ENERGY CONSERVATION OPPORTUNITIES IN TELECOM SECTOR OF PAKISTAN

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ABSTRACT*—In recent years use of alternative energy resources is increasing, BTS sites are using diesel generators for power during load shedding. Load shedding in central region (CII- Faisalabad Region Pakistan) may reach 8-20 hrs/day. Due to load shedding diesel consumption and maintenancecost also increases. Solar Power system is reliable than gen-sets to reduce fuel and maintenance cost with immovable parts and without extra manpower requirements. This paper addresses key issues and analyzes different parameters which must be taken under consideration to reduce CAPEX & OPEX as a countermeasure to optimize and conserve energy. Use of diesel fuel is major cause of hazardous emissions like Carbon dioxide and other harmful Greenhouse gases. To over come these issues Renewable energy solutions need to be considered as another source of energy. This paper proposes and analyzes the complete architecture of the Solar power systems along with DG's for worst case scenario whenever both Wapda and solar are not available, on the other hand we can afford to avoid DG's in most cases.*

Index Terms — Diesel Generator (DG), CAPEX & OPEX**,** Energy conservation

I. INTRODUCTION

In recent decade, alternative energy resources have attracted a lot of attention for conservation of energy and reduction in use of fossil fuels. Thus it is playing a vital role in savingenergy now a days.

In recent year strategies has been developed to analyze and minimize power requirements of radio communication equipment and and by using efficient and more and load adaptive hardware components. Improved softwares and their efficient deployment techniques can lower the number of sites. These techniques as a part of network can monitor performance indicators to improve spectral efficiency and coverage [1].

Methods that are capable of achieving energy efficiency are used which improves transmitter efficiency, system features. Alternative energy source (wind, solar etc.) is now in use to achieve energy efficiency [2]. Energy consumption in wireless networks should be varied depending on traffic load. Energy can be saved by minimizing active devices during off peak hours. Research work showed the role played by air conditioning and transmission equipments while plotting the best areas of intervention for saving energy and improving environmental impact. The implementation of some important techniques like sleep scheduling, algorithms for saving power of dynamic base stations to achieve sustainability and conservation of energy in Telecom sector [3].

Joint green technology program has been started to bring advancements in application of renewable energy sources in telecom sector which can reduce diesel consumption and emission of CO2 and other toxic gases [4].

Network design can lower the number of sites by correct placement ensuring maximum coverage. This will ultimately reduce the power consumption and also CO2 emissions. To minimize energy requirements and cost there must be:

- BTS equipment efficieny improvement.
- Introduction of Solar as renewable source [5].

Deployment techniques of a BTS site play important role in reducing energy requirements by proper designing and placement of core equipment. A chunk of experimental BTS sites for experiment, an NFB solar site, a solar-diesel powered site and a Solar-wind powered site, were considered to check and improve design and techniques to use these sources. Analysis and real time data shows that the power requirements of all sites is reliable and cost saving as compared to dual D.G system [6].

The idea of introducing solar as a separate source with intelligent control of other sources and load is novel. This new sytem will ensure maximum and optimum use of energy to reduce outage and connectivity issues as compared to existing system as shown in figure 1 [7].

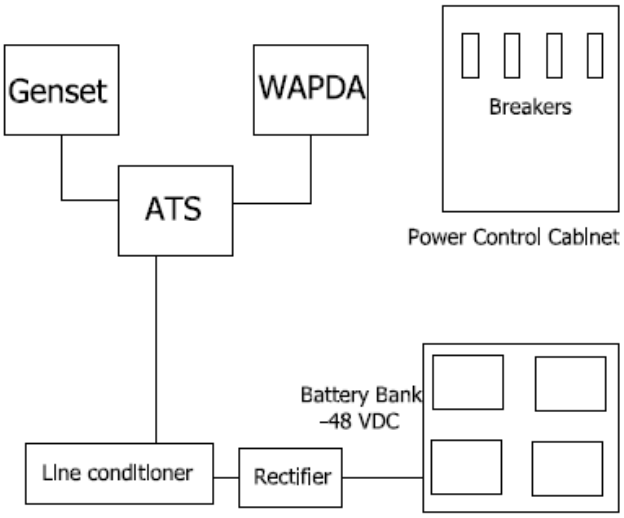

Figure 1. Existing Site Power Plan

II. PROPOSED MODEL FORMULATION

In the proposed model shown in figure 2, a new source of power has been inducted to fulfill power requirements avoiding the use of Diesel Generating set. An array of solar panel has been introduced in existing system controlled and monitored by an autonomous Controller kit. Solar panel are arranged in such a way that these can be installed on existing tower which takes no additional space and no changes are required in existing hierarchy of system. Solar panels are reliable source of energy with no moving parts and environmental hazards [8].

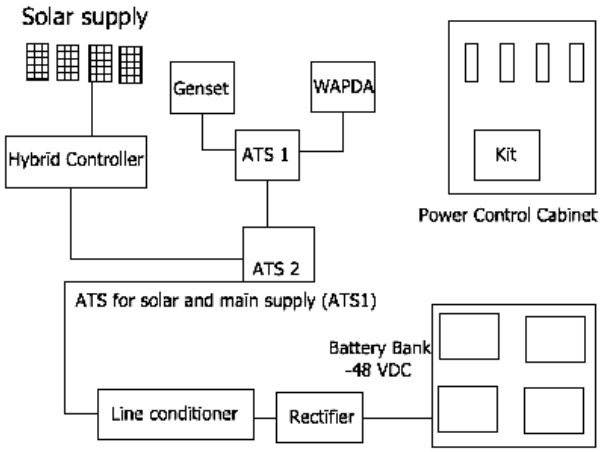

Figure 2.Proposed Site Power Plan

Methodology

Solar panels in this system are third source of energy other than power lines (WAPDA) and DG set. Solar panel power is fed to a new ATS panel (ATS2) [9]. There is a control kit installed in panel which will constantly monitor the battery level and all the three sources. Kit is responsible for switching these sources according to power scenario. First priority is of solar, if battery charge is more than 50% WAPDAand DG set will be cut off and solar power is then used for power requirements and charging of battery at day time. Whenever battery charge goes below 50% kit will immediately switch off the solar and checks power lines as a secondary source. If WAPDA is not available then DG set will be allowed to start until WAPDA is available [10].

Solar power will be switched off at night. Priorities of sources are as follows:

1- Solar power
2- WAPDA
3- DG set

In worst case scenario if no source is available to energize, the load kit will automatically reduce the site load by controlling the main contactors installed in panel. There are three main loads at BTS site [11] i.e., microwave link, Base band unit (BBU), and remote radio unit (RRU). In case of no source and less power kit will cut off RRU supply followed by BBU to avoid disconnection of microwave link as long as availability of power source.

Designing and Erecting of solar panels

Solar panel design, size and arrangement are shown in figure 3. There are three arrays mounted on tower each of 2KW giving total 6 KW. Main components contributing are shown in table 1.

Site Power Requirements

Telecom site load vary according to installed devices and category of site, an average site load with devices detail is shown in table 2 [12].

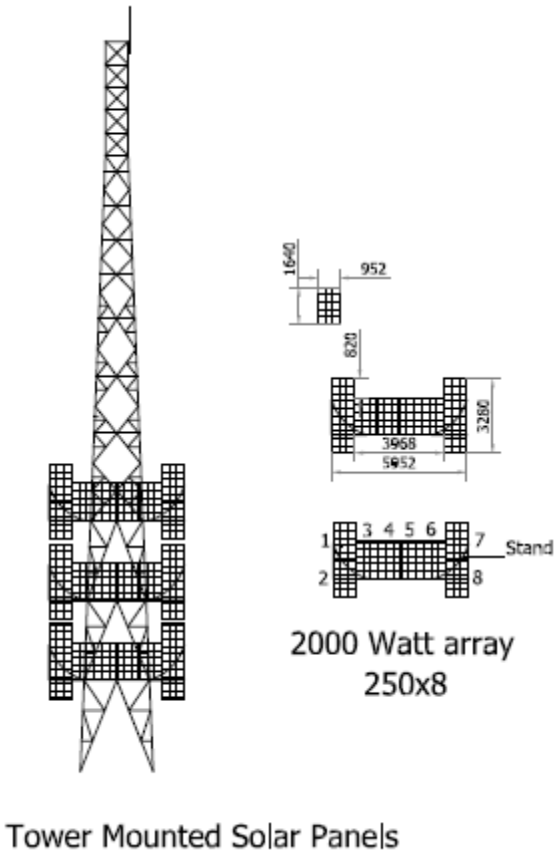

Figure 3. Solar Panel Design and Erecting.

Table 1: Solar System Component

Sr.	Description	Rating
1	Solar Panel (250watt x 24)	6 KWatt
2	Hybrid invertor(3KWatt x 2)	6 KWatt
3	Metallic stands	
4	Wiring	10 mm2
5	Source management Kit	
6	ATS and Magnetic Contactors	

III. ENERGY ANALYSIS AND CALCULATIONS

In Pakistan load shedding of national grid is a major problem that is why alternate sources of energy are required. Table 3 shows the average load shedding and production comparison as shown in figure 4. Unit wise comparison of usage, management of resources and per day energy analysis is shown in Table 4 and graphically shown in figure 5. Induction of solar power system greatly relieves the power requirement and avoids outages in load shedding hours at day time [13].

Table 2: Site Devices Averages Load

Sr.	Equipment	Power (Watts)	Qty	Total Power (W)
1	BBU (20 A)	25	16	400
2	RRU 3004 (10 A)	500	3	1500
3	Tower Light system	100	1	100
4	Honeywell alarm system	200	1	200
5	Microwave Link IDU (10A)	100	1	100
6	Cooling System	1000	1	1000
	Total Watts (Average)			3200

Table 3: Energy Analysis

Average data	Hrs./Kwh
Load shedding (hrs)	10
Batteries compensation (hrs)	7
Generator running in a day (hrs)	3
Solar production per day (Kwh)	25

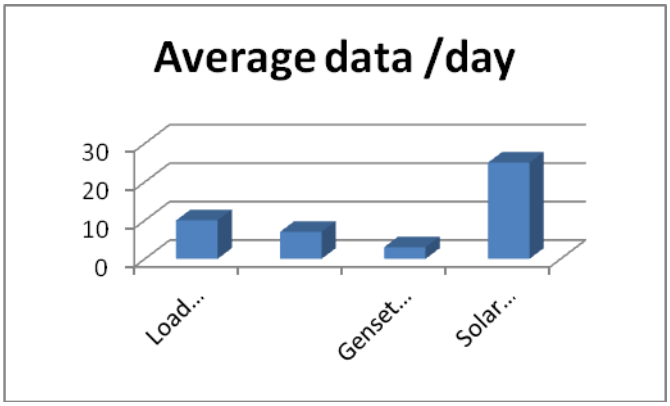

Figure 4: Energy comparison per day

Table 4: Energy Calculations

Per day average data	KWH
Total site load	168
Deficiency covered with genset	21
Solar Production	28
Surplus by solar compensating genset	7
Wapda usage kwh	147

IV. BUDGETING AND BENEFITS OF SOLAR POWER SYSTEM

This section will cover the cost comparison of existing source of energy with solar power system. Wapda is the primary source of energy in Pakistan which costs less than Genset. For scheduled and unscheduled maintenance consumables, man power and additional budget is required that ultimately increases per unit cost as shown in table 5. Diesel genset maintenance also demands spares and technical staff for major and corrective maintenance. Diesel filling is also required promptly when required in order to avoid air lock situation. In gen-set air lock situation maintenance team is then required to start the engine which is an additional expense, detail shown in table 6.

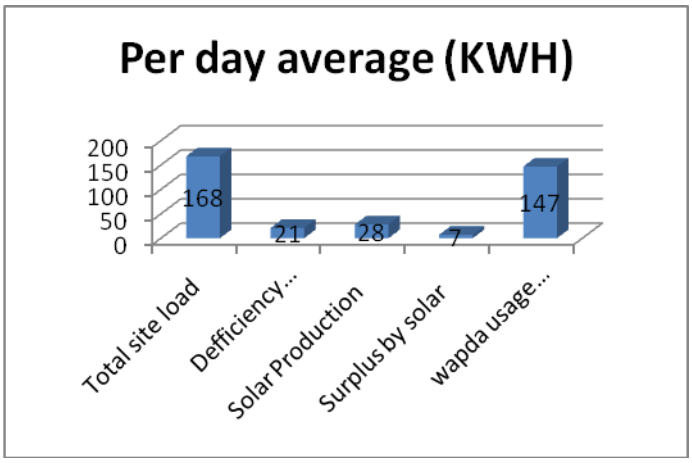

Figure 5: Energy comparison per day

Table 5: Costing of existing sources

Average Cost Of Electricity/Day	Amount(Rs.)
Wapda @ 13.5/kwh	1984.5
Generator @ 3.5 liter/hr.	903
cost of diesel transportation per day	70
Cost of Genset Maintenance	100
Cost of Genset overhauling	205.4795
Cost of Engine oil and filter	111.6667

Solar Power System Cost Analysis

Cost of solar power system in comparison to diesel genset is less, solar power system has zero maintenance cost and requires no man power. Capital cost of solar power system is shown in table 7.

Benefits of solar power system in comparison to existing sources

Solar power system has great benefit over other source especially genset.

- Easy to install with less man power.
- No moving parts.
- Emission of carbon, Nitrogen and Sulpher oxidesbecomes zero.
- Maintenance free system
- Spares and consumables cost reduction.
- No requirement of man power for operation.
- EPA does not allow genset producing more noise and emissions, solar has no noise issue.
- Genset in populated area disturb neighbors, and need to stop due to neighbor issue results in energy outage.
- Genset require fuel for operation but solar requires no fuel or calibration of equipment.

- Wapda is primary source of energy and it covers major part of energy requirement, but due to load shedding we need alternate energy resource i-e solar.
- Due to low voltages of wapda supply genset starts automatically in the presence of Wapda supply.
- Fluctuation of wapda supply voltages cause genset start and stop frequently results in disturbance of system.
- This disturbance may lead to burn the contactor coil of wapda or genset which results in disconnection of both sources from load. During this disconnection genset will keep it self-start burning diesel.
- Installation of control kit helps to avoid this kind of situation by keeping both sources silent.
- Controller kit ensures the site microwave link connectivity disconnecting other load by intelligently sensing the battery charge in case of non availability of all sources.
- Solar power system in bulk can help national grid to fulfill requirements of energy in other sectors.
- Installation of solar power system is a step toward green energy solution with almost zero maintenance [14].
- Cost recovery time of system is very less as compared to its output and benefits [15]

Table 6: Genset maintenance cost analysis.

Sr.	Description	Qty	Unit Price Rs	Total
1	Engine Oil (Liter)	9	450	4050
2	Oil Filter	1	750	750
3	Fuel filter	1	650	650
4	Air Filter	1	1200	1200
5	Coolant	1	200	200
6	Mechanic	1	25000	25000
7	Electric Technician	1	15000	15000
8	Helper	1	10000	10000
9	Vehicle	1	40000	40000
10	Residence etc	1	10000	10000
11	Diesel Filling Team	2	20000	40000
12	Major overhauling	0.5	250000	125000

Table 7: Capital Cost of Solar Power System

Sr.	Description	unit	Amount Rs
1	Solar Panel 6000 watt	70	420000
2	Hybrid invertor	50000	100000
3	Stands	25000	100000
4	Cabling installation etc	50000	50000
5	Source management controller	15000	15000
	Total Cost		**685000**

Table 8: Cost Saving By Solar

Saving per day	Rs.
solar saving genset/day (Rs)	1390.146
solar saving wapda/day (Rs)	94.5
Total saving per day (Rs)	1484.646

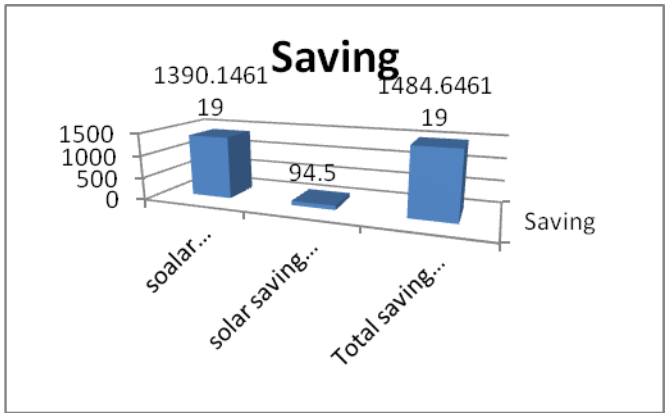

Figure 6: Cost saving chart

Cost saving by solar and recovery period

Solar power system fulfills requirement of energy for which genset is being used. It also saves Wapda energy to some extent as shown in table 8 and figure 6. Cost recovery duration of solar power system is very less as given in table 9

Table 9: Solar system cost recovery period.

Recovery of Solar	Duration
Recovery of solar (days)	461.3894
Recovery of solar (months)	15.37965
Recovery of solar (years)	1.281637

V. CONCLUSION

In this paper, we have analyzed a deterministic model to fulfill energy requirements at BTS site using solar power as alternative energy resource with control system. An intelligent controller has been introduced for resource and load management. The applicability of this system in a classic practical scenario is analyzed. Some of the main theoretical findings of this study are summarized below:

(1) Installation of solar power system is a step toward green energy solution with almost zero maintenance. This system will surely minimize Opex as well as other critical issues like noise, neighbor and owner issue. Emission of hazardous gases will also be contained.

(2) Use of intelligent controller with this system gives us opportunity to manage both resources and load according to priority. Corrective maintenance and fault ratio will be reduced ultimately saving cost of spares and outages.

(3) OPEX and maintenance expenses have reduced. Cost recovery time of system is very less as compared to its output and benefits.

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