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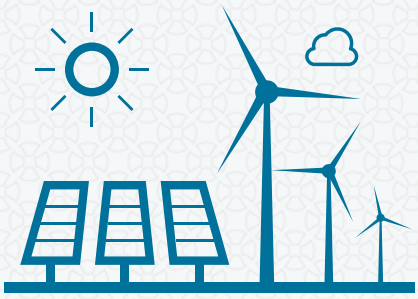

White Paper

"Renewable Energy Sector in the Context of Solving Electricity Market Challenges'

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This paper has been prepared by EDAMA association

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EXCUTIVE SUMMARY

This white paper provides an assessment of Jordan's renewable energy sector status quo. The paper analyzes the sector's challenges and opportunities, taking into consideration the government's perspective and private sector competitiveness. The paper adopts a holistic approach to solving pressing issues that are currently threatening the renewable energy sector's growth, electricity market stability and National Electric Power Company's ballooning debt.

STATUS QUO

The government of Jordan, represented by the Ministry of Energy and Mineral Resources (MEMR), and based on the recommendation of the Energy and Minerals Regulatory Commission (EMRC) aims to solve the National Electric Power Company (NEPCO) existing and new financial and technical problems, by:

- Canceling and /or putting on hold approvals for all wheeling projects,
- Canceling and / or putting on hold RO3 projects, and
- Adopting a 5-year plan to increase wheeling charges for both existing and new wheeling projects. It is worth noting that the charges are still uncertain.

On the other hand, big solar developers should:

- Approve wheeling for all projects with initial approvals,
- Allow wheeling for new projects for day time consumption; additional generation to be considered with grid storage premium fee or actual energy storage,
- Revise wheeling charges on new projects (without initial approvals), and
- Abstain from charging existing wheeling projects.

Considering the above, EDAMA offers a comprehensive solution to strike a balance among all stakeholders, towards a long-term solution and win-win scenarios. Renewable energy projects can contribute to the decrease of financial burdens on NEPCO, when they are managed through a deliberate legislative framework, incorporating all technical and financial solutions to drive Jordan into economic prosperity. In this regard, EDAMA's position is to propose an immediate list of solutions that will contribute to the development of this promising sought-for legislative framework:

- Prioritize net-metering and wheeling approvals for subsidized sectors (reserve grid capacities and offer incentives).
- Oblige subsidized or development sectors (government owned, hospitals, universities, etc.) to purchase RO1 electricity rather than investing in new projects.
- Allow wheeling for non-subsidized sectors, conditional to installing storage systems and revised wheeling charges for both new projects and initially-approved projects.
- Allow wheeling for projects covering daytime consumption and revised wheeling charges.
- Prioritize the demand side of management projects.
- Prioritize adoption of storage projects.
- Adopt universal and transitional best practices towards non-conventional energy systems.
- Allow electricity production trading (ease off single seller - single buyer model).
- Expand grid interconnections.
- Overcome losses resulting from both technical and non-technical causes.

Figure 1 shows a visualized representation of EDAMA's proposed approach. From a long-term planning perspective, solving the single buyer problem remains the main challenge in this context; NEPCO should take the responsibility to adapt all technical best practices to overcome the current challenges.

LEGISLATIVE FRAMEWORK

Subsidized Sectors

- Prioritize approvals for RE projects, reserving grid capacities and funding
- Mandatory legislation to prioritize energy efficiency measures

Non-Subsidized Sectors

- Oblige installing storage systems
- Revise percentage of demand covered by wheeling projects
- Mandatory legislation to prioritize energy efficiency measures

TECHNICAL SOLUTIONS

- Adapt Storage systems technologies
- Utilize the energy surplus
- Adapt electrification strategy
- Adapt Energy efficiency measures
- prioritize grid connection with the neighboring countries
- reduce technical and non-technical losses

FINANCIAL SOLUTIONS

- Revise wheeling charges
- Explore using feed in tariff scheme
- Adjust day/night tafiff
- Adjust tariff based on sun peak hours and demand peak hours
- Add grid storage premium fee for non-subsidized sectors

FIGURE 1: EDAMA'S PROPOSED APPROACH

INTRODUCTION

The renewable energy sector in Jordan is a tremendous success story. Within five years, Jordan has become a regional leader in the adoption of renewable energy due to the collective efforts of the public and private sectors, in addition to the support of international donors and MFIs that have charted the way forward for Jordan's increased reliance on cost effective and locally generated clean energy. The RE share in electricity production in 2016 is illustrated in Figure 2 [1].

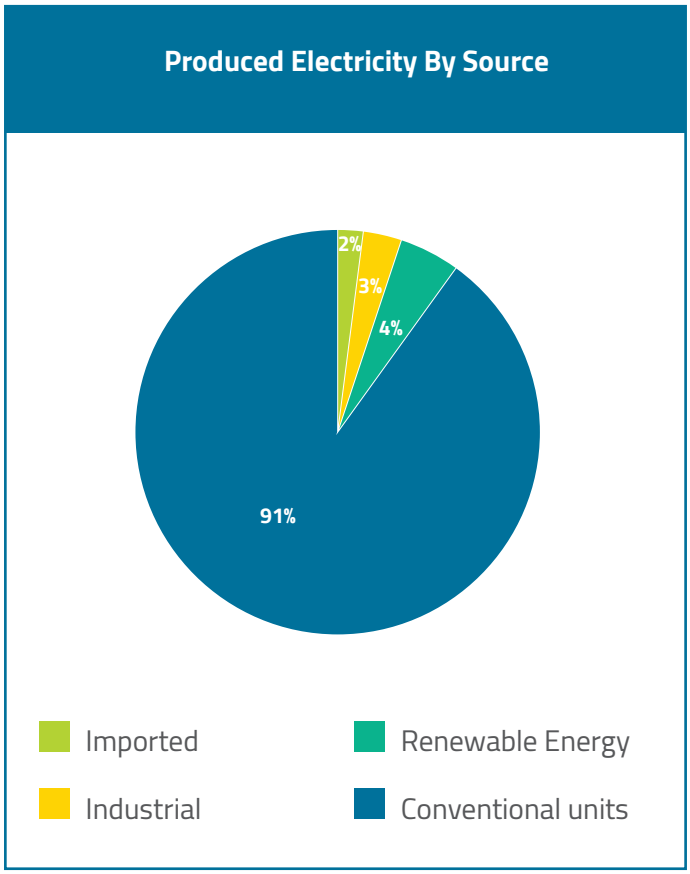

FIGURE 2: PRODUCED ELECTRICITY IN 2016

The continued success of this sector - despite all the tremendous challenges faced - remains a national priority. It is widely acknowledged that increased adoption of RE presents several technical, financial and economic challenges, furthermore, new technical solutions and regulations must be adapted together with increased penetration rates.

Therefore, most stakeholders have a vested interest in ensuring that this vital sector remains a socio-economic and financial asset for Jordan, and that measured adjustments in regulations are required. This must happen through full-fledged consultations, exchanging knowledge and experience with subject matter experts, and working hard to anchor the solid foundations that ensure continued growth and maturation of this sector in a measurable and comprehensive approach within the context of an integrated national energy strategy and the dynamic nature of the RE industry and its technological advancements.

By effectively harnessing the benefits of RE within the context of a comprehensive energy strategy, the Jordanian economy and in particular the private sector, can benefit from the increased competitiveness that will benefit both the public and private sectors due to savings in imported conventional fuel, reduction of energy cost, improved efficiency of the electrical system, job creation, increased profitability and resultant income tax. Innovation in the RE sector will well position Jordanian companies across the region and globe, hence promoting investment and export opportunities.

PROBLEM STATEMENT

With the increased penetration of Renewable Energy Systems (RES), technical and economic considerations become more pronounced and the cost of RE integration increases. Due to such concerns and depending on the particularity of specific projects, solar projects are suffering from uncertainty and lack of flexibility in existing regulations, as well as delays and hesitation in completing approvals for wheeling and net metering projects which in return have a negative impact on the sector.

The net metering scheme is designed to allows a distributed generation system owner who is generating more electricity than they are consuming to export that excess energy to the utility grid, receiving a credit in kilowatt-hours. The credit can be applied to offset consumption of electricity within the current billing cycle (e.g., one month) and often in future billing cycles as well. While in wheeling scheme the use of the electric transport system and distribution system for the transfer of electricity generated from the renewable energy sources system to where the consumption will take place. On other hand, the most frequently used scheme worldwide is Feed in tariff, which is a price-based support instrument aiming at encouraging investment in renewable energy but preventing overcompensation, where a predetermined sell rate for electricity that is fed back into the grid is guaranteed. [2]

the National Electric power company (NEPCO) looks at the reduction in their sales due to the withdrawal of consumers from segments that are currently contributing to cross subsidy inherent in the current tariff structure and its obligation to paying the renewable energy costs, that can become an additional financial burden. Additionally, by the end of 2016, NEPCO was recorded to have suffered from a deficit of over 5.08 billion Jordanian Dinars [1] due to the reliance on heavy and diesel fuel oil during the Egyptian gas outage.

As stated by NEPCO, introducing renewable energy to the national grid, is the main contributor to changing the conventional unit operating scheme, lowering units' efficiency and increasing reliance on high priced peak units. NEPCO also argues that the fluctuation of the produced energy might negatively affect the connection with the Egyptian grid.

Therefore, NEPCO proposed the solution of increasing the wheeling fees (in proportion to the consumers' current tariff) to ensure its obligation towards electricity suppliers and to recover the withdrawal of its largest financial supporters "high tariff segment". Adopting such a scheme while lacking a thorough study and full-fledged stakeholder engagement might affect the sectors' legislative stability and investment climate. The following table summarize the main challenges facing sector players.

TABLE 1 : MAIN CHALLENGES AND RESPONSIBILITIES

Stakeholders	Challenges		Justifications
	Technical	Financial	
NEPCO	Spinning reserve Conventional unit's complications ▪ Lower efficiency ▪ Reliance on peak hours unit Egyptian grid connection	Reduction in the sales Obligation to RE electricity producers Debt	RE intermittency Poor long-term planning Single buyer problem Peak load demand and peak sun hour matching
Developers Big companies	Grid integration/stability	Increased cost of integration legislative stability and investment climate	limited grid capacity Poor long-term planning in both technical and legislative terms
Small to Medium Companies	Available grid capacity	Project opportunities	▪ Limited grid capacity ▪ Poor long-term planning
End Users	Getting RE approval	Higher electricity prices	▪ Tariff structure ▪ Reliance on conventional fuel

EDAMA'S APPROACH

Any adopted solution must be holistic, and within the context of a comprehensive strategy and regulatory framework that ensures that the sector effectively overcomes both technical and financial obstacles.

It turns out that a new regulatory framework is considered as a necessity to address the next stage of RE adoption which leverages innovative technical and regulator solutions to the challenges in grid integration. There are several regulatory and technical solutions that can be put in place to address the challenges facing NEPCO, however, the underlying benefits to the RE sector and to Jordan at large cannot be ignored and must be taken into consideration. Any new wheeling fee structure should also be based on a sound footing, which results in a win-win scenario for public and private sector projects. An allocation of capacities for wheeling and net-metering projects would also help balance the interests of public and private sectors.

STRATEGIC OPTIONS AND SOLUTIONS:

1. Re-visiting existing tariff structure and reviewing regulations

Moving to tariff structure with less dependence on subsidy entails a gradual transition to ease the process and mitigate the effect that might be reflected on end users. The RE sector can take a leading role in this process, if steered in the targeted direction; observing consumers from subsidized and non-subsidized perspective is the first step to develop a legislative framework that focuses on supporting the subsidized sector's adoption of RE through a range of policies and financial incentives which will eventually lead to sizing this segment and the associated financial burden. Figure 3 demonstrates the subsidized and non-subsidized sectors based on end user tariffs announced by Energy and Minerals Regulatory Commission, which is 102 fils per Kilowatt hour [2] (indicated by the red line).

- **Revising Wheeling Charges:**
  any changes in the wheeling charges must take into consideration the particularities of each sector and must be based on a comprehensive and sound feasibility studies to ensure that the return on the investment remains attractive to sector players at large.
  Subsidized Sectors: must be encouraged to invest in renewable energy through funding and incentives to compensate for the absence of large-scale consumers. Wheeling charges should be minimal and limited to the cost of wheeling.
  Non-Subsidized Sectors: new wheeling fees should be based on a comprehensive study that maintains a positive return on the investment while considering the particularities of each consumer bracket separately.

- **Revising the approval process and allocation of capacities for wheeling/net metering projects:**
  The Grid Impact Study (GIS) is the main determinant for project viability. Transparency in the application of processes and available capacity should be reconsidered.
  Subsidized Segments: these sectors should have the precedence in approvals for net-metering and wheeling projects; in case further effort can be directed to study the capacity of the grid, then reservations of known expected capacities for these sectors should be a priority.
  Non-Subsidized Segments: consider revising percentage of demand covered by wheeling projects, this could limit the size of wheeling projects and support the savings of daytime consumption only. Additional renewable generation beyond daytime consumption can be considered with:
  - Grid storage premium fee, or
  - Actual energy storage for the excess electricity produced beyond the daytime that requires a capacity defined according to the size of the project.

- **Tariff Structure:**
  consider the following schemes to ensure fair electricity prices to enhance the competitiveness of the Jordanian industries and services.

  - Reconsider net-metering and explore (instead) the possibility of using feed-in tariff scheme.

- Day and night tariffs:
  devise or adjust the evening/day tariffs to better match production and consumption patterns plus optimize cost.
- Peak load tariff:
  authorize NEPCO to control and adjust electricity peak hours, sun peak hours coupled with demand peak hours, to balance electricity demand as deemed appropriate.

2. Adoption of Innovative Technical Solutions

The future strategy should consider the following enhancement options and recommendations:

- **Storage:**
  Renewable energy storage technologies are mature and feasible solutions that contribute to reducing electricity intermittency and distributing energy production throughout the day. Requiring that investors in the renewable energy sector install storage with certain pre-determined capacities, depending on the size of the project and the bracket of the consumer, will directly contribute to solving the issue of renewable energy surplus during peak generation hours, which will lead to the decrease of the requirements to upgrade the distribution and transmission grid; furthermore it will increase the stability of the grid and the quality of power by increasing operator capability in controlling the active and reactive power injections which will stabilize frequency and voltage.

  Storage includes batteries to backup photovoltaic systems and Concentrated Solar Power technology which will contribute to securing electricity from renewable sources in a way that sidesteps the problems of peak hours and guarantees regulated energy provision throughout the day.

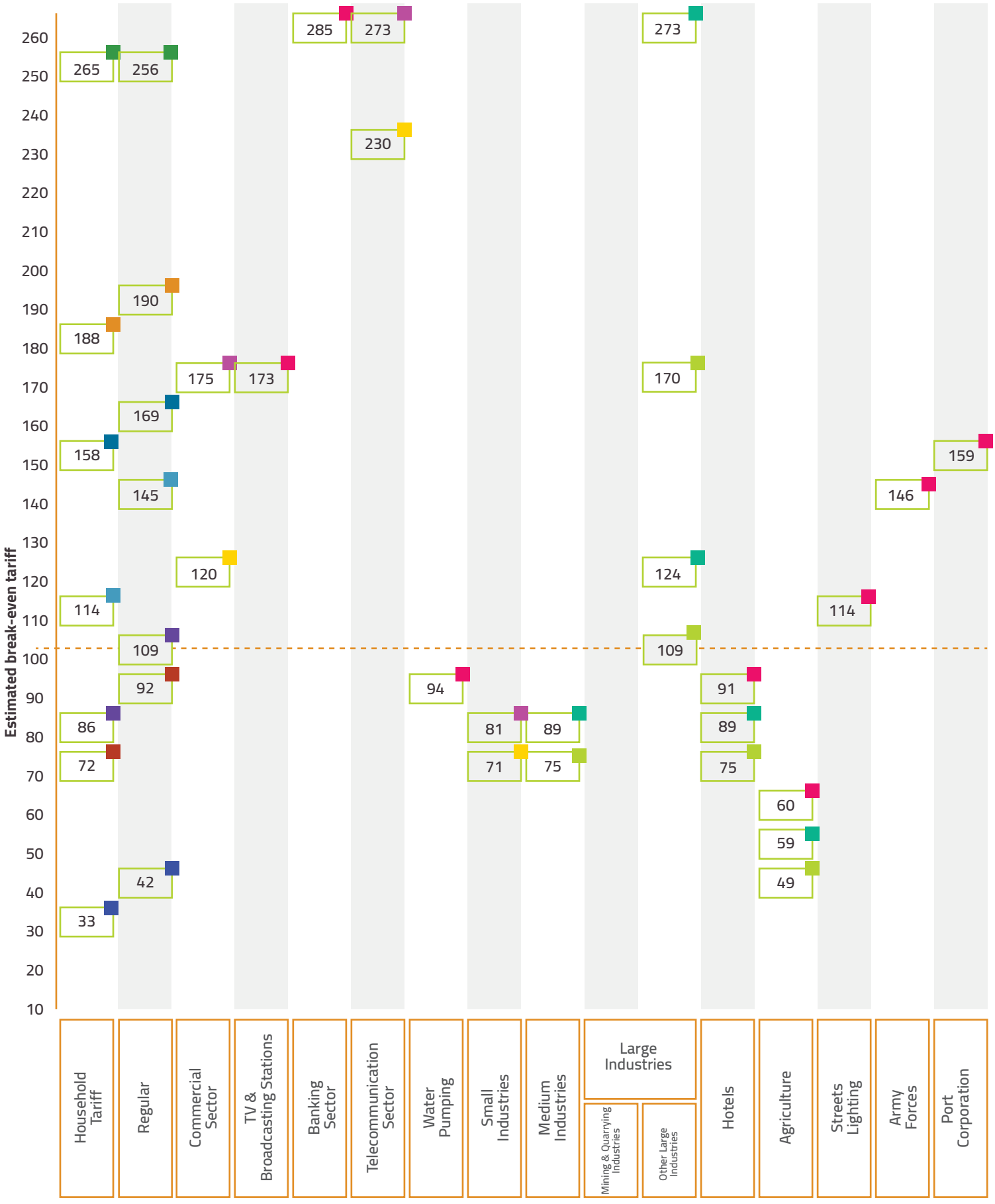

FIGURE 2: CROSS SUBSIDES TARIFF STRUCTURE

▪ Demand Side Management (DSM):

- Utilizing Energy Surplus:
  peak hours surplus can be utilized in a variety of applications including but not limited to water desalination and water pumping facilities.

- Electricity Demand Growth and Less Conventional Fuel Usage:
  consider an overall "electrification" strategy at government institutions and public transport. This can include electric vehicles, electric heating, etc. In addition to improving demand - and thus competitiveness of the electricity pricing, it creates operational efficiency through the use of a "grid" rather than "transport of fuel to every household and every gas station", in addition to being environmentally beneficial.

- Energy Efficiency:
  by taking the proper precautions and issuing appropriate legislations that ensure various institutions conduct energy audits before any RE adaptation that in turn could lead to direct energy savings. Supporting government institutions to begin implementing energy efficiency measures within their institutions and buildings can save around 100-gigawatt hour and can therefore save NEPCO between 25-30 million JDs annually; over and above non-electricity savings resulting from energy efficiency, such as savings on diesel fuel for heating water and space. Energy efficiency applications through mandatory legislative framework, would allocate the RE project to the entitled segment and reduce the requested capacities.

▪ Grid Connection:

Prioritize Grid connection with neighboring countries to sell excess electricity which might involve risk from energy security point of view.

▪ Technical and Non-Technical Loss Management:

Technical and non-technical (theft) losses are estimated at around 14% of the generated electricity. Therefore, a plan must be put in place to reduce these losses. Reducing losses by 0.5% annually for five years will yield a net profit of 156 million Jordanian dinars.

SOLUTIONS - SWOT ANALYSIS:

Further investigation for the proposed solutions is summarized using SWOT analysis in Tables 2 and 3.

Technical Solutions	SWOT Analysis			
	S Strengths	**W** Weaknesses	**O** Opportunities	**T** Threats
Shift to storage included solar technologies such as CSP	24-hour electricity production	High investment cost	Cover the base load from RE sources to lead the regional market	Lack of legislation
Utilize energy surplus through applications including but not limited to water desalination	Better utilization of RE electricity	Initial cost	New business opportunities	New technology penetration challenges
Increase the demand by adapting an overall "electrification" strategy	Increase demand for RE electricity	Long term transition process	Improved quality of life and Good environmental impacts	Conventional fuel industry might oppose this
Prioritize grid connection with neighboring countries	Using neighboring grid as a storage.	Technical difficulties due to RE intermittency	Higher grid penetration from RE sources	Political instability
Manage and reduce technical and non-technical losses.	Huge financial gains	Need for strict observational system	Reduction of the cost per kwh reaching end user.	NA
Adapt energy efficiency measures as a first step before turning to RE	Allocate RE projects to the entitled segment and reduce the requested capacities	Need for legislative framework	New business opportunities Decreased energy consumption	Lack of awareness

Financial Solutions	SWOT Analysis			
	S Strengths	**W** Weaknesses	**O** Opportunities	**T** Threats
Revise wheeling charges based on subsidized and non-subsidized segments	Compensate NEPCO's claimed financial losses	Affect the projects' return on investment	Ensure better allocation of grid capacities	Vague investment climate
Explore using feed-in tariff scheme	- Reflect any increase in electricity prices to RE prices - Encourage subsidized sectors to adapt RE	Legislative weaknesses in the transition process	Shift to non-subsidized tariff structure through RE adoption	Stakeholder acceptance to this new concept
Adjust tariff based on sun peak hours coupled with demand peak hours	Better understanding and management of the demand profiles	Poor technical mapping of load profiles	Effectively utilize RE electricity	Absence of a strong economic model
Require a grid storage premium fee for non-subsidized sectors	Compensate NEPCO's claimed financial losses	Affect the projects' return on investment	Ensure better allocation of grid capacities	Vague investment climate
Revise the percentage of demand covered by wheeling projects for non-subsidized sectors	Reduce the possibility of peak sun hour electricity surplus	Need for legislative framework	Ensure better allocation of grid capacities	Limit size of wheeling investment

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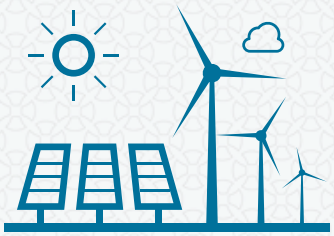

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