Policy brief
Enterprise and Research Accelerator

Project funded by the
EUROPEAN UNION

ENPI
CBCMED
CROSS-BORDER COOPERATION
IN THE MEDITERRANEAN

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Index

Abbreviations & Acronyms

AfDB AfDB African Development Bank Group

AFD Agence Française de Développement

ASRT Academy of Scientific Research and Technology

CSP Concentrated Solar Power

EBRD European Bank for Reconstruction and Development

EEHC Egyptian Electricity Holding Company

EETC Egyptian Electricity Transmission Company

EIA Environmental Impact Assessment

EdL Electricité du Liban

ENPI European Neighbourhood Partnership Initiative

EPBT Energy Pay Back Time

ERA Electricity Regulatory Agency

EUMENA Europe, the Middle East and North Africa (EUMENA)

EU European Union

EUR Euro, official currency of the Eurozone

FEI Federation of Egyptian Industries

GAFI General Authority for Investment

GDP Gross Domestic Product

GHG Greenhouse Gases

GNP Gross National Product

GWh Gigawatt hour

HPA Hydropower Projects Authority

IFC International Finance Corporation

IMC Industrial Modernisation Centre

JNBC Jordanian National Building Council

JREEEF Jordanian Renewable Energy and Energy Efficiency Fund

kWh Kilowatt hour LCA Life Cycle Analysis

LCOE Levelised Cost of Electricity

MEDREG Support to Cooperation between the Euro-Mediterranean Energy Regulators project

MEDSTAT Euro-Mediterranean Statistical Cooperation

MENA Middle East and North Africa region

MoERE Ministry of Electricity and Renewable Energy

MoE Ministry of Environment

MoEW Ministry of Energy and Water MoF Ministry of Finance

MoP Ministry of Petroleum

MSP Mediterranean Solar Plan – Project Preparation Initiative

MTOE Million Tonnes of Oil Equivalent

MTECO$_2$ Million Tonne Equivalent of CO_2 MW Megawatt

MWe Megawatt Electrical

NEEAP National Energy Efficiency Action Plan

NEA Nuclear Energy Agencies

NREA New and Renewable Energy Agency

NGO Non-Governmental Organisation

NIP National Indicative Programme

PGEF Power Generation Emission Factor

PFZ General Investment Incentives for Private Free Zones

PPA Power Purchase Agreement PV Photovoltaic

REA Rural Electrification Authority

REF Renewable Energy Fund

SEC Supreme Council for Energy

TEC Total Final Energy Consumption

TOU Time of Use

TPA Third-Party Access

TWH Terra Watt-hours

UfM Union for the Mediterranean

UNDP United Nations Development Programme

US United States (of America)

Introduction

SHAAMS counties mainly Egypt, Jordan and Lebanon have an opportunity to use solar energy for a substantial part of their total energy requirements. The successful establishment and maintenance of a viable solar market depends on stable and reliable solar policy and regulation. The aim of this Paper is to identify key requirements of various solar technologies and applications and how such requirements should be addressed.

The Research and development R&D in the three countries is very limited on the upstream level and there is a clear decoupling between the Industries and the academic research. In Lebanon the main actors by law are the CNRS (National Council for scientific researches) and the IRI (Industrial research Institute) whereas the main three Universities hosting various types of research is American University of Beirut (AUB), USJ and Lebanese University.

View the markets structure in the three countries, Except Egypt where large scale utility projects are target by multinational investors, it looks very clear that the SME in both Jordan and Lebanon are growing fast view the specificity in policy for each country. Whereas BDL (Central Bank of Lebanon) has adopted very flexible and successful financing mechanism at very low rate, Jordan enjoyed an appropriate tariff structure and modern renewable Energy Law the most recent among the three countries, it will be of interest to launch an in depth research to explore how we can merge these complementary prerequisite to ensure better development of solar development in the three countries Egypt, Jordan and Egypt.

The statements contained in this Discussion Paper are aimed to serve as basis for further discussions and to present options to policy makers.

Country	Global Horizontal Irradiance (kWh/m²/year)	Direct Normal Radiation (kWh/m²/year)	Wind-Full Load Hours/year
Egypt	2 450	2 800	3 015
Jordan	2 320	2 700	1 483
Lebanon	1 920	2 000	1 176

Table 1. Renewable energy resource indicators in the Arab countries
Source: German Aerospace (2005)

1. Structure

This Discussion Paper will toggle on general level the potential characteristics of policies that can be applied in the three countries but distinguishes between two different types of solar energy generation: utility scale or ground mounted installations and rooftop installations. Both generation types share similar basic requirements which will be discussed in detail in sections **I.** and **II.** below. In addition to these common basic requirements, both types of installation have some further requirements which are specific to them. We will deal with these issues in sections **III.** and **IV.** below.

2. Solar application types and advantages

One advantage of ground mounted systems from a legal perspective is that the off-taker of all generated electricity will have to deal with only a few plant operators and they are generally easier to structure as there typically will be only a limited number of landowners/users. Rooftop installations, on the other hand, are generally smaller in scale and may be operated by a wider range and different category of private investors (individuals and SMEs). Hence, the off-taker is likely to be faced with a medium to large number of electricity producers.

In addition, large ground mounted systems are more cost effective due to their scale and thus, are able to generate electricity at lower cost/kW h than solar rooftop systems. Today, ground mounted systems are able to compete on an unsubsidized basis with conventional generation in some regions*. As such, ground mounted systems can be economicall development R&D to improve grid controls and advances in load balancing and system design, is needed to show that large amounts of ground mounted PV can be integrated into the generation mix to a certain considerable extent.

Utility scale ground mounted systems require a significant amount of investment, which is usually supplied by large corporate investors or government entities. This, in turn, may have the effect that unless sufficient large scale investors are available, capacity building is slower than with small, privately funded systems.

Solar rooftop systems are typically installed (and financed) by private households or small to medium enterprises SME ,in Jordan for example ,the increase of tariff for certain type of consumers mainly banks, mosques and hospitals has driven the industry forward while the price of electricity in Lebanon sold by the utility EDL is still below market price causing a real obstacle for roof top pv solar to flourish, while in Egypt the technical mechanism of net metering is still not mature till today . Hence, encouraging private investment in small to medium scale installations will attract a much larger group of investors. Depending on the policy, capacity building is likely to occur at a much faster rate than with larger ground- mounted systems.

Country	Solar - CSP	Solar - PV	Wind	Other
Egypt	20 MW*	15 MW	550 MW	2 800 Mw hydro
Jordan	N/A	16 MW	15 MW	3.5 MW biomass; 12 MW hydro
Lebanon	N/A	1 MW	0.5 MW	282 MW hydro

Table 2. Renewable energy installed capacity in the Arab countries - 2012

Source: RCREEE (2013); REN21 (2013); League of Arab States (2014) *Solar fraction of ISCC plants

For example, in most markets that have encouraged private investment into renewable/ solar energy generation, utility scale plants account for only a comparatively small part of overall investments. The bulk of investment is generated from private households and small to medium sized enterprises SME.

Further, small to medium scale rooftop installations have a great potential to provide an educational, long term effect. Those who invest in self-generation of electricity are usually inclined to use electricity more carefully (thus encouraging energy efficiency).

The best way to build significant solar capacity is a combination of both utility scale and rooftop systems. Together, utility scale and rooftop systems will create a substantial demand for solar infrastructure products. Such demand, in turn, will create a local solar market (including in many cases local production) for related products, such as inverters, mounting structures electrical components and, depending on the size of the market, even solar panels.

3. Solar Policy Basics

Based on the policy lessons learnt in other parts of the SHAAMS countries, it would be possible to point out some simple policy principles that we believe will help the three counties Egypt, Jordan and Lebanon to maximize the value of solar technologies.

These are some policy principles that may effectively affect market growth:

1. Policy should be driven by goals
2. Policy should be clear and stable
3. Policy should support lower Levelised Cost of Electricity (LCOE)
4. Jobs should be enabled (not forced)
5. High level quality and reliability objectives should be set

If these principles are adopted, it will be hopefully reflected in a long- term sustainable ground-mounted solar industry.

Country	2020 Target	2030 Target
Egypt	20% of electricity generation	N/A
Jordan	10% of primary energy	N/A
Lebanon	N/A	12% of electrical ang thermal energy

Table 3. Renewable energy targets
Source: Egypt, Jordan, Lebanon (2013), RCREEE (2013 a,b), REN21 (2013); Dubari and Qatar (2020) from EU-GCC Clean Energy, and Masdar Institute (2013); Qatar (2030) from Eversheds, and Ernst and Young (2013); Kuwait 2030 target from Alsayegh, *et al* (2012).
*Unofficial targets **2025 target ***2032 ****2031

Principle 1: Policy should be driven by goals

It is important that governments clearly explain and prioritize their policy goals and use these goals as the basis for designing their solar policy mechanisms. Globally, government policy making in the solar sector has historically suffered from conflicting or non- prioritized goals. This resulted in policy measures that were contradictory and under- achieved. As a result, the industry was not able to achieve its full potential and government goals have been frustrated. Examples of conflicting goals include:

- **Cost impact of conflicting goals**. Governments frequently set goals whose success relies on lower solar costs-such as high solar targets to meet environmental, energy and security goals-while at the same time implementing policy that raises solar costs-such as restrictive local content requirements.

- **Conflicting total jobs versus manufacturing job goals**. The larger the solar market, the more jobs are created, in all stages of the value chain. Yet, many policy makers focus on creating manufacturing jobs locally, which often results in higher priced solar as a result of reduced economies of scale, a fractured manufacturing basis, and ultimately less market growth. As a result, total job growth is sometimes sacrificed to manufacturing job growth**.
- **Overall economic growth versus manufacturing growth**. Growing solar at a low cost so that it becomes a meaningful part of the energy mix can help achieve larger economic goals such as GDP growth or fuel substitution with resultant balance of payments and income benefits and concomitant jobs and wealth gains. These goals can be undermined through policies that focus solely on manufacturing.

The above examples serve to illustrate that it is important for governments to have an articulated set of consistent and prioritized goals. W ithout these prioritized goals, policy mechanisms have the potential to be conflicting.

Country	Overview of Institutional Framework
Egypt	New and Renewable Energy Authority (NREA) is responsable for promoting and supporting renewable energy
Jordan	Jordan does not have a dedicated agency to promote and regulate renewable energy projects. Activities relating to renewable energy promotion fall under the suspices of the Ministry of Energy and Miseral Resources and Electricity Regulatory Agency
Lebanon	Currently, all activities related to supporting and promoting renewable energy in Lebanon under the suspices of the Lebanese Center for Energy Conservation (LCEC), LCEC in established and supported by UNDP, a national affiliated with the Lebanese Ministry of Water and Energy

Table 4. Examples of renewable energy institutional framework in the Arab countries
Source: RCREEE (2013); EU-GCC Clean Energy, and Masdar Institute (2013); the League of Arab States (2013)

Principle 2: Policy should be clear and stable

Despite the existence of initial projects in the three countries i.e. Egypt, Jordan and Lebanon, the solar industry is still in its infancy. Although there have been announcement of ambitious long-term targets, the pathway to reach those targetsremains unclear. Policy makers should introduce responsible intermediate targets (and mechanisms to reach those targets) as soon as possible. These intermediate targets give investors visibility about market development and allow them to make long-term investment decisions.

Investment clarity is particularly important in the utility-scale market segment because of the relatively long project lead times and high degree of localization that is often required in this segment. Overseas companies will usually need to find a local engineering and construction company, a local financing partner and establish a local supply chain that is robust enough to support a utility scale project. Finding, engaging and qualifying local partners takes time and investors will be wary of investing in markets that do not appear stable and visible.

Finally, the governments in these countries are encouraged to put in place a stable regulatory framework. Solar investments are long term investments and therefore are highly dependent on a stable and predictable legal framework. Unsteady frameworks keep sustainable solar markets from developing or, even worse, destroy even established solar markets by undermining investor confidence by eliminating stability and predictability as cornerstones of any sustainable solar market.

Principle 3: Policy should support lower LCOEs

When comparing generation costs across different technologies, a commonly used metric is LCOE. This metric is useful because it measures the cost of electricity throughout the entire life of power plants; taking into account the capital investment, fuel costs, financing and other operating costs. Therefore, driving down the LCOE of a portfolio of generation assets should reduce the total generation cost of electricity.

It is important to recognize that lower cost solar electricity (irrespective of technology used, PV, CPV or CSP) has many ancillary benefits in addition to reducing the price of electricity.

By driving-down LCOEs, policy makers will also reduce the costs of any support mechanisms and ultimately allow utilities and governments to set more ambitious long term goals. As a result, the industry will create more jobs, localize these jobs and bring many other economic and security benefits.

For solar power plants, the main factors determining LCOE are: financing conditions, CAPEX and local conditions. The first two of these factors can be shaped by government policy.

- **Cost of financing**: The LCOE of a solar power plant is extremely sensitive to the cost of financing. This is because solar power plants have a relatively high up-front CAPEX, minimal OPEX and no ongoing fuel costs. The fact that the majority of the investment is made at the time of commissioning makes investors particularly cautious about government policy and regulation. If policy makers want to reduce the cost of financing then they can do this either directly or indirectly.

  To directly reduce the cost of financing, governments can offer concessional loan guarantees or similar schemes.

  To indirectly reduce the cost of financing, governments can create regulatory framework conditions that create certainty and reduce investment risk. Any perceived risk of retroactive regulatory changes will cause the cost of financing to rise and drive up solar LCOEs. On the other hand, policies that create certainty will cause the cost of financing to be reduced and drive down solar LCOEs.

- **CAPEX**: Policy makers should allow the industry to innovate and find ways to drive down the cost of its solar capital expenditure. Complex specifications and specific component requirements will inevitably drive costs up. Forced local content requirements should be avoided because they will also drive costs up and reduce competitiveness (see the next section for more details).

Finally, LCOEs will be reduced if the solar industry is given time to adapt to local conditions. Policy makers should seek to create an environment in which the solar market can develop in Egypt, Jordan and Lebanon that allows for this adaptation period. For example, the industry needs to adapt to local laws, supply chains, financing conditions, engineering standards and environmental conditions (like dust). Without familiarity with these factors, investors will be cautious and local suppliers will not have had time to tool-up and reduce the costs of locally supplied materials.

Principle 4: Jobs should be enabled (not forced)

In spite that job creation is of high importance in the region and is fully supportive of policies which promote local job growth. The region has already recognized the enormous potential of the solar industry to create new jobs along the entire solar value chain. However, there remain two main questions:

1. How do policy makers maximize job growth?
2. How do policy makers ensure that this job growth is long-term and sustainable?

To answer these questions, the three countries in question may have the advantage of being able to look to historic precedent. Broadly speaking, government policy makers have historically adopted two contradictory approaches to job creation: job enabling vs. job forcing.

- **Job enabling**: Any policies that facilitate the growth of the solar market will enable job creation-first through direct development, construction and supply chain as well as numerous indirect jobs and second by attracting manufacturing investment based on a sustainable and growing solar market. Jobs that are enabled are more likely to be sustainable over the long term because decisions to create those jobs were based on market fundamentals. Policies that grow the solar market and thus enable job growth have the additional benefit that they generally support other solar-related goals that depend on a growing solar market, such as broader economic, environmental, energy, and security goals.

- **Job Forcing**: Job forcing policies include such instruments as local content requirements and market set-asides for local manufacturers. These policies may result in some growth in local manufacturing jobs, but raise the cost of solar projects. In turn, this reduces market growth potential and overall job growth. Job forcing mechanisms can hamper competition, create equipment supply constraints as local suppliers' tool up, stifle growth and create investment uncertainty – potentially leading to fewer rather than more local jobs. In addition, most local content requirements are non-WTO compliant and are subject to WTO complaints and negative rulings. As an example, Canada's local content requirements have been ruled non-WTO compliant in a recent WTO judgment. These legal challenges can create even more market uncertainty which reduces investment appetite and further dilutes job growth. Finally, jobs that are forced are more likely to be eliminated once the forcing mechanism has been removed or a market slows down.

To the extent that some "forcing requirement" to create local jobs is deemed as unavoidable or necessary, the requirement should be imposed at a project level to encourage supply chain developments that encourage local job creation. They should be technology neutral (taking differences in technologies into account) and should be phased in to allow time for a local supply chain to develop. Finally, if forcing requirements are introduced, long-term visibility about future requirements is critical to maintain market confidence.

Experience has shown that the best way to create long-term jobs in the solar industry is through sustained market growth coupled with policy certainty. Abiding by these simple principles will drive job creation in all stages of the solar value chain, including manufacturing. The more long-term the certainty in a particular market, the more likely that jobs will be created.

Principle 5: High level quality and reliability objectives should be set

Quality and reliability are important factors when designing any type of power plant, including a solar power plant.

To build the solar system of the future, governments should focus on policy mechanisms which encourage "smart" solar power plants, both on utility scale and rooftop level. These smart power plants bring more value because they stabilize the grid, optimize power output and create long-term jobs.

Today´s best-in-class solar power plants (photovoltaics, concentrated photovoltaics and concentrated solar power) provide stability to the electricity grid. Some of the features that bring stability to grids are: reliable forecasting to manage variability, power and voltage regulations, active and reactive power controls, ramp rate controls, frequency regulation and fault ride through capabilities. In the years to come, the solar industry will develop new and innovative technologies to make their power plants "smarter". Policy makers should ensure that their regulations and procurement activities encourage this innovation.

While the desired outcomes with respect to stability and integration should be well identified and specified, over-specifying technical or component parameters may have major side effects. Over specifying the requirements of a particular project can actually reduce innovation and increase cost. Government should set out high- level targets and let bidders decide how they will technically achieve those targets.

4. Specific Policy Considerations for Ground-Mounted Systems

The solar industry has learnt from recent experience that overly generous government policies that result in high short-term profits are usually even more detrimental in the medium to long-term than policies that are insufficiently attractive. The boom and bust policies most recently experienced in Europe –overly generous Feed-in-Tariffs (FiTs) followed by draconian cuts or even program elimination– resulted in the destruction of jobs just as quickly

if not more so as when they were originally created. In addition, the high and artificial profit levels resulting from the initial policies did not encourage the industry to reduce its cost structure, thus resulting in numerous insolvencies that might have been avoided. For an industry to invest and continue to invest, it must be able to rely on consistent policies that result in sustainable market growth. Creating a policy framework that explicitly avoids boom and bust cycles but encourages scale over the medium- /long-term and cost reduction will reduce uncertainty and allow companies to make decisive and long-term investment decisions.

Traditionally, the ground-mounted segment has been encouraged by market creation mechanisms combined with project financing mechanisms.

Competitive bidding can also be conducted by governments, which is typically done on an LCOE or engineering, procurement and construction (EPC) basis and managed through a build, operate and transfer (BOT) contract. Government EPC contracts have already been used successfully in the region, such as in the first and second round of bidding in Jordan.

In order to enable the achievement of RPS requirements, government policies that serve to reduce the cost to the utility or IPP and the end- consumer of the electricity generated should be endorsed until solar pricing comes down to a level that is sustainable without them. Such mechanisms include: loan guarantees to reduce financing costs, bundling of renewable electricity with fossil fuels to reduce electricity costs; direct viability gap funding to reduce up- front costs or increase production revenue.

Feed-in-tariffs (FiTs) and Feed-in-premiums (FiPs): FiTs and FiPs successfully created solar markets in Europe and other markets such as Japan and Canada. The advantages of these systems were that they very effectively promoted the deployment of new capacity at a time when solar was a fairly nascent technology and that they were relatively simple to administer. One major disadvantage of a FiT is that it is challenging for policy makers to set the FiT at just the right level, particularly for utility scale applications. This may result in FiTs that are set too high, resulting in an oversupply of solar into the markets with the highest FiTs. Policy makers concerned about the cost of these programs are then tempted to slash or even eliminate FiTs, resulting in cascading boom and bust cycles from one market to another. Conservative tariff setting, combined with tariff increases as may be required in order to stimulate more investment, is therefore usually the better approach in tariff setting.

Furthermore, FiTs may promote a narrow vision within the utility scale solar industry because they do not encourage the industry to work with utilities, grid operators or end users on a variety of technical issues because utilities are required to purchase the electricity produced at the FiT price. As a result, solar companies are often less inclined to work on system solutions that benefit the grid or the utilities that are required to purchase the electricity produced under FiT regimes. As a result, with respect to utility scale solar plants, FiTs and FiPs can promote solar systems which do not integrate well with the rest of the system and therefore bring less value or could even be detrimental to grid stability. Having said this, FiTs are well-suited to rooftop applications due to their relative simplicity and repeatability over many small-scale systems (see **VI. 4.5** below). If FiTs are introduced, then finding the correct incentive level is critical. Furthermore, a regular monitoring mechanism must be introduced and be able to quickly adapt the incentive level in the case of a sudden boom in installations.

Grid Stability and Reliability: The main concern that is often expressed is that solar generation (and particularly photovoltaic generation) does not contribute to the reliability and

stability of bulk generation. However, when a solar power plant has sufficient controls, it can actually improve grid security and reliability. Examples of controls that policy makers should incentivize include:

- Voltage, VAR control and/or power factor regulation
- Fault ride through
- Real power control, ramping, and curtailment
- Primary frequency regulation
- Frequency droop response
- Short circuit duty control

With these controls, solar power plants have been integrated successfully into power portfolios around the world while contributing to stability and reliability.

Load Balancing: A secondary concern is that solar power plants are not fully dispatchable and that this complicates daily operation. However, it is important that policy makers recognize that dispatchable resources already follow a demand curve (which is forecasted) and that increasing penetration of variable resources simply involves more forecasting. With this in mind, the most important way to cost-effectively reduce the impact of variability on the grid is to integrate variable generation forecasting into daily operations. Importantly, as PV becomes more geographically spread, and as plant size becomes larger, predictability increases. Therefore, grid operators, can create an aggregated forecast and forecasting of individual resources is less important. As forecasting techniques become more intelligent, the ability of dispatchable resources to match with a broad array of variable generation sources will improve.

Power Systems Planning and design: A further important factor when planning and designing a power system is to ensure its long-term flexibility and fit with variable generation sources. Furthermore, consumers should be incentivized to change their behavior through demand-side management.

Country	Solar (type)	Wind	Other (type)
Egypt	100 MW (CSP) 240 MW (PV)	1 070 MW	32 MW (small hydro)
Jordan	400 MW	360 MW	N/A
Lebanon	<1 MW (PV)	60-100 MW	N/A

Table 5. Renewable energy projects in Arab countries announced in 2013

Source: Kuwait from EU-gCC Clean Energy (2013); Lebanon, Palestine and Sudan from RCREEE (2013); all other countries REN21 (2013).

5. Specific Policy Considerations for Rooftop Systems

There are a number of challenges presented by the markets in Lebanon and Egypt and not in Jordan for rooftop markets, including as follows:

- The low, subsidized price of electricity that creates a challenge for renewable energy. It provides a comparatively low level of incentive to residents and commercial enterprises to reduce energy bills by producing their own electricity from renewable sources.
- System maintenance – solar rooftop installations will require regular maintenance (i.e. cleaning of dust and sand). Tenants might not appreciate having to grant regular access to maintenance workers, who will require access to the roof.

1. Auction vs. Incentive Schemes

Auction schemes usually work by way of one or more large scale investors bidding to build photovoltaic systems on pre-selected roofs and sell the generated electricity at a unified tariff. We will demonstrate the benefits and disadvantages of such auction scheme compared to more commonly applied incentive schemes.

Auction schemes

An auction scheme offers a number of advantages over an end user FiT which seeks to encourage individual/commercial building owners to install rooftop solar:

(a) Advantages

- Other than industrial or commercial premises, there is a risk that an end user FiT will not result in significant adoption of rooftop solar due to (a) there being relatively few owner occupiers and the installation needing to be carried out by the building owner rather than those occupying the building who will benefit from the electricity generated (i.e. how will building owners receive a return on the capital costs of installing rooftop solar); and (b) the fact that the true cost of electricity production is not passed onto consumers so they may not perceive sufficient financial incentive from a FiT to adopt rooftop solar (compared to, for example, Europe where the cost of electricity makes FiTs an attractive proposition).
- Administratively, it will be less burdensome for utility providers to deal with fewer companies who will each own a number of rooftop sites, as opposed to a multiplicity of small scale solar developments. This includes installation, legal fees and cost of financing.
- Larger scale projects are likely to benefit from lower overall costs due to economies of scale when compared with the cost of more small scale solar arrays being procured for individual buildings.
- Large scale developers taking responsibility for the maintenance of a number of sites will be able to employ dedicated staff trained to clean and maintain the solar panels so as to optimize their ef-

ficiency whereas individual/commercial building owners are likely to arrange cleaning by non-specialists on an ad hoc basis which is likely to lead to sub-optimal performance.

- Large scale developers are more likely to have the institutional capacity to effectively apply for carbon credits which should reduce the cost of this scheme to local utilities.
- By adopting an auction scheme, the market will set the value of the rooftop solar. This is likely to result in lower costs for utilities due to the competitive element.

(b) Disadvantages

There are a number of challenges with an auction system but many of these are similar to those that would arise with an end user FiT and/or are offset by advantages over an end user FiT.

- The upfront involvement of local utilities and costs of an auction scheme will be higher than with a FiT as it will be necessary to carry out roof surveys, structural analysis, create the bundles to be auctioned and sign building owners to a standard rooftop agreement.
- However, these costs may be offset by:
  - the potentially lower overall costs of an auction scheme compared to an end user FiT scheme; and
  - the potentially lower ongoing administrative costs of an auction scheme compared to the costs of administering an end user FiT if such administration is not streamlined as set out below.
- Arrangements will need to be made with building owners for access to their rooftops for the installation and ongoing maintenance of the solar panels.
- Insurance issues will need to be considered as the owners of the solar panels will not have a proprietary interest in the buildings on which they are sited. They will also have personnel visiting these buildings to carry out maintenance, etc. who will need to have contractually or legally-granted access rights.
- One of the main drivers for the adoption of rooftop solar over a ground mounted system is, we understand, to encourage greater awareness of the benefits of energy saving measures. Arguably, this is not achieved through an auction system as there is no direct involvement by individual/commercial consumers.
- However, given that consumers do not pay the full cost of producing electricity, an end user FiT may not necessarily prove to be any more effective in this respect.
- New buildings may impact negatively on the efficiency of particular rooftops if they shade all or part of those rooftops. This will impact on the return made by investors and they will likely seek protection from this as it is something which is outside of their control. This may equally be the case, however, with individual and commercial building owners if they invest in solar panels and a new adjacent building reduces the amount of electricity that they are able to feed in to the grid.
- Investors may ask the utility provider (or other responsible entity) to provide guarantees regarding lease agreements, long term solar access and structural integrity of the roof, i.e. the local utility is likely to be expected to assume a greater level of risk associated with each site than via an incentive scheme (see below).

Incentive schemes

An alternative to the implementation of above mentioned auction scheme is the implementation of an incentive scheme.

Incentive schemes that encourage a multitude of private investors SME to invest in smaller scale rooftop installation (usually on roofs that are owned by the investor itself) come with the following advantages and disadvantages:

(a) Advantages

- **Limited upfront cost**: An incentive scheme can be implemented without conducting roof surveys, etc. Individual and small to mid scale commercial investors will have to decide themselves whether or not their investment in solar is worthwhile.
- **Public participation**: Involving individual investors and small to medium-sized enterprises in the process of generating renewable / solar energy takes the financing burden off governmental entities.
- **Simple administration**: Property owners will decide themselves whether or not an investment into solar energy generation is a worthwhile investment. Hence, the government is not required to determine which roofs are suitable for such installations. The market will regulate itself.
- **No ownership issues**: Individual investors are likely to use their own roof space, so there will be no need for a large scale investor to agree on terms with a multitude of private roof space owners.
- **Capacity building**: Involving the general public in solar investments is more likely to create sufficient demand to establish a local solar industry than other more limited mechanisms.

(b) Disadvantages

- **Cost**: Small scale installations will not benefit from economies of scale effects to the same extent as would larger scale installations. Electricity will be generated at a higher cost than such generated by utility scale applications.
- Off-takers will have to deal with a multitude of private investors.

Through subsidization, the cost of electricity is very low in Lebanon and relatively in Egypt. Renewable solar energy cannot yet be generated at a cost comparable to that of conventional fuels. A governmental policy or incentive scheme is required to close the gap between current electricity cost levels in Lebanon and the cost at which private investors will be able to generate renewable energy themselves. Only once such gap is closed and a certain financial incentive (i.e. profit) is granted to investors are private investments into solar energy generation likely to take place.

The most commonly applied incentive schemes, and a discussion of their relative advantages and disadvantages, are discussed below. It should be noted that many countries use a range of incentive schemes and not just one.

Tax incentives/exemption

Tax incentive/exemption schemes aim to provide a financial incentive to private investors by granting tax exemptions if investments into renewable (solar) energy generation are made. These schemes can either be linked to the capital investment in projects or to the energy produced.

(a) Advantages

- Used effectively in jurisdictions with tax regimes.

(b) Disadvantages

- Lebanon is a little tax jurisdictions so such an incentive is not very practical.

Net-metering

Net-metering requires a meter which records electricity in both directions. Effectively, the operator of a solar rooftop installation will be able to offset his consumption from the grid with the electricity he generates himself, thus lowering his total electricity bill.

(a) Advantages

- Easy to administer in terms of billing.
- No extra cost (e.g. premium tariff or capital contribution).

(b) Disadvantages

- Net-metering schemes provide the required incentive to investors only where the cost of self-generated electricity is lower than the tariff at which the investor is able to source electricity from the grid.

Capital Rebate Subsidies

Subsidy schemes operate by governments or government entities offering a financial contribution to the private investors' system related capital expenditure. Such financial contribution can be granted either by way of a direct capital contribution to the cost of the installation (on an $$/W basis), or by way of a loan that is granted on favorable terms.

(a) Advantages

- An immediate financial incentive for the consumer is likely to create interest in private investments into solar energy generation.

(b) Disadvantages

- Such a scheme is likely to be administratively burdensome, particularly if there are criteria for eligibility that require assessment.

- Upfront cost for government.
- The lack of generation-linked incentive does not create an incentive to optimize the system output.
- Capital rebate subsidy schemes generally create a market that is focused on low cost installations and not quality systems that are built to last 20 or more years.

The above mentioned disadvantages outweigh the advantages, why it will not be recommended to apply a subsidy scheme.

Renewable or quota obligations

Renewable or quota obligation schemes operate by requiring certain entities to obtain a certain number of renewable energy certificates. Such certificates can be obtained from electricity generators in exchange for such entities producing renewable energy. In the UK if a supplier does not obtain its quota of certificates it then has to pay a penalty into a fund. This fund is then redistributed to suppliers in proportion to how many certificates they have produced. Such schemes create a market in the certificates.

(a) Advantages

- Commits suppliers to sourcing a certain amount of energy from renewable sources. This, in turn, creates a demand for investments in solar energy generation.

(b) Disadvantages

- Not possible to create a market in certificates when the single supplier is state- owned.
- Scheme does not apply to individual investors.

Renewable or quota obligation schemes do not generally apply to individual investors save for voluntary schemes where certain consumers wish to purchase electricity from renewable resources

Feed-in-tariffs

For solar rooftop applications, feed-in tariff schemes are the most commonly applied form of incentive schemes globally. Feed-in tariff schemes provide individual generators of renewable energy access to the public grid and pay such generators a set amount for all electricity such individual investor subsequently produces during a pre-determined time frame. The essential characteristics of a FiT are as follows:

- The right of the generator (who may or may not be the owner of the building) to feed any electricity he produces into the grid;
- An obligation on the relevant utility company to purchase all electricity so produced;
- The payment of a premium tariff by the utility company/government to the generator for all renewable electricity generated by such generator and supplied to the grid;
- The payment of the premium tariff is guaranteed for a pre-determined time frame (often 20 to 25 years, but could potentially be significantly shorter in the three countries, given the very high solar irradiation levels).

In unsubsidized utility regimes, the additional cost is usually passed on to consumers by way of higher energy prices. The tariff reduces as the cost of the technology decreases, ultimately disappearing once generation costs become lower than grid supplied electricity.

(a) Advantages

- FiT schemes are open to the general public, thus having a long-lasting educational effect by teaching participants the value of electricity.
- FiT schemes are likely to create sufficient demand in order to sustain a local solar industry where there is regulatory certainty and a clear and transparent digression structure.
- FiT schemes are comparatively easy to administer (i.e. can be administered mainly by computer systems – no training of additional staff required).
- Level of tariff paid directly impacts the attractiveness of the scheme. Hence, the amount of private investments can effectively be steered by adjusting (for future installations only!) the level of tariff paid.
- Long term guarantee of tariff means that the private sector can secure private finance, which is particularly attractive for large schemes that may use project finance although this can also be achieved through a long term power purchase agreement.
- Risk of site selection, generation, roof-top lease agreements falls with the owner/investor.

(b) Disadvantages

- The level of tariff needs to be set carefully in order to incentivize private participation without creating an uncontrolled boom in investments.

Challenges and Solutions

Tariff level

Certainly the most challenging task in introducing a feed-in tariff scheme is setting the tariff to be paid to investors at the right level. A tariff that is too attractive will lead to a boom in solar investments. A tariff that is too low, on the other hand, will keep investors from investing.

This is a particular challenge in Lebanon and Egypt given the low cost of electricity.

Irrespective of the tariff level it is of utmost importance to ensure a stable investment environment. Private investors require a reliable legal framework within which their investments are made. The same applies to banks which are supposed to finance investments into renewable energy generation. The more stable and secure the legal framework, the lower the risk the banks will face, which in turn will result in lower financing costs and thus, lower (solar) electricity generation costs.

The risk of attracting too much investments in solar energy generation by setting the tariff too high can be mitigated as follows:

Country	Public Competitive Bidding	Fit	Net Metering
Egypt	Exists for development of large-scale private renewable energy (wind and solar) projects.	FiT under preparation.	In January 2013, EgyptERA adopted a net-metering policy that allows small-scale renewable energy projects to feed in electricity. To the grid. Generated surplus electricity will be discounted from the balance through the Net-metering process.
Jordan	Exists for development of large-scale private renewable energy projects.	The Reference Pricelist Record for the Calculation of Electrical Energy Purchase Prices from Renewable Energy Sources Issued by the Council of Commissioners of ERC to The Renewable Energy and Energy Efficiency Law No (13) for the Year 2012.	Net-metering is authorized in the Directive governing the sale of electrical energy generated from renewable energy systems issues by the Council of Commissioners of Electricity Regulatory Commission pursuant to Article 10 (b) of the Renewable Energy and Energy Efficiency Law No (13) (2012).
Lebanon	Exists for development of large-scale private renewable energy projects.	NO	Decision of Board of Directors of Electricité du Liban (EDL) legalised net- metering since 2011. As of late 2013, 120 applications were received and 119 two- way meters were donated by LCEC.

Table 6. Solar pv supporting policies in Egypt, Jordan, and Lebanon

(a) "Natural ceiling" on solar investments

If achievable, the ideal solution is a natural ceiling on solar investments. A natural ceiling, in this sense, means that investors are discouraged from investing in too much solar capacity.

This could be done by allowing the solar system size to be based on the electricity consumption of the applicant. For example, the electricity generated by the solar system would be equal to or less than the consumption for the previous year.

Another option is that, instead of making payments to investors, energy credits are being granted. For example, an investor would be granted a credit of X KWh on his regular utility bill for each KW h of solar electricity he generates. In an ideal scenario, the investor would thus be able to use the energy credits for all such electricity that he cannot generate himself. The payback on his installation costs would then be generated by savings on electricity bills. Without any payment being made to investors, there is no incentive to build systems that generate more electricity than the investor requires in order to "zero" his electricity bills.

However, such "natural ceilings" will work only in scenarios where the investor is also the person consuming the generated solar electricity and the savings in electricity costs are sufficient to recoup costs of installing the solar system. In large cities, however, most people do not own the houses they occupy. The majority of the population are tenants. As tenants, individuals are unlikely to install solar rooftop systems, given that any FiT scheme, with or without "natural ceiling" will require some years until the initial investment is returned and a profit generated. Solar installations are thus more likely to be installed by landlords. Landlords do not benefit from their investment unless they are being paid, however. It may be possible for owners and developers to form joint ventures for the purposes of FiT projects which could also pass on a benefit to the tenant, although this may be complicated to incentivize at the outset of the program. Hence, due to the required connection between generation and consumption, "natural ceilings" are unlikely to work.

(b) Cap on eligible capacity

Another way to avoid an unhealthy boom in solar installations is to introduce an overall cap on capacity that is eligible for tariff payments. Such cap could be structured, for example, by setting a maximum of X MW of permissible newly added capacity per year.

The advantage of introducing such cap is that the maximum amount of incentive payments throughout the financial year is clearly determined. An uncontrolled boom in new solar rooftop installations will not occur, given that investors are discouraged from installing new capacity if such new installations do not qualify for any incentive payments. This would also allow the off-taker to set a new FiT based on the market reaction.

The disadvantage of introducing an inflexible cap is that it is likely to trigger a run on approvals for new capacity at the beginning of a financial year (when the cap has not yet been reached) with little to no activities towards the end of the year. It could also stifle early investment because there is in effect a race. If the participants have no visibility on other projects in the pipeline, it will be difficult to secure funding. One way around this is to create a registration mechanism which requires developers to register their projects including details of when key milestones are reached so that other developers and investors can reach an informed view as to whether to progress with their projects. This is being considered in European jurisdictions which are faced with similar challenges but in other technologies.

Introducing a cap further means that the amount of new solar capacity will need to be monitored in order to be able to determine at which point of time the maximum capacity for the year has been reached. Performing this monitoring function manually is likely to create administrative hurdles that should be avoided and it would incur additional cost, such as training personnel and paying salaries.

A more effective approach will be to monitor capacity building online. Applications should be filed by contractors that have been pre-approved by the relevant authority(ies) once such contractors have secured an order from their customers. Restricting the filing of online applications to pre-approved contractors has the advantage of limiting the risk of individuals filing bogus applications in order to secure a share of the permissible capacity and to on- sell such capacity to third parties as has occurred in other markets. Furthermore, restricting applications to pre-approved contractors will ensure that applications are completed in a professional manner and including all relevant information.

(c) Careful tariff setting

An even simpler approach will be to set a rather conservative FiT to start with.

A significant mistake that has been made in a range of other markets, such as Spain, is that feed-in tariff schemes have been introduced with an overly generous tariff. This has led to an almost immediate boom in solar investments, but also to very high tariff related costs which rendered the whole scheme unsustainable. Governments have been forced to cut tariffs even for existing solar arrays, resulting in the newly created solar markets falling apart as quickly as they were created.

This could be avoided by applying a rather conservative tariff in the beginning that is likely to attract only moderate growth. Should the tariff prove not to be sufficiently attractive in order to attract the desired amount of investment, the tariff can moderately be increased, also for existing installations, until expectations are being met.

The main advantage of this approach over introducing a cap as set out under (b) above is that the market is regulating itself without requiring any substantial administrative actions. Increasing a tariff once granted is unlikely to create any distortion in the market. It will merely make solar investments more attractive. Cutting tariffs for existing installations is what rapidly destroys solar markets unless there is a clear and transparent digression structure in place which is not impossible to achieve. This requires (i) a policy that is clear upfront on the process for digression and (ii) sufficient notice before digression is implemented i.e. a structured process. This, coupled with a registration system as suggested above, could give the government and investors the clarity they require.

The challenge with setting overly conservative tariffs is that they would not stimulate investment and thus the goal of the program would not be met.

Disconnect – landlords / tenants – how to deal with maintenance issues

(a) Tariff

Feed-in tariff schemes, however, by their very nature, require several years until the initial investment pays for itself and generates a profit.

On the other hand it must be assumed that those persons who purchase property intend to stay for a longer period of time. Owners of properties are therefore the target group for all rooftop solar investment.

In many cases, home owners may rent their property to others. This creates a disconnection between those who invest in solar energy generation (landlords) and those who benefit from such installations (tenants). Landlords will invest in solar arrays only if they themselves benefit from such investment. This is achieved if the landlord, not the tenant, receives any tariff his solar array generates.

Another option to overcome this is by requiring that a percentage of the feed-in tariff recovered is paid to the actual tenant of the property at the time of occupation. This could be built into the feed-in tariff regulations. This would connect the occupiers and landlords.

(b) Maintenance

Another issue that needs to be dealt with is that solar rooftop arrays need to be cleaned and otherwise maintained in order to generate to maximum capacity. In light of the fact that such solar arrays are installed on tenants' roofs, obtaining access to such installations may become a problem in some cases.

This problem can be dealt with on a contractual level, however. Even without solar arrays installed, landlords have the right to visit their property at pre-agreed times. There is no reason why a landlord appointed maintenance company should face difficulties if the fact that the company will visit the premises in order to maintain the system in regular intervals is pre- agreed between landlord and tenants.

Application process

An important factor in individual investors / small to medium sized enterprises deciding for or against investing into installing a solar system on their roof is the administrative effort required in order to obtain approval to install such system. For that reason, it is of utmost importance to keep the application process as simple as possible.

As mentioned in section 2.6.1 (b) above, it might be worthwhile asking solar contractors to pre-qualify with the relevant authority(ies). Once pre-qualified, such solar contractors could deal with potential solar investors directly and design a system with such customers

To further simplify the application process, it is recommended that ideally only one authority is charged with approving solar roof applications. Technical, as well as legal requirements of all authorities usually involved in similar matters, such as municipality, civil defense, etc. should be coordinated between these authorities and administered by only one approving authority, thus avoiding identical processes having to be repeated multiple times.

Electricity off-taker

It is critical that the off-taker of electricity be identified and has both the authority and the obligation to purchase electricity at a premium to the market rate.

The benefits of adding solar energy to the general energy mix are multifold. Apart from the obvious reduction of CO_2 emissions and a healthier environment, other important factors, such as a reduction of energy dependency on imported natural gas deliveries and the establishment of an additional local industry with positive side-effects such as job creation come into play.

For the time being, however, most solar energy generation depends on a stable, dependable and bankable legal and regulatory framework in order to be economically viable. Global solar capacity building has led to significant technological development and cost reduction, however, so it is foreseeable that solar generation costs will soon drop below fossil fuel dependent generation costs. Hence, financial incentives, though currently required, are merely an interim measure.

A suitable policy will clearly define the goals it aims to achieve, will be stable, dependable and bankable, will drive LCOE down further and will encourage high-quality installations which add to the overall grid quality and safety.

Solar energy can be made part of the general energy mix, solar industry can be established and maintained in a sustainable, prosperous fashion.

The key drivers for integrating more renewables into the country's energy mix are clear, and there is political support from all of the stakeholders. There is a consensus to diversify the energy mix, particularly through increased use of renewable energy, increased energy efficiency and greater integration of the private sector. However, key obstacles holding back developments in the renewable energy sectorinclude:

1. the absence ofaclear strategy and policy for renewable energy,
2. the lack of a clear institutional framework to facilitate implementation of the policy and
3. the lack of a clear financial mechanism to support the deployment of renewables projects (both on- and off-grid).

A national strategy and policy for renewable energy therefore should be launched in the three countries with involvement of the key stakeholders.

The renewable energy strategy can be segmented into four main pillars:

- Legal and regulatory framework
- Institutional and organizational framework
- Capacity building, R&D and outreach
- Financial framework and incentives.

Project funded by the EUROPEAN UNION

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