoods of the poor in rural areas. The project has significant potential of widespread acceptance by consumers with extensive social, economic and financial impacts.

التعليق [U3]: Addition from UNDP paper

The main idea of the project is to create awareness and finance, hence, market demand for solar power. With this, the project should see a large section of the country's energy needs derived from solar sources, thus, cutting down its grid-based electricity needs dramatically. Awareness will be created through pilot projects done in different regions in the country to explain the long-term benefits of using solar power, particularly to individual farmers.

The Ministry of Industry and Trade (MoIT) will be the facilitator and the presiding ministry for the project in partnership with UNDP under the chair of HE Dr. Saadaldeen Talib, Minister of Industry and Trade. Funds obtained will be put in an account under the SME fund which comes under the MoIT. These funds are meant to be "revolving funds" to provide accessible financing source for the beneficiaries of this long-term project. An

التعليق [U4]: Addition for consideration

estimated initial fund of USD 50 million is expected to kick-start the project by the end of 2014.

III. ALTERNATIVE ENERGY SOURCES IN YEMEN

التعليق [U5]: Addition from UNDP paper

Yemen has vast untapped potential of renewable energy sources. A recent study by the Ministry of Electricity has outlined the various aspect of potentiality for five types of renewable energy in Yemen. Table (1) illustrates the five sources of renewable energy, and the various aspects of their potentials including theoretical and physical.

It worth noting that among the five sources of renewable energy in Yemen, solar has the largest gross technical potential but ranks second after wind in terms of gross practicable potentiality. The average solar radiation is about 18 - 26 MJ/m²/day over 3,000 hours per year clean blue sky and the theoretical potential for solar electric using concentrated solar power (CSP) reaches about 2.5 million MW. Wind energy on the other hand reaches a potential of 308,000 MW and Geothermal potential of about 304,000 MW. As such, the National Strategy for Renewable Energy and Energy Efficiency has set targets including a 15 percent increase of renewable energy contribution to the power sector by 2025.

Table (1): Renewable Energy Potentials in Yemen in MW

Resource	Theoretical Potential (MW)	Technical Potential	
		Gross Practicable (MW)	Gross Practicable (MW)
Wind	308,722	123,429	34,286
Geothermal	304,000	29,000	2,900
Solar electric	2,446,000	1,426,000	18,600
Biomass-landfills	10	8	6
Hydropower- Major Wadies	12 – 31	11 – 30	-
Solar thermal-Solar Water Heater	3,014	278	278

Source: Joint Socio-economic assessment

III. PROJECT OBJECTIVES

The primary objective of the project is to create market demand for solar power through awareness campaigns and providing affordable financing (possibly partial grants); hence, expanding the use of solar power and greatly decreasing fossil fuel subsidies. It also aims to:

- Enhance the quality of life for a large number of people, particularly in rural areas.

- Create job opportunities through the development of new enterprises and improving the performance of SMEs and SSIs.
- Diversify the country's energy mix to decrease the dependence on fossil fuels
- Eliminate energy shortages faced by the electricity sector
- Create investment opportunities to foreign and private sectors
- Support the local economy by stabilizing energy prices

IV. EXPECTED IMPACT

Geographically, Yemen is located in the Sunbelt area of the world, and endowed with solar energy radiation ranges between 6.8–5.2 kWh/m² per day, and annual average of daily sunshine ranges between 7.3 and 9.1 hours/day. Even in winter, the daily average of sunshine hours is estimated of about more than 8 hours per day. On such ground, Yemen has immense naturally endowed potential to generate solar energy to significantly contribute in filling the energy gap in Yemen especially in remote rural areas using a range of available solar technologies on a sustainable manner. In general, solar energy has numerous financial, economic, social and environmental advantages.

التعليق [U6]: Addition from UNDP paper

○ Financial impact

Currently, fuel subsidies contribute a formidable burden in state budget. Petroleum subsidies in Yemen make up more than 20 percent of government budget. This expanded cost of subsidies comes at the expense of other development sectors like education, health, infrastructure and social affairs.

One of project goals is to decrease the high dependence on fossil fuels for electricity production, especially in the agricultural sector, which is a main target of the project. Statistics from the Ministry of Agriculture shows that 40% of total diesel consumption goes to the agricultural sector for irrigation and water pumping which makes up a total of around 650 million litres of diesel per year.

Initial calculations show that capital investment in solar power will have direct returns of around 70%. The overall impact of the investment is much wider in the social, economic and environmental arenas. Beneficiaries will achieve a direct impact in job creation and improved living standards, hence, reduced poverty. It is estimated that the overall economic returns of investment is 40 to 50 percent.

○ Economic, social and environmental impacts

- Contribute to a clean environment by reducing pollution especially the pollution caused by generators used over long hours of power cuts
- Contribute to development of the welfare of the society by alleviating poverty through job creation. Several studies come to the same conclusion that solar and

renewable energy are much more significant job creators than the fossil fuel industry, creating ten times the jobs.

التعليق [U7]: Addition from UNDP note

- Provide independent and affordable energy sources
- Provide better educational environment to students
- Reduce health risks associated with using alternative energy sources like kerosene and candles
- Provide long-term benefits to users mainly farmers
- Meet energy demands for people in remote rural areas and provide them with safe and affordable energy sources

V. PROJECT MECHANISM

- Formation of a steering committee comprising of members from related ministries, local funds and agencies
- Formation of a focal point at MoIT for contact and project coordination
- Opening a solar revolving funds account at the SME fund in MoIT
- Creation of partnerships with interested parties
- Obtaining needed funds from donors to expand the benefits of the project
- Operation of pilot projects in at least five regions in the country
- Awareness campaigns on cost-benefit analysis of solar power use
- Cabinet support will be sought for the project

VI. PROJECT SUSTAINABILITY

A major barrier that hinders people in the country from using solar power is the lack of secure funds to invest in solar power. With the revolving funds, this project will provide affordable means of financing to beneficiaries to implement solar projects.

The project aims to alleviate as much as possible financial burden of the investment. This can be done through alleviation of interest and, possibly providing partial grants. Government and donor funds are required for such alleviation. Beneficiary repayments of the loans will be reused for financing further beneficiaries.

VII. ADMINISTRATIVE STRUCTURE

The project will be directed by the **steering committee** which will be responsible for approving the project mechanism, overseeing the smooth flow of the project stages, policy making and evaluation of the project outcomes.

The steering committee is chaired by H.E Dr. Saadaldeen Talib, Minister of Industry and Trade and is composed of representatives of:

- Ministry of Industry and Trade
- Ministry of Finance
- Ministry of Planning and Development
- Ministry of Electricity and Energy
- Ministry of Technical and Vocational Training
- Ministry of Water and Environment
- Ministry of Agriculture
- United Nations Development Program (UNDP)
- Social Development Fund
- Small and Medium Enterprises Fund
- Economic Opportunity Fund
- Agriculture and Fisheries Production Promotion Fund
- Sana'a University (Faculty of Engineering)

التعليق [U8]: Addition

Executive Committee: Will be responsible for administering the project and will also be responsible for decision making and job delegation to other team members.

Technical team: Will be responsible for providing data, statistics, studies on the project mechanism and implementation. It will also be responsible for preparing project reports, coordinating with partners, providing necessary documents to the steering committee on held meetings, decisions of the meetings and follow up designated tasks.

Executive secretariat: Responsible for secretarial and communication duties.

Communication point: Responsible for correspondence and communication with local and international donor agencies.

VIII. COMMUNICATION PLAN

Involved parties and team members will communicate through the project's executive secretariat. Communication mediums are emails, formal reports and scheduled meetings. Quarterly and required meetings will be held by the steering committee to oversee the project and to undertake decisions. Other teams will meet regularly for the smooth implementation of the project.

IX. POTENTIAL APPLICATIONS OF SOLAR ENERGY IN YEMEN: BUSINESS MODELS FOR SMES

التعليق [U9]: Addition from UNDP note

In Yemen, the industrial sector accounts for about 43 percent of the GDP which includes about 19 percent as oil sector contribution in 2011. Although SMEs and SSIs sector accounts for considerable percentage of employment opportunities in Yemen, the sector faces substantial challenges which directly reduces its performance and increases its vulnerability to shocks as occurred, for instance, in 2011 crises. The sector has very low levels of productivity and weak annual turnover due to high operation costs including high energy costs. Lack of sufficient and reliable energy system is among the top obstacles of running businesses which has consequently been hindering development of businesses and small industries in Yemen.

Alternatively, solar energy has tremendous potential in provision of a viable and sustainable business model for SMEs and SSIs which promotes improved energy security, enhanced productivity and profitability. In addition, improving the performance of SMEs, and SSIs through solar energy solutions will consequently have additional spill-over effect on the performance of the economy at large which ultimately reduces poverty by generating employment opportunities.

As such, deployment of solar energy by SMEs and SSIs will largely contribute in improving their performance and realizing their potential in terms of growth and job creation.

Various feasible solar applications include; Solar Home Systems, Water Pumping, Water Desalination, Water Heating, Lanterns, Street Lightening, Lightening of Government buildings and agencies, schools, hospitals and other public facilities. There is also high potential for solar application by small businesses and industries including agricultural sector for example in coffee bean drying, roasting and packaging; drying and packaging of different fruits like apricot, figs, dates and grapes.

It worth mentioning that coffee bean in Yemen has a particular unique comparative advantage to capitalize on. Owing to its quality (i.e. taste and flavor), global, and historic reputation (Mocha coffee), implementing of pilot Solar Coffee Drying and Roasting

Systems will significantly upgrade its quality to higher standards for either local market and/or export. Introduction of Solar Coffee Drying and Roasting Systems will create new jobs, and reduce post-harvest losses, increases profitability of agricultural post-harvest business and industries while at the same time promoting expansion of coffee bean production and its competitiveness in local and global marketplace.

Solar energy market is still limited despite the number of small entrepreneurs entering the business as suppliers. The majority of solar initiatives across the country are either donor driven or small-scaled with limited potentiality for expansion. For instance, the UNDP Yemen Country Office (CO) has made preliminary feasibility assessment of conversion into renewable energy supply system using PV panels and steps to implement the new proposed solar energy systems that have already been initiated.

X. PROPOSED INTERVENTIONS

التعليق [U10]: Addition from UNDP

Based on the aforementioned analysis, following longer term actions on policy, legal and financial mechanism are proposed to facilitate access and expand solar addressing the high upfront investment, a major barrier confronting engagement and marketing of solar energy.

i. **Develop solar policy and legislative framework:** Develop policy and legal frameworks that will remove barriers preventing expansion of solar energy as well as promote extensive engagement of private sector. The policy will identify appropriate instruments (i.e. economic, financial, fiscal policy instruments) to incentivize expansion of solar energy and extensive engagement of private sector in Yemen. It worth noting that signing of the official accession to the World Trade Organization (WTO) by the Government of Yemen is an opportunity to build on in that it implies Government's commitment to reduce or remove tariff of imported goods and services including solar technologies. In addition, the policy will identify suitable places including solar Atlas for large-scale on-grid solar projects. On the other hand, appropriate legal frameworks as well and solar quality standards will be defined too. The solar framework will encourage business entrepreneurs to engage in electric power generation of solar energy including feeding of electricity surplus to the grid (i.e. Feed-in Tariff for large-scale private entrepreneurial investments, and net-metering for small-scale initiatives). Land tenure related to feasible large-scale solar energy projects need to be legalized, and appropriate social, and environmental impacts assessments need to be perused, if any.

ii. **Set-up a financial mechanism to facilitate access to solar finance:** Establish a Solar Revolving Fund as financial mechanism to support solar energy initiatives and facilitate access to finance. Due to high upfront capital costs of solar energy projects, developing of appropriate financing mechanisms to support expansion of on-grid, and/or off-grid solar energy especially for rural electrification is critical. The fund will be the main financial instrument to support and provide incentives or loans for solar energy projects. It will provide support for greater access to financing by private

sector especially the first movers whose investments might imply high implementation risks. The fund will also enhance and foster strategic public-private partnership (PPP), and provide incentives especially for rural investment.

However, in the shorter term and, the following include key programme interventions to catalyze expansion and use of solar technology particularly for small business and industries in Yemen:

1. Create solar revolving fund to provide sustainable and secure finance means for beneficiaries

2. Promote private sector investments in solar energy

iii. Assess solar energy market potential and outline strategic marketing Mix: Assessment of solar energy market will open new horizons for private sector, and a marketing mix will support partners to pursue additional awareness activities to encourage private engagement and influence demands of solar energy. As such, partnership with solar energy Non-Governmental organization (NGOs) will contribute in raising awareness as well as market research and promote expansion of solar energy in Yemen.

iv. Organize a national conference on prospects and investment opportunities in solar energy: The conference will bring together the various stakeholders, and partners including private sector, and financial institutions as well as rural development partners. It will raise awareness about market prospects of solar energy, and new investment, and opportunities with private sector.

v. Implement pilot solar energy interventions: Demonstrate the feasibility of solar energy alternatives by implementing pilot interventions (i.e. power supply for drying of fruits and vegetables, community electric supply, street lighting, refrigeration systems of rural health centers ...etc) in collaboration with private sector.

vi. Encourage south-south cooperation for joint business venturing and investment. There is high potential for business engagement in solar energy production and supply either in the rural areas or to fed into the electric grid. The cooperation will enable gaining of current international best practices addressing energy poverty. As such it will enable drawing upon relevant experiences from emerging and partner countries, and will also illustrate processes that achieved involvement and investment of the private sector.

التعليق [U11]: MoIT point;

Item dealt with in the policy intervention above

XI. LOCAL INITIATIVES

Some of the local solar-power projects that have been implemented in the country include:

1. Lightings for Balqis Basketball Club in Sana'a.

Donor: USAID (PYCE) Cost: \$28,000

2. Nassim Club Basketball Court in Marib.

Donor: USAID (PYCE) Cost: \$30,000

3. Mena Club in Aden (Lighting, fans, computers, water pumps)

Donor: USAID (PYCE) Cost: \$ 109,000

4. Intelak Club football stadium in Lahj

Donor: USAID (PYCE) Cost: \$38,000

5. Water pumps for irrigation in Bada'an

Donor: USAID (CLP) Cost: \$15,000-\$20,000

6. Water pumps for irrigation and lighting in Soqotra

Donor: UNDP Cost: Different for each project