INTERNATIONAL SOLAR ALLIANCE: NURTURING POSSIBILITIES

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CONTENTS

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LIST OF EXHIBITS

LIST OF TABLES

LIST OF ANNEXURES

EXECUTIVE SUMMARY

Introduction

As the world undertakes its chartered path towards development, growth and employment generation, to ameliorate the lives of millions of people, it becomes imperative to appreciate the looming ramifications of environmental degradation and ecological imbalances – best reflected in carbon emissions – caused by climate change. Of late, growth in emission has been directly linked to overall economic growth and this linkage is unlikely to be broken in the years to come. At the same time, it is increasingly being realized that climate change is unequivocal and therefore an international collective action is critical in driving an effective, efficient and equitable response to this challenge.

Energy and climate are inextricably linked with any change in energy sector activity, seemingly affecting the latter. The irony is that the energy so used is neither adequate to satiate the demands of the global populace nor is it helping the planet to remain healthy and inhabitable for future generations. Although, there is no single remedy to this issue, a series of measures could be undertaken by various stakeholders in addressing challenges arising out of climate change and thereby help in sustainable development.

In terms of per capita emissions, the oil producing countries have been leading the flock with 6 countries (namely Qatar, Kuwait, Bahrain, UAE, Brunei, Saudi Arabia) figuring in the top 10 during 2013 apart from Luxembourg, Tobago, Australia, and USA. India, with an annual per capita CO_2 emission of 1.49 MT/person was ranked among the lowest.

Set against this backdrop, the progressive substitution of fossil fuels as primary sources of energy becomes a critical component of any noteworthy measure aimed at climate change mitigation. This is especially relevant for developing and emerging countries whose energy needs are increasing rapidly in line with their strong economic growth.

The panacea for all this is increasing usage of renewable sources of energy including solar. Solar is one of the key renewable sources of reliable and accessible electricity. Once the solar infrastructure is installed, energy from it can be accessed for a long duration with relatively less cost. For years, solar has been a potential solution for millions who do not have access to electricity across the world, but high costs and slow development in technology has left it largely out of reach. This however is changing – with increased investment, cheaper products and innovative business models, energy generation from solar rays is not only on the rise but could potentially transform the way the world is powered. An added, and perhaps more important, benefit is the rapid and sustainable development of solar energy applications, which is a key to accelerating solar energy's global march to achieving grid parity.

The solar industry is still young and the market opportunities are massive. Despite the significant potential and opportunity for solar energy development, and the geographic and socioeconomic advantages, there exists an anomaly amongst countries in harnessing solar power. This situation runs the risk of a 'solar divide', where developing and less developed countries are not able to participate in the fruits of green growth that developed countries are pursuing, creating a paradoxical situation where the countries rich in solar resources are not in a position to harness their resources, while the countries with relatively less solar resources are in a position to do so.

Taking cognizance of such an anomaly, the Government of India along with like-minded partner countries have conceived the International Solar Alliance as a coalition of 121 solar resource rich countries lying within the Tropics of Cancer and Capricorn with the objective of harnessing solar energy that these countries are endowed with. This Study highlights that capacity building, financial cooperation, and technological development remains the key to the success of this Alliance, and discusses possible strategies towards capturing the true potential of solar energy in these countries. The Study has also made an effort towards preparing a 'Cooperation Matrix' and has outlined various financing models that could be explored among member countries, going forward.

Global Solar Energy Sector: An Insight

Global renewable energy capacity has increased significantly since the turn of the 21st century. The total renewable energy produced from all sources increased from 843 GW in 2000 to 1829 GW in 2014 – registering a compounded annual growth rate of 5.7% during the period. Asia, with a fairly modest base, witnessed one of the fastest growths, recording a CAGR of 9% as its renewable capacity increased from 209 GW to 707 GW between 2000 and 2014. Europe, which had the highest installed renewable capacity of 217 GW during the turn of the century, came second in 2014 with 472 GW as compared to 707 GW in Asia.

Hydropower, which used to constitute almost 93% of the renewable energy share globally during 2000, witnessed a gradual decline to 86% in 2006 and further to 64% in 2014. Other renewable sources of energy that emerged during this period were solar and wind. The share of solar energy (PV and CSP), which was negligible in 2000, shot up from less than 1% in 2006 to 10% in 2014. During the same period, the share of wind energy increased from 2% in 2000 to 7% in 2006, and further trebled to 20% in 2014.

The solar energy installations during the last 10 years increased at a substantial pace, registering a CAGR of 48.6%, from 3.4 GW in 2004 to 179.6 GW in 2014. Europe exhibited a phenomenal growth in installation of solar – from 1 GW in 2004 to 91 GW in 2014. During the same time, Asia and North America also showed a significant interest in energy produced from the sun, as their solar capacities touched 60 GW and 22 GW by 2014, recording a CAGR of 47.6% and 39.5%, respectively. The other regions, namely, Oceania, Africa, Middle East, and LAC together accounted for 7 GW of solar capacities in 2014.

In terms of technology, solar photovoltaic (PV) has developed from a niche segment into a high growth market and is now moving into a position to become a game changer for the utility industry. The top 10 countries in terms of installed solar energy were at the vanguard of this dynamic growth, exhibiting significant increase in capacities over the last few years. Germany, China, Japan, USA, and Italy were amongst the major countries producing energy from solar technologies. India ranked tenth in the world with a share of 1.8% in global solar energy installed capacity.

The drivers towards harnessing solar energy are gradually changing. The historical drivers like direct incentives, renewable energy targets, and environmental concerns have resulted in a significant growth in solar installations in the last few years. However, going forward, this growth will largely be determined through other new drivers including falling costs of solar installations, global PV deployment, emergence of decentralized system, downstream innovation and expansion, greater concern about energy security, and supportive policy framework from the Governments across the globe.

International Solar Alliance: Overcoming the Challenges in Solar

The International Solar Alliance (ISA) is conceived as a coalition of solar resource rich countries, located between the Tropic of Cancer and the Tropic of Capricorn, to address their special energy needs and to provide a platform to collaborate on addressing the identified gaps through a common, agreed approach. Currently, there is no focused international agency in place to address the specific solar technology deployment needs of the solar resource rich countries.

The International Solar Alliance represents a conglomeration of a huge diversity in terms of access to electricity. An analysis of data for the 121 member countries of this Alliance reveals that only 23 countries had 100% of their population having access to electricity in 2012, while 54 countries had less than 66% of their population having access to electricity. The figure 66% has been considered as the benchmark given that it is the average percentage of population having access to electricity in the 121 ISA member countries.

These countries can potentially harness solar energy in a cost effective manner, if a concerted and coordinated effort is made to share the experiences from other similar countries and efforts are undertaken on finding solutions which are designed to be locally appropriate for difficult conditions, while still remaining affordable. Some of these countries have limited access to technologies and shortage of financial resources hampers large-scale deployment. A coalition of these countries for solar energy development and solar technology applications would help in addressing the special energy needs of these countries, and in the long run, reduce reliance on fossil fuels by increasing the share of solar energy in their energy mix.

Select Case Studies of Solar Projects

Globally, almost 17% of the world's population lack access to electricity. While energy demand is rapidly increasing, driven by economic growth and a growing population, the challenge is to provide electricity to all, especially providing access to those who live in remote pockets of the ISA member countries. In such a situation, decentralised renewable energy offers an ideal platform to leave behind fossil fuel based energy production and addresses some of the many challenges posed by climate change. The study highlights a few case studies of firms and institutions which have been able to reach out to provide solutions through access to solar energy either by designing mechanisms to create solar capacities, or finding innovative funding instruments. Interestingly, most of these have happened over the last few years and have been proven to be successful in achieving their objectives. These cases include OMC Power in India, Azuri Technologies in Africa, Gham Power in Nepal, Mosaic in USA, and the Agahozo solar park in Rwanda.

Solar Energy: A Funding Perspective

One of the major hurdles in reaping the potential of solar energy is the availability and cost of capital. The inability of obtaining funds by firms for solar energy projects at competitive costs have often been cited as a strong deterrent to investments in solar energy projects in many countries around the world, especially the developing and less developed economies. The main hurdle in investment in solar energy remains the high upfront costs, particularly for installing equipment.

To some extent, strengthening capacity building, promoting an enabling environment, developing suitable policy frameworks, and incentivizing demands for solar energy technologies can help in mitigating the steep transaction costs in underdeveloped economies. However, despite such initiatives, the up-front investment costs of solar energy projects may still remain higher than those of conventional technologies. Nevertheless, such initiatives if undertaken over prolonged periods of time, are likely to reduce the cost of investments in the solar energy sector.

Globally, a well-designed policy support mechanism including fiscal incentives by the Governments is equally crucial for the success of solar energy programs. Such mechanisms are required to help support shifting the investment paradigm of energy sector away from the undervalued investment costs of fossil fuels which generally do not factor in the economic and environmental costs associated with generating energy from fossil fuels. Given the barriers, innovative financing mechanisms can lead the way to increase the demand for investments in solar energy technologies, and generate a sustainable market for the deployment of the same.

However, it will not be out of place to assert that the success of the usage and the proliferation of solar energy technologies will only be possible through a two-pronged strategy – a sound financial support mechanism coupled with constructive policy initiatives which catalyses investments into the sector, both of which need to exist in tandem. These could include accelerated depreciation, production based incentives, mandated market share, grants, and investment incentives.

The International Solar Alliance: Forging Partnerships for Effective Implementation

The ISA as a platform would need to share the collective ambitions to reduce the cost of finance and technology that is needed to deploy solar power widely. This would require adapting generation and storage technologies to the individual countries' needs. Among the tasks that the Alliance could engage in is forging a strong and concerted partnership amongst the member countries within a predefined timeframe. The Study has categorised these partnerships under three broad mechanisms, namely financial cooperation, technological collaboration, and capacity building.

The Study has also made an effort to exploring various financing models that could be implemented towards securing a feasible solar financing mechanism. These may include active participation of multilateral and regional development banks along with developmental financial institutions and export credit agencies across the globe, where solar projects could either be financed alone or jointly through co-financing or parallel financing. Financial instruments like guarantee facilities and buyers' and suppliers' credit could be the means towards achieving them.

Technology cooperation is of paramount importance towards the proliferation of solar energy across the globe, in particular in the ISA member countries. There is also a felt need for the ISA as an institution to encourage the developed member countries to volunteer to provide the developing and less developed member countries with the necessary technology know how so as to equip them to harness energy from the sun on commercially sustainable basis. In an attempt to give a boost to new and innovative technologies in the field of solar energy applications and realize low cost operations, the ISA could promote joint R&D efforts in the field of solar energy. This could include facilitation in the development of new and renewable energy technologies, processes, materials, components, sub-systems, product and services at par with international specifications, standards and performance parameters.

As the ISA members are at different stages of economic development, their capacity to harness solar capabilities remains a challenge. Hence, capacity building becomes quite important. This can be achieved through exploring the possibility of setting up a corpus of fund with the contribution from member countries as also from non-member developed countries for whom climate change mitigation serves an important strategic objective (this could, inter alia, be used for providing guarantees for specific solar projects with a view to render them commercially bankable and for covering specific soft expenses for capacity building), mobilizing government support, encouraging decentralized solar capacity creation, exchanging best practices, and encouraging participation from private players.

Sum Up

After the IT boom in the 90's, the world is poised to witness the next round of euphoria in the solar energy technology arena. Climate change presents humanity with a significant challenge. At the same time, investments in clean energy and low carbon alternatives, presents business and capital with an opportunity, which may become one of the largest commercial opportunities of the current era.

Solar installations have increased phenomenally in the last couple of years. World solar PV installations have shot up from a mere 3.4 GW in 2004, to touch 179.6 GW as in 2014. This meteoric rise of solar installations is a testimony to the determination of countries across the continents, including the emerging and developing countries, to transform this need to have energy from solar to an opportunity for green investment.

Appropriate mechanisms need to be created to overcome the barriers at the early stage of solar project development, while simultaneously creating enhanced deal flow for later stage private and foreign institutional investors.

It is estimated that the newly-installed capacity from solar sources in the world as a whole could increase significantly in the next couple of years. This could be achieved through innovative financing and incentive mechanisms. Favourable policies are already in place in many countries, however, to maintain the upward trend in solar energy growth, policy efforts need to be taken up to a higher level. This is where the role of the ISA gains significance. The ISA has the potential to encourage massive scale up of solar technologies across the world through forging fruitful partnerships.

1. INTRODUCTION

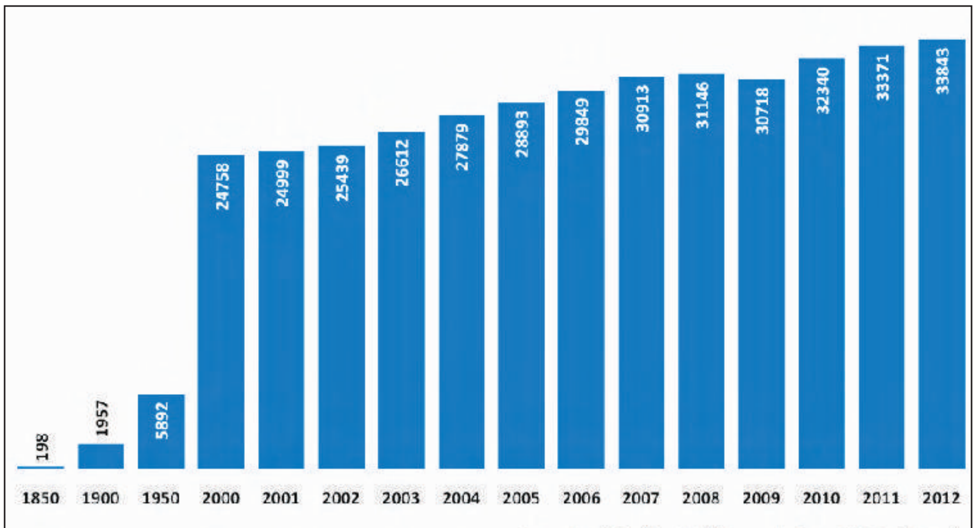
"We do not inherit the Earth from our ancestors, we borrow it from the generations to come"

Human-induced climate change, i.e., a change in the statistical properties of the climate system, when considered over a period of time – has today become a global phenomenon, not just confined to any particular country or region in its causes or consequences. Issues such as rising sea levels, drought and managing greenhouse gas (GHG) emissions have forced nations across the world to take proactive measures towards mitigating the causes of climate change. Coupled with these issues are the rising concern on energy prices and the fast depleting fossil fuel resources across the world.

As the world continues to take its chartered path towards sustainable development, growth and employment generation, to ameliorate the lives of millions of people, it becomes imperative to appreciate the looming ramifications of environmental degradation and ecological imbalances – best reflected in carbon emissions – caused by climate change. Of late, growth in emission has been directly linked to overall economic growth and this linkage is unlikely to be broken in the years to come. At the same time, it is increasingly being realized that climate change is unequivocal and therefore an international collective action is critical in driving an effective, efficient and equitable response to this challenge.

Energy and climate are inextricably linked with any change in energy sector activity, seemingly affecting the latter. The irony is that the energy so used is neither adequate to satiate the demands of the global populace nor is it helping the planet to remain healthy and inhabitable for future generations. Although, there is no single remedy to this issue, a series of measures could be undertaken by various stakeholders in addressing challenges arising out of climate change and thereby help in sustainable development[1].

Exhibit 1: Historical Trend of CO_2 Emission ($MtCO_2$) in the World: Increasing due to Enhanced Industrialisation



Source: Data derived from World Resource Institute; Exim Bank Research

One of the most critical measures of climate change mitigation is enhancing the usage of clean and renewable sources for meeting the ever increasing global energy demand. The situation gains even more significance in light of the exponential growth in the current and future demand for energy emanating from emerging countries to fuel their rapidly growing economies, most of which through mediums that release carbon-di-oxide.

[1] Sustainable Development basically meets the needs of the present without compromising the ability of the future generations to meet their own needs

Carbon-dioxide Emissions

Since the beginning of the industrial revolution, atmospheric concentrations of carbon dioxide have increased phenomenally which has resulted in an unprecedented adverse effect on climate. Besides carbon dioxide, there are other greenhouse gases like methane, nitrous oxide, etc. which are also contributing significantly to the heat-trapping capability of the earth's atmosphere.

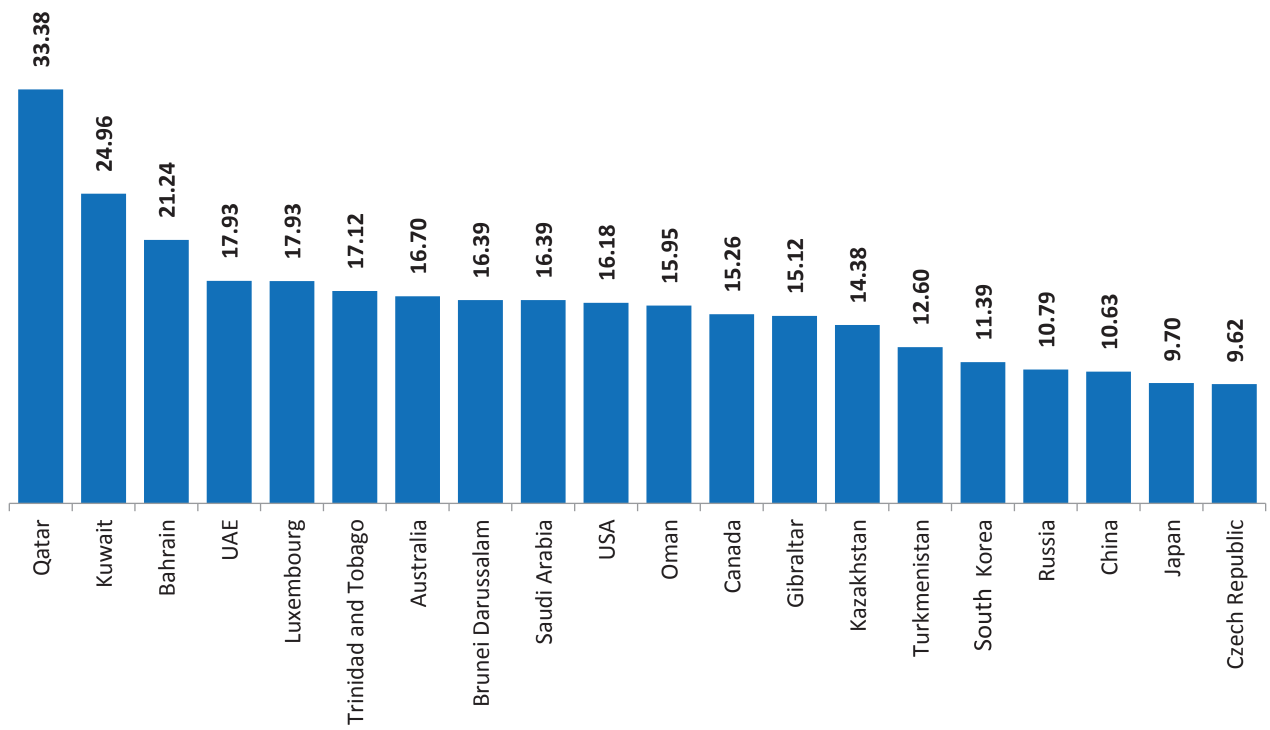
Scientists generally believe that the combustion of fossil fuels and other human activities are the primary reasons for the increased concentration of carbon dioxide. Plant respiration and the decomposition of organic matter release more than 10 times the CO_2 released by human activities. However, these releases have always been in balance with the carbon dioxide absorbed by plant photosynthesis. What has changed in the last few hundred years is the amount of additional carbon dioxide released by human activities. Increased agriculture, deforestation, landfills, industrial production, and mining have contributed a significant share of emissions. CO_2 emissions have increased consistently – from 25439 $MtCO_2$ (million metric tons of CO_2) in 2002 to 33843 $MtCO_2$ in 2012.

In terms of annual per capita emissions of CO_2 the oil producing countries have been leading the flock with 6 countries figuring in the top 10 during 2013. Qatar (33.38 MT/person), Kuwait (24.96 MT/person), Bahrain (21.24 MT/person), UAE and Luxembourg (17.93 MT/person), Trinidad & Tobago (17.12 MT/person), Australia (16.70 MT/person), Brunei (16.39 MT/person), Saudi Arabia (16.93 MT/person), and USA (16.18 MT/person were leading per capita CO_2 emitters. India, with a per capita CO_2 emission of 1.49 MT/person was ranked among the lowest.

Promoting Energy from Solar

Set against this backdrop, the progressive substitution of fossil fuels as primary sources of energy becomes a critical component of any noteworthy measure aimed at

Exhibit 2: Top 20 Per Capita Carbon-di-Oxide Emitters in the World (MT/Person) - 2013



Source: Data derived from IEA; Exim Bank Research climate change mitigation. This is especially relevant for developing and emerging countries whose energy needs are increasing rapidly in line with their strong economic growth. However, this renders the world being embroiled in the twin objectives of sustaining its economic growth (which can only be fuelled with increasing energy consumption) while simultaneously maintaining a low carbon emission environment.

In such an emerging scenario, it is paramount to explore and understand the various viable alternatives to conventional energy. This is all the more critical in light of the evolving energy transitions which are creating shifts in energy demand faster than ever expected, and as a result challenging the existing infrastructure and suppliers, and causing energy price volatility. This is further exacerbated by concerns over the possible longer-term supply constraints to conventional oil and gas and coal supplies, apart from the geographical distribution of these resources.

The panacea to all this is usage of renewable sources of energy including solar. Solar energy is a clean and, virtually an inexhaustible source of energy. Over the past decade, increasing awareness of climate change hazards and energy security considerations have forced the global community to focus on renewable energy sources.

Solar is one of the sources of reliable and accessible electricity. Once the solar infrastructure is installed, energy from it can be accessed for a longer duration with relatively less cost. For years solar has been a potential solution for millions who have limited access to electricity across the world, but high costs and slow development in technology have left it largely out of this reach. This however is changing – with increased investment, cheaper products and innovative business models, energy generation from solar is not only on the rise but could potentially transform the way the world is powered. As an added and perhaps more important benefit, is the rapid and sustainable development of solar energy applications, which is a key to accelerating solar energy's global march to achieving grid parity.

The solar industry is still young and the market opportunities are massive. Despite the significant potential and opportunity for solar energy development, and the geographic and socioeconomic advantages, there exists an anomaly amongst countries in harnessing solar power. This situation runs the risk of a "solar divide," where developing and less developed countries are not able to participate in the fruits of green growth that developed countries are pursuing, creating a paradoxical situation where the countries rich in solar resources are not in a position to harness their resources, while the countries with relatively less solar resources are in a position to do so.

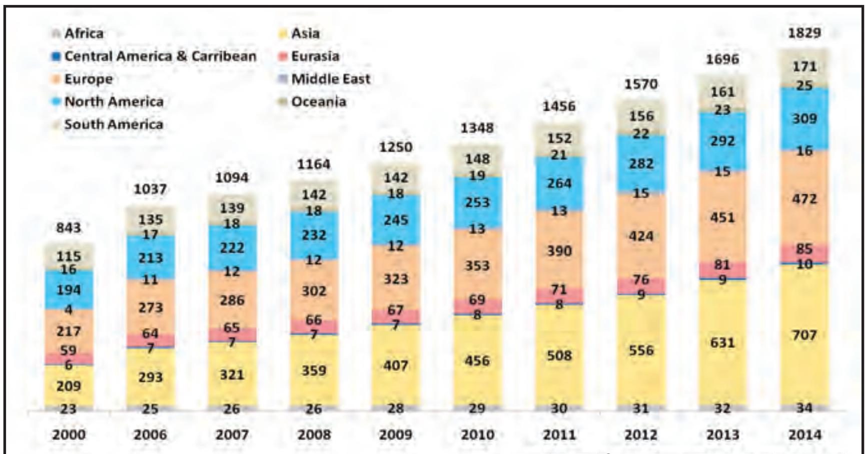
Taking cognizance of such an anomaly, the Government of India in partnership with select countries, including France, has conceived the International Solar Alliance as a coalition of 121 solar resource rich countries lying within the Tropics of Cancer and Capricorn with the objective of harnessing the solar energy that these countries are endowed with. This paper discusses the possible strategies which this alliance could consider in capturing the true potential of solar energy in these countries. A number of organizations across the world have already identified solar power as the solution for enhancing access to electricity at affordable cost for the benefit of the wider population at large. This has also catalyzed a new breed of solar energy entrepreneurs (or solar-preneurs), which will augment access to power while simultaneously generating sustainable revenues.

2. GLOBAL SOLAR ENERGY SECTOR: AN INSIGHT

SOLAR CAPACITY

Global renewable energy capacity has increased significantly since the turn of the 21st century. The total renewable energy produced from all sources increased from 843 GW in 2000 to 1829 GW in 2014 – registering a compounded annual growth rate (CAGR) of 5.7% during the period. Asia, with a fairly modest base, witnessed one of the fastest growths, recording a CAGR of 9% as its renewable capacity increased from 209 GW to 707 GW between 2000 and 2014. Europe, which had the highest installed renewable capacity of 217 GW during the turn of the century, came second in 2014 with addition of 472 GW as compared to 707 GW in Asia (Exhibit 3).

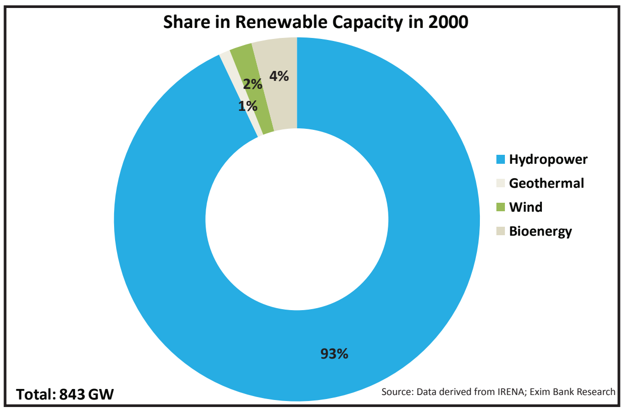
Exhibit 3: Cumulative Renewable Capacity Trend Regionwise (in GW)

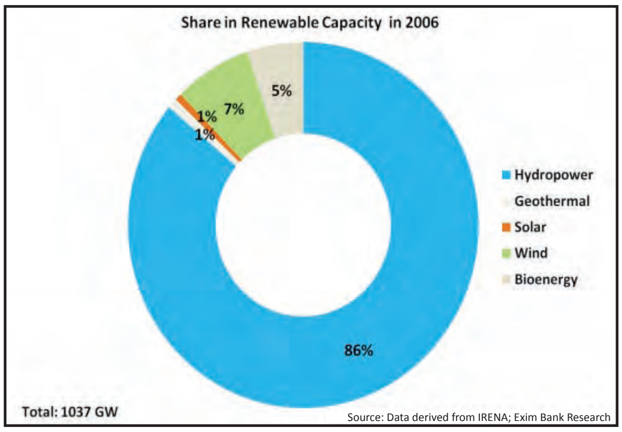


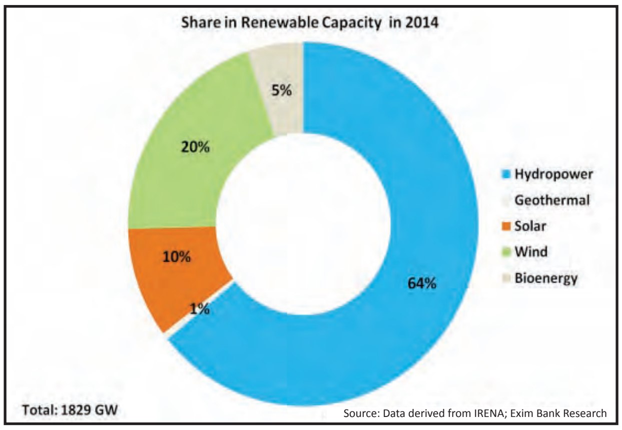
Source: Data derived from IRENA; Exim Bank Research

Hydropower, which used to constitute almost 93% of the renewable's share globally during 2000, witnessed a gradual decline to 86% in 2006 and further to 64% in 2014. Other renewable sources of energy that emerged during this period were solar and wind. The share of solar energy (PV and CSP), which was negligible in 2000, shot up from less than 1% in 2006 to 10% in 2014 (Exhibit 4).

Exhibit 4: Increasing Share of Solar in Renewable Energy



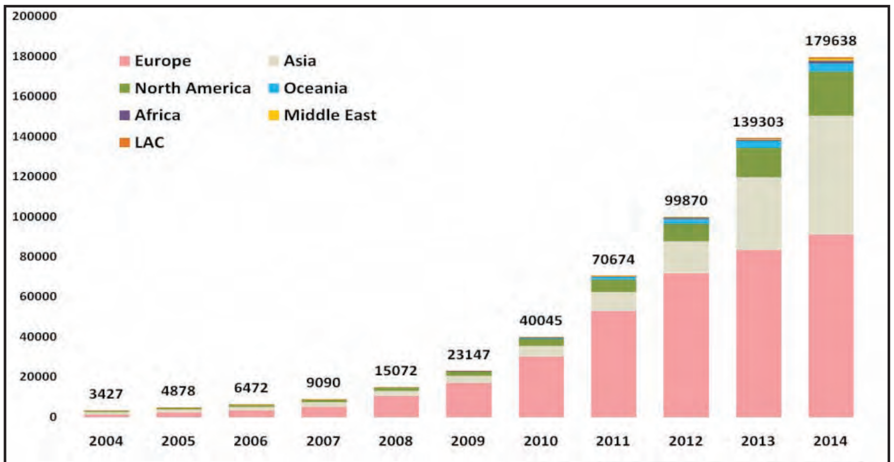




During the same period, the share of wind energy increased from 2% in 2000 to 7% in 2006, and further trebled to 20% in 2014.

The solar energy installations during the last 10 years increased at a substantial pace, registering a CAGR of 48.6%, from 3.4 GW in 2004 to 179.6 GW in 2014. Europe exhibited a phenomenal growth in installation of solar – from 1 GW in 2004 to 91 GW in 2014. During the same time, Asia and North America also showed a significant interest in energy produced from solar, as their solar capacities touched 60 GW and 22 GW by 2014, recording a CAGR of 47.6% and 39.5%, respectively. The other regions, namely, Oceania, Africa, Middle East, and LAC together accounted for 7 GW solar capacities in 2014 (Exhibit 5).

Exhibit 5: Cumulative Solar Capacity Trend Regionwise (in MW)



Source: Data derived from IRENA; Exim Bank Research

In terms of technology, solar photovoltaic (PV) has witnessed significant developments over the last decade and has emerged as the main technology anchoring solar energy installations. In just 10 years, solar PV has developed from a niche segment into a high growth market and is now moving into a position to become a game changer for the utility industry. The top 10 countries in terms of installed solar energy were at the vanguard of the dynamic growth, exhibiting significant increase in capacities over the last few years (Details in Annexure 1).

Germany, which ranked 3rd in 2000 with an installed solar capacity of 114 MW, moved up to the first position in 2014, with its capacity touching 38238 MW. China, which was at a nascent stage in solar installation at the turn of the century, with just 19 MW, catapulted itself to the second position with 28061 MW solar capacity in 2014, ahead of countries like Japan (23300 MW in 2014), and USA (19921 MW in 2014). Italy and Spain, which also witnessed rapid increase in solar energy capacities, touched 18811 MW and 7022 MW, respectively in 2014. India too has made phenomenal progress from having almost negligible solar installed capacity in 2000 to becoming the 10th largest by 2014, with its capacity touching 3290 MW (a share of 1.8% of the total world solar energy capacities).

Table 1: Top 10 Countries producing Solar

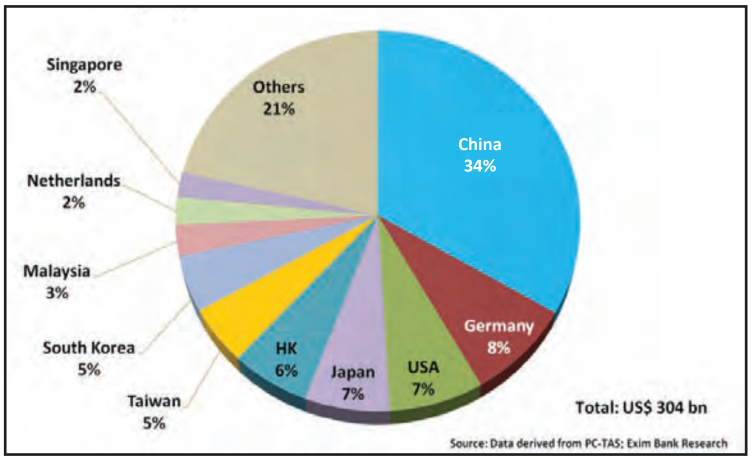
		2000			2006			2014	
Rank		Share %	In MW		Share %	In MW		Share %	In MW
1	USA	48.6	595	Germany	44.8	2899	Germany	21.3	38238
2	Japan	26.9	330	Japan	26.4	1708	China	15.6	28061
3	Germany	9.3	114	USA	17.0	1099	Japan	13.0	23300
4	Australia	2.0	25	Spain	2.8	180	USA	11.1	19921
5	China	1.6	19	China	1.2	80	Italy	10.5	18811
6	Italy	1.6	19	Australia	0.9	61	Spain	3.9	7022
7	Switzerland	1.3	16	Netherlands	0.8	52	France	3.1	5600
8	Mexico	1.1	14	Italy	0.7	45	United Kingdom	2.9	5228
9	Netherlands	1.1	13	Austria	0.6	36	Australia	2.3	4139
10	Spain	1.0	12	South Korea	0.6	36	India	1.8	3290
	Total		**1225**	**Total**		**6472**	**Total**		**179638**

Source: IRENA; Exim Bank Research

INTERNATIONAL TRADE IN PHOTOVOLTAIC

The products considered to be related to PV trade are primarily of multiple use items with the exception of photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels and light-emitting diodes (HS 854140). If all such multiple use products are included, then global exports amounted to US$ 304.9 bn in 2013, with a compounded average growth of 10.7% during the period 2009 and 2013.

Exhibit 6: Key Exporters of Solar PV Products in the World - 2013



The major exporters includes China (US$ 103.4 bn), Germany (US$ 24.3 bn), USA (US$ 21.3 bn), Japan (US$ 20.2 bn), and Hong Kong (US$ 18.2 bn) Exhibit 6). Amongst the top 10 exporters in the world, Malaysia exhibited the fastest growth registering a CAGR of 39.4% during the 2009-2013 period. Following Malaysia was

Table 2: Global Exports of Photovoltaic and Related Goods (US$ mn)

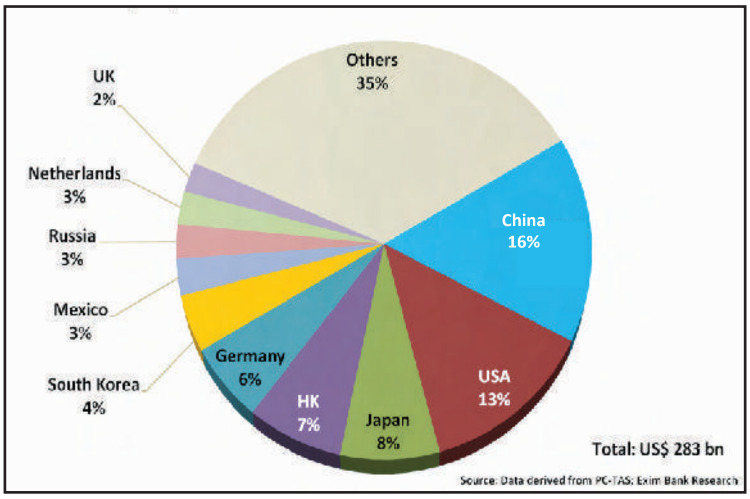
HS Code	Product Name	2009	2010	2011	2012	2013	CAGR (%)	Share in 2013 (%)
850440	Static Converters	63807	87737	98805	98979	103716	12.9	34.0
854140	Photosensitive semi conduct device, photovoltaic cells & light emit diodes	76900	144898	149985	108833	99825	6.7	32.7
711590	Articles of precious metal or of metal clad with precious metal nes	4782	5919	15852	38825	30707	59.2	10.1
900190	Prisms, mirrors & other optical elements of any material, unmounted, nes	11346	15449	16060	17926	16515	9.8	5.4
841989	Machinery, plant/laboratory equip for treat of mat by change of temp nes	14601	13753	15380	16019	15675	1.8	5.1
841990	Parts of machinery, plant and equipment of heading No 84.19	11024	10894	12691	13315	13458	5.1	4.4
850239	Electric generating sets	8059	8154	8567	11362	8416	1.1	2.8
900290	Lenses, prisms, mirrors and other optical elements, mounted, nes	2469	3769	4265	3939	4666	17.2	1.5
841919	Instantaneous or storage water heaters, non-electric, nes	3556	3527	3681	3642	3646	0.6	1.2
700992	Glass mirrors, framed	1305	1826	2138	2404	2614	19.0	0.9
732290	Air heaters, hot air distributors, iron or steel & identifiable parts, nes	1939	2016	2350	2285	2369	5.1	0.8
700991	Glass mirrors, unframed	1369	1550	1903	1799	1841	7.7	0.6
900580	Monoculars, other optical telescopes, astronomical inst & mountings, nes	709	894	814	818	820	3.7	0.3
830630	Photograph, picture, or similar frames and mirrors of base metal	626	649	731	703	583	-1.8	0.2
Total		**202492**	**301035**	**333222**	**320849**	**304851**	**10.8**	**100.0**

Source: UN COMTRADE Database, Exim Bank Research

China which recorded a CAGR of 30% during the same period.

As far as India is concerned, it was ranked the 27th largest country in terms of exports of PV and related goods in 2013. While India's exports amounted to US$ 2.1 bn in 2009 it reduced to US$ 1.7 bn in 2013. However, the encouraging point to note is that while exports may have declined, more of the production in the country is being consumed locally as solar installations have been picking up in the country, following the renewed vigour of the Government's policies towards this sector.

Exhibit 7: Key Importers of Solar PV Products in the World - 2013



The key single-use item identified for solar energy is Static converters (PV panels/ modules HS-850440). Global exports of this product amounted to US$ 10.37 bn in 2013, recording a CAGR of 12.9% during the period 2009-13.

China and USA together accounted for close to one-third (29%) of the world imports of PV panels/modules in 2013 (Exhibit 7). In the case of China, imports of PV panels/ modules recorded a CAGR of 12.1%, increasing from US$ 28 bn in 2008 to US$ 45 bn in 2013. USA on the other hand has experienced an CAGR in imports to the tune of 11.2% during the same period as imports touched US$ 37.5 bn in 2013 from US$ 24.5 bn in 2009.

Static converters and photosensitive semiconductor device, photovoltaic cells & light emit diodes together constituted more than 71% of the total imports of PV and related items. Both these items also exhibited significant growths in terms of CAGR during the period 2009 and 2013 – at 15.3% and 10.2%, respectively.

Table 3: Key Importers of Static Converters (HS-850440)

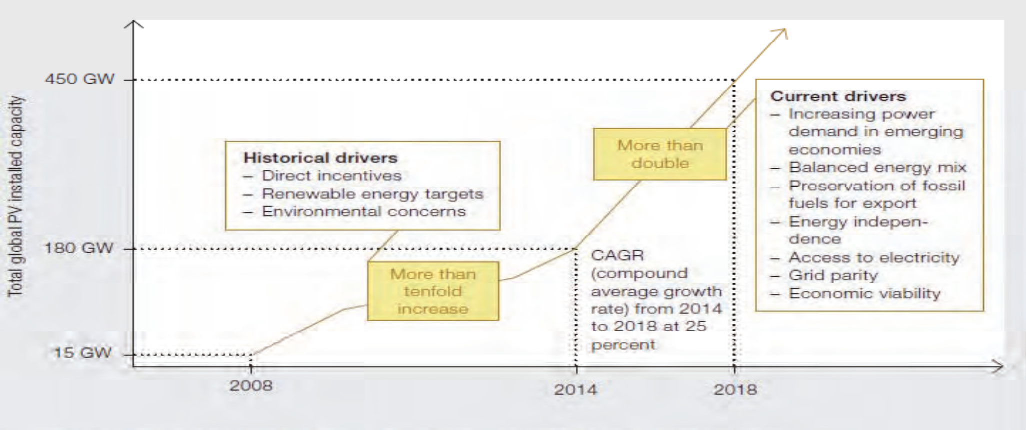
	Import Value (US$ Mn)					CAGR	Share in Imports
	2009	2010	2011	2012	2013	2009-13	2013*
USA	10846	13959	15285	16137	16994	11.9	16.6
China	9378	13144	15453	12533	14993	12.4	14.7
Hong Kong	5757	9280	9873	9794	9925	14.6	9.7
Germany	4904	6678	6766	6412	6200	6.0	6.1
Japan	3005	3668	4223	4267	4357	9.7	4.3
Mexico	2367	3005	3127	3286	3477	10.1	3.4
Netherlands	1777	2476	2993	2906	3162	15.5	3.1
KOREA REP.	2150	2690	2707	2930	2952	8.2	2.9
France	1885	2988	3211	2789	2834	10.7	2.8
UK	1595	2056	2816	2237	2414	10.9	2.4
Total Above	**66827**	**91450**	**103143**	**98094**	**102303**	**11.2**	**100.0**
Total Solar Products	**202492**	**301035**	**333222**	**320849**	**304851**	**10.8**	

*share in total imports of Static Converters (HS-850440)
Source: UN COMTRADE Database, Exim Bank Research

KEY DRIVERS OF HARNESSING ENERGY FROM SOLAR

The drivers for harnessing solar energy are gradually changing. As is evident from Exhibit 8, the historical drivers like direct incentives, renewable energy targets, and environmental concerns have resulted in a significant growth in solar installations in the last few years. However, going forward this growth will largely be determined through other new drivers including power demand, grid parity, amongst others.

Exhibit 8: Evolving Drives of Solar Energy

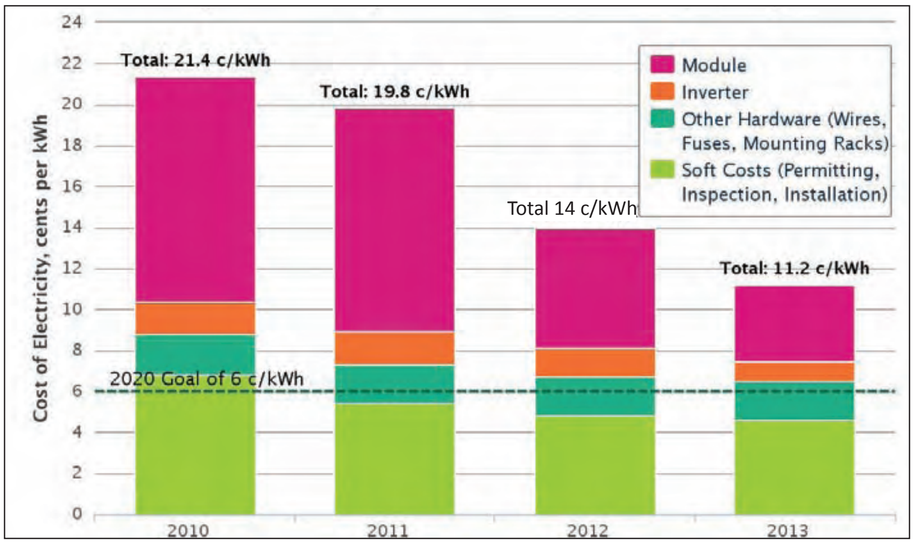


Source: IEA, Bloomberg New Energy Finance, European PV Industry Association; Exim Bank Research

Falling costs: The rapid decline in the cost of solar PV over the last 10 years is largely because of the agreement of countries to support the deployment of solar PV, working in combination with the rapid technological advancement towards manufacturing more efficient solar panels. Utility-scale solar PV projects are expected to gradually have lower installed costs than for wind in some markets and have lower installed costs than for coal-fired power stations in virtually all OECD countries. In some countries, solar is on the cusp of economic feasibility, so each incremental decline in prices opens up the market to new potential customers and makes solar more competitive with the other alternative, whether it is retail electricity or new combined-cycle natural gas plants.

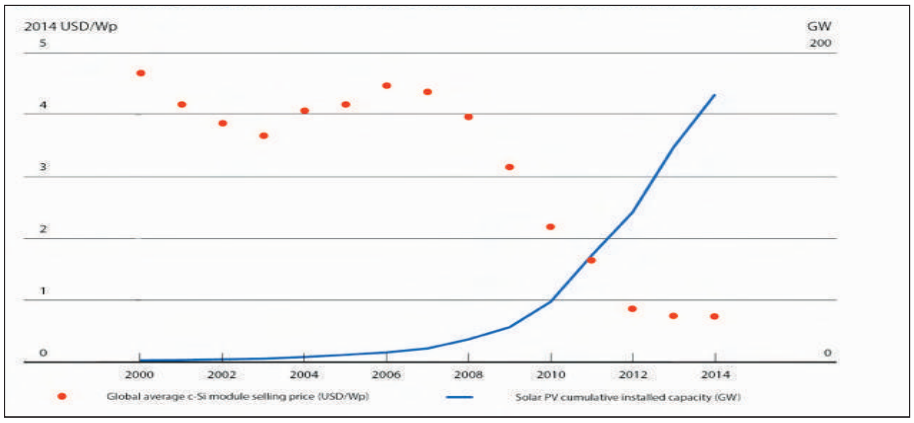
It may be noted that USA has conceptualised a 'SunShot Initiative' which provides an in-depth assessment of the potential for solar technologies to meet a significant share of electricity demand in the United States during the next several decades. The 'SunShot Initiative' aims to reduce the total installed cost of solar energy systems to US$ 0.06 per kilowatt-hour (kWh) by 2020. Since SunShot's launch in 2011, the average price per kWh of a utility-scale photovoltaic (PV) project has dropped from about US$ 0.19 to US$ 0.11 (Exhibit 9).

Exhibit 9: The Falling Price of Utility-Scale Solar Photovoltaic (PV) Projects



Source: US Departmentof Energy

Exhibit 10: Cumulative Global Solar Photovoltaic Development and Solar Photovoltaic Module Prices, 2000 to 2014



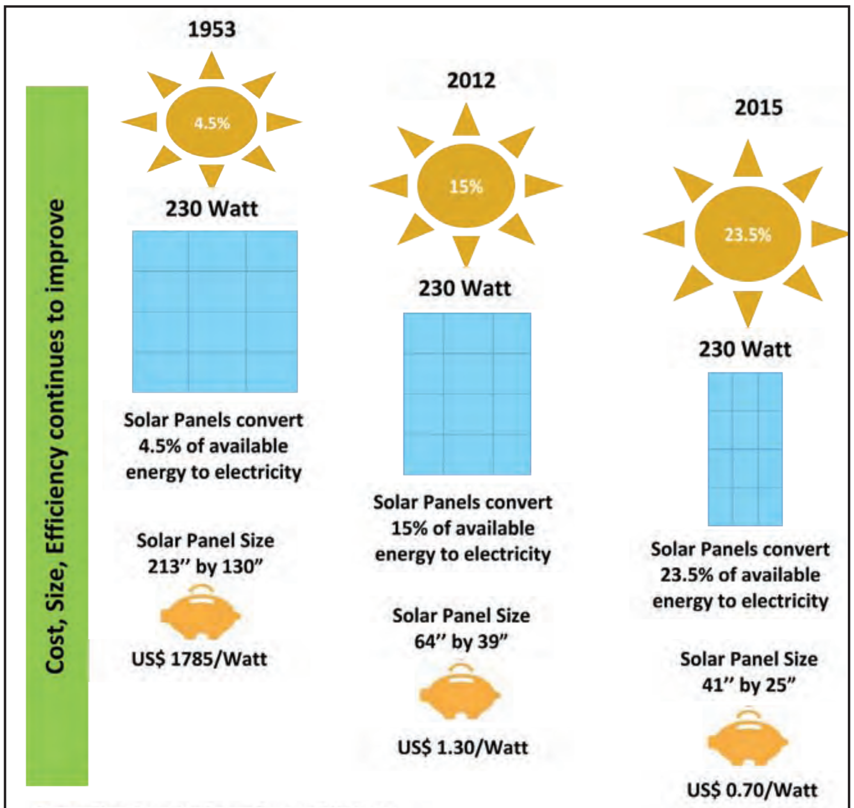
Source: IRENA; pvXchange; Exim Bank Research

Cumulative Global PV Deployment and Solar PV Module Prices:

As the number of installed solar PV panels has grown, the price of solar panels has come down. Prices for panel modules have dropped from around US$ 100 per Watt peak (Wp) in 1975 to below US$ 0.60/Wp in 2014 (Exhibit 10). In addition, the efficiency of solar panels have increased while their size continues to decline – a 230 Watt solar panel in 1953 with a size of 213"by 130" had an efficiency of 4.5% (i.e. could convert 4.5% of available energy to electricity) as against an efficiency of 23.5% in 2015 on a comparatively smaller panel size of 41"by 25". The cost of producing energy from solar rays too has declined significantly from US$ 1785/Watt in 1953 to US$ 0.70/Watt in 2015 (Exhibit 11).

As per a study by the United Nations Environment Programme, a record 39 GW of solar PV capacity was constructed in 2013 at a lesser cost than the construction of 31 GW capacity in the year 2012. On the other hand, the IEA estimates that the cost of solar panels has come down by a factor of five in the past six years, between 2008 and 2014 and the cost of full PV systems, which include other electronics and wiring, by a factor of three.

Exhibit 11: Improving Efficiency of Solar Panels



Source: Bloomberg New Energy Finance; Exim Bank Research

The levelised cost of electricity (LCOE) – the total cost of installing a renewable-energy system divided by its expected energy output over its lifetime – of solar PV has also come down, reaching US$ 119-318/MWh for utility-scale systems and US$ 135-539/MWh for residential application. The LCOE ranges are large due to the significant differences in irradiation, import levies on modules, and the differences in installation costs between countries and their chosen weighted cost of capital. Rapid advancements in technology is leading to higher module efficiencies coupled with lower module / inverter costs and increasingly competitive structures in most markets pave the way for lower LCOEs going forward. Penetration rates of solar electricity are also set to surge with such a clear trend of declining LCOE. The continued decline of LCOE will eventually increase the robustness of grid parity in the residential segment, as well as in utility-scale solar PV, which will be able to compete with wholesale prices in more countries around the world. As a result of the low system prices, grid parity has already been reached in many countries, including in the residential applications in Germany, Spain and Italy, where the price of solar PV compares well with the regular retail price, including transport costs and taxes.

Table 4: Projected Levelized Cost of Electricity of Solar PV (US$/MWH)

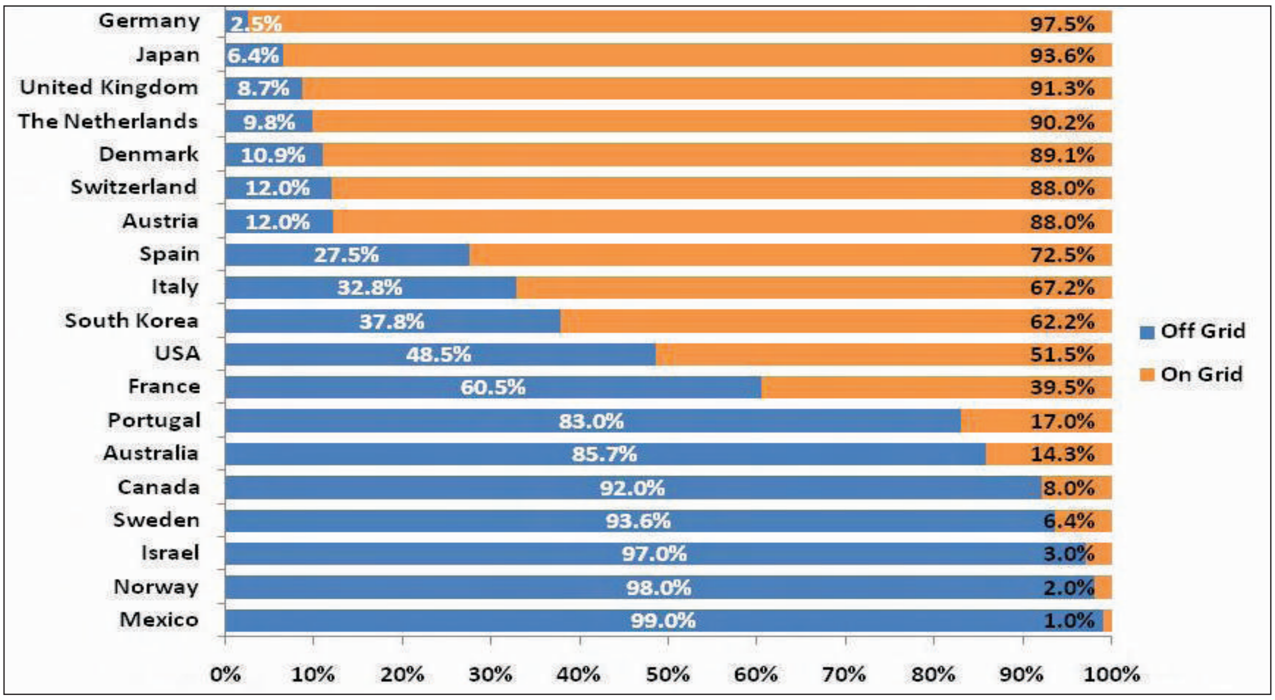
	Utility-scale	Rooftop
2020	96-250	108-422
2030	56-139	63-231
2040	45-109	51-180
2050	42-97	45-159

Source: IEA; Exim Bank Research

Emergence of decentralized system: The centralized system, which was once a major growth industry, is increasingly being complemented by the expanding decentralized system. This trend is especially positive as it will maximize the likelihood of gradual restoration of many of those isolated population who are not connected to the grid. This will help to position the economy with low-cost energy, facilitate the transition towards expanded use of renewable energy, and preserve a larger and economically more valuable role for the centralized system. Grid connections in developing countries are scarce and unreliable, and improving them would take far too long, especially in remote rural areas where the poorest live. Most of Africa's best prospects for sustainable economic growth would be for a cheap energy future emanating from a decentralised model.

In fact, a decentralized system would be requiring less land than a utility-scale renewable project, experience less distance-related transmission losses (as it serves only a local customer or area), and provides electricity like a traditional grid connection. For developing and less developed countries, providing and maintaining energy access is an important driver for off-grid renewable energy systems. An estimated 1.16 billion people (17% of the world's population) currently live without access to electricity[2]. Off-grid renewable energy systems are in many cases the most economical solution for regions which are either isolated or where it is costly to have a grid in place. Off-grid solar systems can be cheaper than extending power lines in certain remote areas.

Exhibit 12: Share of Off Grid and On Grid in Select Countries



Source: www.greenrhinoenergy.com

[2] IRENA

Many of the developed countries in Europe such as Norway, Sweden, Portugal and France have a substantial share of their electricity generated through solar consumed off grid. For countries like Mexico, almost the entire electricity generated from solar is off-grid. This data may not allude to any direct co-relation between the stage of development of an economy vis-à-vis the application of PV being either grid or off-grid. However, off-grid PV applications are likely to expand significantly in countries with vast expanses and less reliable national grid such as India.

Downstream innovation and expansion: The first market for solar PV cells was spacecraft, which used the cells to extend the lifespan of satellites beyond the limits of batteries. In the following decades, companies expanded the application of solar to provide power in remote locations such as offshore oil and gas rigs or lighthouses. The establishment of federal laboratory facilities and R&D programs in the 1970s and 1980s helped in bringing solar energy technologies to the scale at which it is today. During the last decade, innumerable organizations and companies have been involved in financing and installation of solar PV projects around the world.

At the same time as the cost of solar has been falling, solar companies have created new and better ways to make solar available and attractive to more customers. In the residential market, the advent of financial solutions including power-purchase agreements (PPAs), leases and increasingly concessional loans has opened up a wide swath of demand that previously did not exist. In the commercial market, developers standardize their contracts to streamline financing, and now offer energy storage as an add-on to maximize solar's benefits by reducing demand charges. The more solar PV and other technologies gain ground, traditional generation capacities face the risk of being accessed only in peak demand times.

Concerns about energy security: Energy is the engine for growth and its access is of strategic importance to every country. Energy multiplies human labour and increases productivity in agriculture, industry and services. Thus, easier, cost-effective and sustainable access to energy in the developing world holds the key to bridging the widening inequality prevalent in such economies. While the conventional sources of energy (oil, coal and natural gas) are currently easier in terms of access, primarily due to associated infrastructure designed for their conversion to usable forms, the same cannot be said of either their sustainability over medium and long-term or their cost-effectiveness. Over the past few years, oil prices have fluctuated immensely, from a record high in July 2008 of around US$ 145 per barrel to about US$ 31 per barrel (February 2016). While the price is not expected to reach the previous high any time sooner, but the uncertainty always remains over the medium to long term.

The IEA defines energy security as "the uninterrupted physical availability at a price which is affordable, while respecting environment concerns". However, security of energy supply is not only influenced by the cost of fuels but also by their long term physical availability. Countries without their own fossil fuel supplies have begun to evince increasing interest in renewable energy sources, not only because of the price stability they bring but also because they are indigenous and locally produced. Thus, the adoption and promotion of renewable energy technology becomes critical for ensuring energy security. This is buttressed by the fact that the economics of renewables are expected to improve further as they develop technically, and as their saving of greenhouse gas emissions are assigned a monetary value. As far as developing and less developed countries are concerned, energy security today has become a matter of prime concern, especially in light of the fact that countries like India import more than three-fourths of their crude oil requirements. Given that renewable energy options are cost-effective compared to traditional measures in the longer term and on a lifecycle cost basis, coupled with their proven sustainability over longer periods, the adoption of renewable sources of energy is bound to shoot up if countries are to ensure energy security.

Supportive policy framework from the Government: Governments across the globe have been supporting the efforts towards deriving energy from solar. The success of such an initiative is very aptly reflected in Europe, where most of the countries in the continent have come forth to support solar energy. These support, across the globe, are through various concessions and incentives provided on producing solar energy, such as through feed-in-tariffs, and renewable purchase obligations, amongst others. Many countries understanding the issues of feeding electricity through the grid, have also been promoting off-grid solar electricity generation through roof top installations. This initiative helps in consuming the electricity as and where it is produced. A supportive policy framework from the Government also facilitates in equipping the private sector to play a greater role in the solar energy sector.

3. INTERNATIONAL SOLAR ALLIANCE: OVERCOMING CHALLENGES IN SOLAR

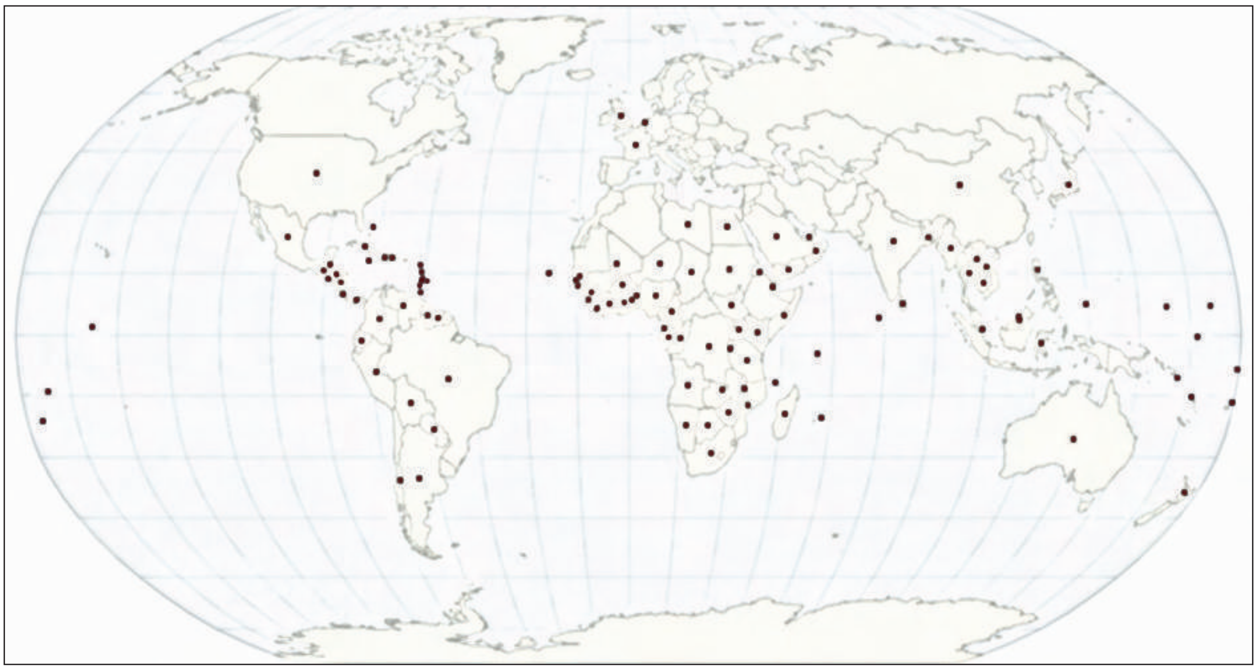
International Solar Alliance (ISA) is conceived as a coalition of solar resource rich countries to address their special energy needs and to provide a platform to collaborate on addressing the identified gaps through a common, agreed approach. There is no specific body in place to address the specific solar technology deployment needs of the solar resource rich countries located between the Tropic of Cancer and the Tropic of Capricorn.

Most of these countries are geographically located for optimal absorption of the sun's rays. There is a great amount of sunlight year-round which can lead to cost effective solar power and other end uses with high insolation of almost 300 sunny days in a year. However, the availability of a rich and freely available source of energy is not enough to ensure the development of solar projects. Though there are indeed high levels of irradiation in all the identified countries, the potential remains largely untapped. One of the structural problems is that some countries lack a clear renewable energy policy, and in addition strong policy alignment. Most of these countries have large agrarian populations. Many countries face gaps in the potential solar energy manufacturing eco-system. Absence of universal energy access, energy equity and affordability are homogenous issues common to most of the solar resource rich countries lying between the two Tropics.

INTERNATIONAL SOLAR ALLIANCE COUNTRIES

These countries can potentially harness solar energy in a cost effective manner, if a concerted and coordinated effort is made to share experiences from other similar countries concentrating on finding solutions which are designed to be locally appropriate for difficult conditions, while still remaining affordable. Some of these countries lack access to technologies and shortage of financial resources hampers large-scale deployment. A coalition of

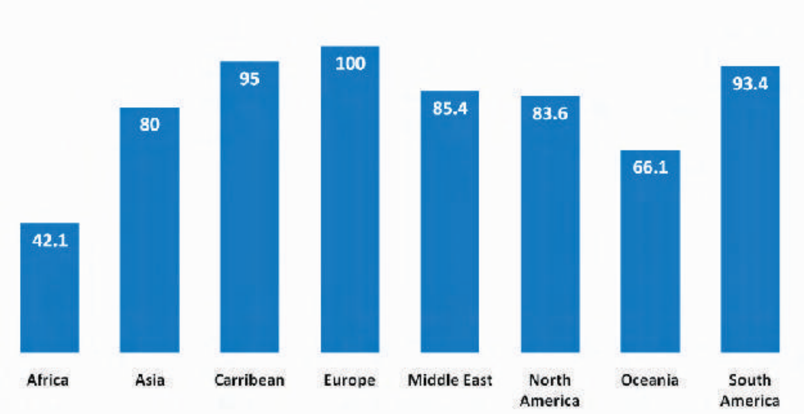
Exhibit 13: International Solar Alliance



Source: Exim Bank Research

these countries for solar energy development and solar technology applications would help in addressing special energy needs of these countries, and in the long run, reduce reliance on fossil fuels by increasing the share of solar energy in their energy mix.

Exhibit 14: Access to Electricity Regionwise in ISA (in percent)



Source: Data derived from WDI; Exim Bank Research

The International Solar Alliance also represents a conglomeration of a huge diversity in terms of access to electricity. An analysis of data for the 121 member countries of this Alliance reveals that only 23 countries had 100% percent of their population having access to electricity in 2012, while 54 countries had less than 66% of their population having access to electricity. The figure 66% has been considered as the benchmark given that it is the average percentage of population having access to electricity in the 121 ISA member countries.

An analysis shows that 40 of the 50 ISA member countries in Africa have less than 66% of the electricity, thereby reflecting chronic electricity deficit. African economies may be booming, but continued growth and quality of life are being jeopardized by lack of reliable power. In the Sub-Saharan region, the growing needs are immense, especially in the commercial and industrial sphere. The estimated energy demand in this segment is expected to touch 1100 TW/h by 2040 from less than 500 TW/h currently.[4] At the same time, the region finds itself in dire need of upgrading the existing energy infrastructure, as thermal plants have failed to operate to full potential due to long overdue maintenance. This calls for further regional push for upgrading the grid and utilities. The International Energy Agency (IEA) estimates that about 585 million people in Sub-Saharan Africa lack access to electricity, with the electrification rate as low as 14.2% in rural areas. Low water levels undermine the large hydropower resources in the region, mainly in Zimbabwe and Zambia which faces power deficits on account of low rainfall. The problem is most acute in East Africa, where only 23% of Kenyans;

Table 5: Access to Electricity (percent of total population)

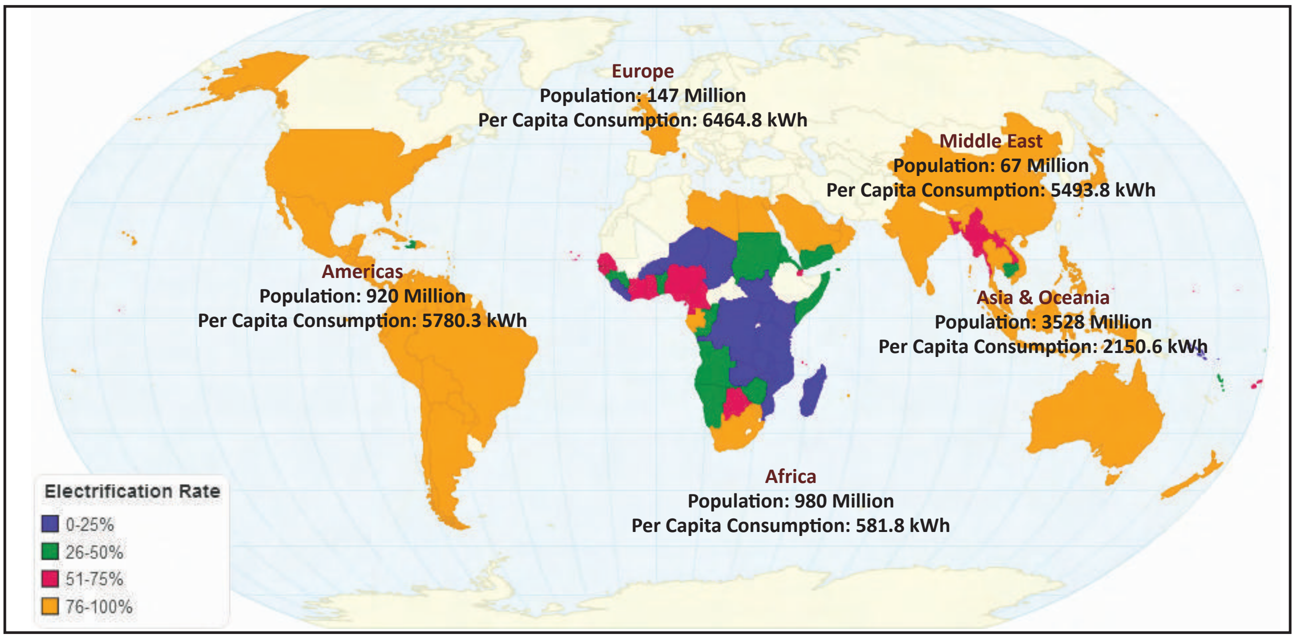
Region of the World	Average	Number of ISA Countries	
		100% access	< 66% access
Africa	42.1 (50)	5	40
Asia	80 (18)	6	5
Caribbean	95 (7)	1	0
Europe	100 (3)	3	0
Middle East	85.4 (4)	0	1
North America	83.6 (7)	1	1
Oceania*	66.1 (11)	3	7
South America	93.4 (19)	4	0

Figures in parenthesis shows the number of ISA countries in the region

* Data for Nauru and New Guinea is not available

Source: Data derived from World Development Indicators, World Bank; Exim Bank Research

Exhibit 15: Electrification in ISA countries: Africa demonstrates Huge Potential for Solar Energy



Data represented are for only ISA countries; latest data available is for the year 2012
Source: Data derived from World Development Indicators; Exim Bank Research

18% of Rwandans; and 15.3% of Tanzanians have access to electricity supply. On the other hand, while access to electricity in countries like Botswana is at 53%, energy production primarily comes from coal and oil, which remains a cause of concern from the sustainability angle. Further, the situation in countries like South Sudan, Chad, Burundi, Liberia, and Malawi leaves much to be desired with the share of population having access to electricity being in single digits.

Situation in the 18 ISA member countries of Asia is relatively better with an average electricity access to the population being 80%. At the same time, it may be noted that the region encompasses extremely diverse countries with vast differences in their levels and patterns of energy consumption and production, differing regulatory frameworks and market dynamics, as also the level of economic development. Furthermore, the rapid economic and demographic changes in the region present a range of opportunities and challenges for energy production and consumption. However, Asia is better placed and endowed with significant solar energy generation potential for both large-scale grid and off-grid applications, unlike in Africa where grid connectivity is not so robust. According to the IEA, Southeast Asia's energy demand alone is expected to rise by 80% by 2040, as the economies in this region grow multifold. However, like in Africa, there are countries in Asia where access to electricity remains a challenge. Countries like Bangladesh, Fiji, Myanmar, and Cambodia have more than one-third of their population without access to electricity.

As nations worldwide continue the search for alternate energy options, traditionally oil-rich Gulf states have started looking up to their other abundant resource coming from sun. The Middle East Solar Industry Association (MESIA) has predicted that the region will tender as much as 2,020 megawatts (MW) of solar energy projects in 2016. While the ISA member countries in the Middle East are well placed in terms of access to electricity, Yemen is an exception with access to electricity being just 48.4%.

In the Oceania region, Australia and New Zealand are blessed with 100% access to electricity, although the average electricity access in the region is pegged at 66.1%. This is largely due to the small island countries in the region – Vanuatu, Tuvalu, Kiribati, Marshall Islands, Micronesia and Palau having at least one third of their population without access to electricity.

The Americas including South and North, and the Caribbean region have significant access to electricity for their population. At the same time, the European ISA members have near 100% access.

Such diversities in the countries notwithstanding, there is one common binding factor – the availability of sun as a source of energy. This provides ample opportunities for many ISA countries which are bereft of electricity to undergo a 'Leapfrog Effect' through technology transfers, which will be an important factor in global development and emergent markets in an era facing serious climate change. The end result, or product, is autonomous from all the preceding stages which generally involve the traditional process of substitution of fossil generated energy. As cleaner methods of energy production are made available, new technologies are developed. On the contrary, the less developing nations need not follow the same path, but instead could just leapfrog over coal-fired to the cleaner technologies like solar.

CHALLENGES IN SOLAR IN ISA COUNTRIES

Constraints in transmission and distribution to grids

The IEA cites grid accessibility and integration issues as challenges that may prevent solar PV technology from achieving its objective of achieving 11% of global electricity production by 2050. The distributed and remote nature of renewable projects limits their coverage through existing transmission grids. Most ISA member countries are hesitant to deploy limited funds to transmission development for such renewable projects of relatively lesser scale (i.e., those generating energy intermittently). Simultaneously, transmission losses can be crippling for solar developers, as the net available energy for sale will be lower. Thus, there is a need to develop an internationally agreed upon set of codes and standards for connecting solar (and other remote location and intermittent renewable energy) projects. Development in smart grid and storage technologies is expected to lead to increased deployment of a variety of solar power generation technologies amongst the ISA member countries.

High costs and insufficient budgetary resources

The steep up-front cost of solar projects, and high borrowing costs, is stalling solar energy growth, especially in developing countries. The high cost of solar technologies during the transition stage (i.e. before the costs become competitive in comparison to alternate, but polluting, power generation technologies) means that in most cases, they have to be supported through a combination of public funds and user levies, the quantum of which are usually limited by government budget constraints and customer affordability. In this regard, the large-scale participation of ISA member countries in solar energy development is the key to a rapid reduction in solar power generation costs and unsubsidized supply.

Lack of appropriate financing mechanisms

The availability and cost of long-term debt remain one of the biggest challenges for solar energy project developers in the region. Long-term loans for non-recourse financing are generally available in emerging markets where there is a directly subsidized FIT (feed-in-tariff), strong power purchase agreement regime, creditworthy borrower, and clear regulatory signals. Without such an enabling environment, the cost of debt increases, and the available tenor decreases. Loan tenors for renewable energy projects in emerging economies vary typically between 10 and 12 years (sometimes up to 18 years from export credit agencies under arrangements facilitated by OECD), while solar projects have a life of 25 years. Moreover, the risk perception of financiers is distorted due to the very few project (cash flow) based financing of solar projects in the region, high dependence on government subsidies, lack of exposure to solar power generation projects among financiers in the region, and inadequate data on insolation levels. These factors get reflected in the prevailing high interest rates for debt. Financing solutions are needed to catalyze solar energy development within the ISA member countries so that solar energy investments are facilitated even under such adverse circumstances.

Constraints in institutional capacity

Although some developing countries, such as China, India, and Thailand, have formulated policy and regulatory frameworks for the promotion of solar energy, many ISA member countries lack the institutional capacity to design and develop these frameworks, thereby creating a demand pull for solar energy. Weak institutional capacity of government is viewed as risky by investors hesitant to commit to projects that rely exclusively on support mechanisms that are not well developed, have shorter durations, or are likely to change over time. Generally, the lack of strategic capacity-building and training activities, and parallel research and development programs, are key obstacles to stimulating catalytic solar energy development in many of the ISA member countries. The spread of knowledge and good practices on the various issues and aspects of solar energy will be helpful in enhancing and strengthening the sector in the ISA member countries.

Inadequate coordination of Knowledge Management activities

Most countries pursuing solar energy development often set targets for, and offer projects on, public–private partnerships without adequate project preparatory measures, and with insufficient data on solar insolation and climate conditions that influence the output of solar power generation. Thus, information and perception gaps persist in the minds of investors, manufacturers, suppliers, and financiers, who play a major role in implementing solar energy development policy. Further, the absence of a comprehensive knowledge-sharing mechanism exclusively for solar energy and stable grid development in the region accentuates this gap by limiting the dissemination of lessons learnt and best practices to local stakeholders, policy makers, and project developers.

DEVISING A STRATEGY THROUGH A 'ISA CO-OPERATION MATRIX'

The 121 ISA member countries are in different stages of economic development, and hence their propensity to adapt to solar technologies remains varied.

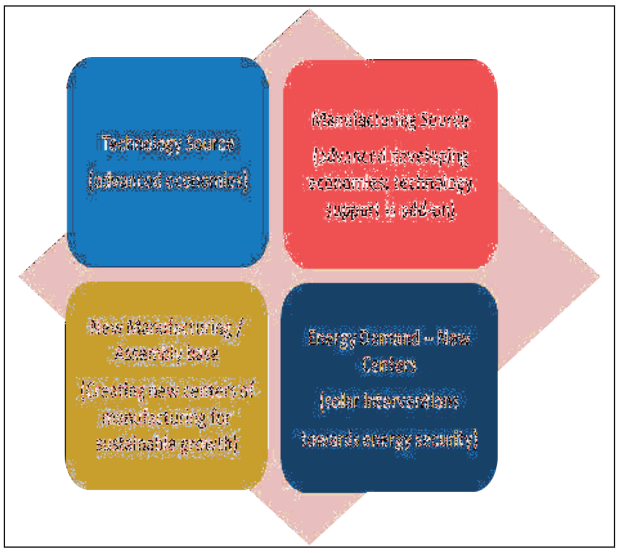
Taking cognizance of this heterogeneous nature, a 'ISA Cooperation Matrix' for the ISA members can be designed. The Matrix envisages classification of countries so as to work in tandem with each other in achieving the objectives of ISA, by drawing upon each other's strengths.

The matrix can be divided into four quadrants. The first quadrant comprises the technologically sound advanced countries which are at the upper end of technology and are continuously undertaking R&D activities to bring out more efficient and effective means to tap energy from solar rays. This is largely so because innovation is costly and risky and hence most innovation activities are concentrated in a few advanced countries.

The second quadrant focuses on the manufacturing of solar equipments where emerging countries have made significant progress. These are the countries which have the capability to produce solar equipment and cater not only to their domestic demand but also to exports. These countries also have been making significant progress in terms of technology adoption.

The third quadrant envisages the potential of many ISA member countries that are at the lower end of the value chain. These ISA countries are essentially the new

Exhibit 16: ISA Cooperation Matrix



Source : Exim Bank Research

Table 6: An Indicative List of Countries in the ISA Cooperation Matrix

TECHNOLOGY SOURCE	MANUFACTURING SOURCE
France, Japan, Netherlands, USA, Singapore, etc.	China, India, South Africa, Brazil, etc.
NEW MANUFACTURING/ASSEMBLY BASE	**ENERGY DEMAND – NEW CENTERS***
Ghana, Namibia, Zambia, Ethiopia, Indonesia, Vietnam, Malaysia, etc.	Ghana, Guinea-Bissau, Sao Tome & Principle, Bangladesh, Marshall Islands, Palau, Fiji, Kiribati, Micronesia, Senegal, Cote d'Ivoire, Nigeria, Cameroon, Djibouti, Botswana, Myanmar, Yemen, Namibia, Tuvalu, Congo, Timor Liste, Zimbabwe, Benin, Haiti, Angola, Eritrea, Gambia, Somalia, Sudan, Togo, Cambodia, Vanuatu, Ethiopia, Guinea, Mali, Kenya, Solomon Islands, Zambia, Mauritania, Mozambique, Uganda, Rwanda, Congo DR, Madagascar, Tanzania, Niger, Sierra Leone, Burkina Faso, CAR, Malawi, Liberia, Burundi, Chad, South Sudan

* less than 66% of the population in these ISA countries have access to reliable electricity (as in 2012)
Source: Exim Bank Research

manufacturing and assembly centers. With the growth in demand and increasing manufacturing capabilities these centers are expected to move up the value chain.

The last quadrant is significant in the ISA Matrix, given its capability to cater to the huge and growing energy demand. These countries are those that are either deprived of electricity and are mostly less developed countries, or are those where there is a huge requirement for alternative sources of energy to plug the existing energy deficit. Such characteristics are typically evident in developing member countries of ISA.

Africa's Potential in Solar

Africa's economy is growing at a healthy pace. One of the core challenges that the African countries face while continuing to grow and develop is meeting the rising demand for power, transport and other uses in a way that is economically sustainable and safeguards livelihoods, by cutting down on carbon emissions. This has created an opportunity for exploring renewable energy in Africa, particularly solar, as the region is extremely well endowed with sunshine.

According to the International Energy Agency, with more than 85% of the population living in rural areas lacking access to reliable electricity, sub-Saharan Africa will require more than US$ 30 billion in investment to achieve universal electricity by 2030. . Overall, an estimated 70% of people in Sub-Saharan Africa are without reliable access to electricity. In Gabon and Nigeria for example, manufacturing struggles as electricity remains expensive with inconsistent availability. According to the African Development Bank (AfDB), manufacturers in sub-Saharan Africa experience an average of 56 days of shutdown time per year due to power outages.

While the problem remains daunting to solve, there is a silver lining as solar costs comes down and become more prevalent and accessible on the continent. Africa is often denoted as the "Sun Continent" as the continent receives many more hours of bright sunshine during the course of the year than any other continent of the Earth. The distribution of solar resources across Africa is fairly even, with more than 85% of the continent's landscape receiving atleast 2000 kWh/m2year.

It is significant to note that a person in Europe or North America uses 110000 Kwh/year on average (much it through industrial processes), while a person in Sub-Saharan Africa uses only 137 Kwh – less than a typical American refrigerator uses in 4 months.

Energy access and infrastructure are fundamental to eliminating poverty and improving people's lives. With increased investment, cheaper products and innovative business models, solar technology is anticipated to transform the way the continent is powered. Solar energy is likely to boost economic activity as businesses stay open late and students are able to study after dark.

Building an electric grid and having centralized power remains untenable for much of Africa, while decentralized power availability through inexpensive solar lanterns, solar home systems, or micro and mini grids has the potential to illuminate thousands of households in the continent – especially those who live in remote clusters.

The cumulative installed capacity of solar energy was 1402 MW at the end of 2014, more than 28 times larger than in 2005 (51 MW), with South Africa leading this rapid growth, adding nearly 775 MW alone between 2013 and 2014, and Kenya having seen sizable investments in solar PV, with 60 MW installed by 2014. Some of the countries in Africa have also adopted voluntary solar targets - Burundi [40MW PV by 2020], Egypt [700 MW by 2020 PV; 2.8 GW CSP by 2027], Swaziland [20% of all public buildings installed with solar water heaters], Mozambique [2GW of solar capacity and installation of 82000 PV systems and 100000 solar heaters].

Mirroring rapid reduction of PV costs worldwide, which fell by 46% from 2012 to 2015, the levelised costs of electricity (LCOE)[3] of best practices for African utility-scale projects, has also rapidly fallen. According to IRENA, LCOE for African solar PV utility projects in 2013 and 2014 ranged between US$ 0.13 and US$ 0.26 per/kWH.

While the lowest cost for utility scale PV in South Africa is below US$ 0.075 per kWh, which is among the most competitive PV projects, the average is US$ 0.112 per kWh. This gap between the best practice and cost range in Africa suggests further cost reduction potential of installed solar penetrating into the African countries.

[3]LCOE is often cited as a convenient summary measure of the overall competiveness of different generating technologies. It represents the per-kilowatthour cost (in real dollars) of building and operating a generating plant over an assumed financial life and duty cycle. Key inputs to calculating LCOE include capital costs, fuel costs, fixed and variable operations and maintenance (O&M) costs, financing costs, and an assumed utilization rate for each plant type.[3] The importance of the factors varies among the technologies. For technologies such as solar and wind generation that have no fuel costs and relatively small variable O&M costs, LCOE changes in rough proportion to the estimated capital cost of generation capacity. For technologies with significant fuel cost, both fuel cost and overnight cost estimates significantly affect LCOE. The availability of various incentives, including state or federal tax credits, can also impact the calculation of LCOE. As with any projection, there is uncertainty about all of these factors and their values can vary regionally and across time as technologies evolve and fuel prices change

4. SELECT CASE STUDIES OF SOLAR PROJECTS

Globally, almost 17% of the world's population lack access to electricity. While energy demand is rapidly increasing, driven by economic growth and a growing population, the challenge is to provide electricity to all, especially providing access to those who live in remote pockets in the ISA member countries, especially those in Africa and South Asia. In such a situation, decentralised renewable energy offers an ideal platform to leave behind fossil fuel based energy production and address some of the many challenges posed by climate change.

At the same time there are the digitally financed off-grid solar models that are increasingly transitioning from pilot scale to a diverse and substantial sub-sector of the global off-grid energy market. These business models are mostly digitally-financed or 'pay as you go' (PAYG) off-grid energy . Varied combinations of energy systems with connected hardware and software are currently being explored in a diverse set of regional markets throughout the developing world. The diversity of business models and technologies provides a rich opportunity for learning best practices in customer acquisition, portfolio structure, loan product design, etc. Some of the common models that are described as 'DESCO' - distributed energy service companies that provide a given level of energy service in exchange for ongoing payments. Others are better described as asset finance or microloan providers, with a transfer of asset ownership to the user after a limited payment period.

This chapter highlights select off grid case studies which have shown promising results and render themselves amenable for replication and upscaling. This is where an institution likes ISA, which is as diverse as 121 countries, could come and forge cross-border partnerships by facilitating collaboration and technology transfer.

Case Study 1: OMC Power, India

Hardoi district in the Indian state of Uttar Pradesh highlights an interesting trend. In the un-electrified areas of the district, most of the electricity needs were being earlier fulfilled by diesel generators as the power cuts were all too frequent. But this has changed since Omnigrid Micropower Company (OMC) set up a solar power plant in Jangaon village in Hardoi district, a couple of years ago.

With packages ranging from Rs. 110 a month for powering a 7 watt LED light and a mobile charging socket with 24X7 supplies, the company tries to address the needs of all strata of the society. This has reduced the cost spent by businesspersons on electricity drastically, and enabled the students to use their computer labs, which hitherto remained largely unused owing to want of reliable electricity supply. At the busy village crossing, nearly 40 shops selling a variety of fruits, medicines, snacks and sweets have lights powered by the OMC grid. Prior to the installation, most of these shops had to shut early. By being able to serve their customers even late in the evening, their business has increased significantly.

Taking inspiration from its first project, OMC now has replicated its solar project in 70 other villages of Uttar Pradesh. Each plant has a capacity between 27 KW and 100 KW with a mini grid network of about 1 to 5 km long. The capacity of any plant is determined by prior assessment of demand. The solar plants are set up on a relatively small area of less than 1000 square metres with the land being taken on a long-term lease (typically 20 years) from the land-owners (who are mostly farmers). Given the modular design of its solar project, any additional spike in demand in future can be addressed by installing more solar panels at the project site. A typical solar project of OMC takes about three months from concept to commissioning. OMC has entered into power purchase agreements with telecom companies, setting up their plants near the telecom towers to provide them uninterrupted solar power with a claimed 99.9% uptime. Because of this reliability, these telecom towers now no longer have to invest and maintain diesel generators (which not only add to air pollution but also have a running cost of purchasing diesel) or hire people to run them.

The company runs on an 'ABC' business model that is found to be sustainable and scalable. A stands for the anchor load which are the telecom towers, B denotes the micro and small enterprises ranging from petrol pumps, irrigation pumps, mills, banks, hospitals, schools and countless rural micro entrepreneurs. C is the community (rural households), a majority of whom are below the poverty line. Through smart grids and highly segmented offerings for illumination, mobile charging, entertainment and cooling, OMC has been serving the rural customers at highly affordable prices. Product packages have been designed for each segment in the village. Smart metering allows OMC to prefix loads and timings. The community pays for the subscription in advance. Rs. 110 a month gives them two 7-watt LED light and a mobile charging socket, for 6 hours a day at a time of their convenience. There is an additional Rs. 50 to be paid as a onetime charge initially for installing the sockets, etc.

OMC is planning to double its capacity from 2.5 megawatt to 5 megawatt, making it one of the largest solar mini grid operators in the State.

The best part of OMC's story is that they have achieved so much till date without any debt in their account. More importantly, OMC had not relied on any government support in the form of subsidies for its initial success. This is a critical factor considering that most of the member countries of ISA where this model can be replicated, have budgetary constraints which could potentially act as a bottleneck for any solar project to succeed.

Case Study 2: Azuri Technologies, Africa

Azuri is transforming the prohibitive upfront cost of renewable energy into a pay-as-you-go model by combining mobile and solar technology. They call it Indigo technology. After paying a small one-time installation fee for the solar home system, the user then purchases a scratch card, or uses an integrated mobile money service to top-up their unit. This top-up costs up to 50% less than their current weekly budget on kerosene and phone charging. Users are able to avoid the normally large up-front costs of solar systems and instead pay for them over one-week or four-week activation. Customers can charge their mobile phone and have 8 hours of lighting per day typically at US$ 1.50 a week.

The smallest system starts at three watts, and a single payment is enough to charge a mobile phone and light two rooms for eight hours a day for one week. Some of the scratch card fee goes to paying off the system. Once the system is paid off, the customer can upgrade to a larger system, eventually purchasing the largest 80-watt system, which can run four lights and multiple appliances. The dealers are responsible for installing the systems, selling scratch cards, and providing after-sales service in their local area, working to Azuri specifications. Online records are kept for all sales and scratch card activations, so that both Azuri and the local dealer can track the progress.

Dealers sell scratch cards directly to customers, but also work through local resellers so that all customers have easy access to top-up facilities. After 80 payments, users can pay a fee of about US$ 5 to have their system permanently unlocked, and can use renewable energy at no further cost.

According to UNFCC, while 85% of Azuri customers used kerosene lamps prior to installing the solar home system, only 17% still use kerosene now. Across its operations, Azuri calculates that its systems have provided 28.5 million hours of clean light and 9.5 million hours of emission-free mobile phone charging. This equates to 3,504 metric tons of CO2 emissions avoided in 2013.

This technology has benefitted tens of thousands of units in 11 countries across Sub-Saharan Africa, in Tanzania, Kenya, Ethiopia, Uganda, Sierra Leone, Malawi, Zimbabwe, South Africa, Rwanda, Togo, and Ghana. The scratch card payment system works well, and payments are lower than the cost of the kerosene and phone charging that the Indigo unit replaces. Reducing the use of kerosene lamps cuts the damage to health from air pollution. Mobile phones are widespread in Sub-Saharan countries like Kenya, and off-grid households spend both money and time to keep their phones charged. Phone charging with an Indigo system at home is useful, and avoids the cost and time of taking a phone or phone battery to a charging shop. The Azuri distribution chain contributes to the local economy through income and employment, not just for dealers and installation technicians, but also for scratch card sellers.

Case Study 3: Gham Power, Nepal

Gham Power, started in Nepal in 2010, installs and provides support for solar micro-grid systems which curb diesel use and reduce the overall cost of self-generated electricity. The company provides complete solar project development, EPC and O&M services to businesses, rural communities and residences. Gham Power installed PV systems are found at urban factories, rural communities/ organizations, and many small businesses and households in Nepal.

Gham Power operates a microgrid model that focuses on helping businesses manage their power costs by replacing part of the diesel use with solar. This model targets companies with large diesel generators that struggle to manage backup power costs and are often forced to shut down. Gham's technology involves adding a smart solar PV system and a battery bank to an existing generator. The design of the hybrid grid is done by the engineers of Gham Power in Nepal. This system helps businesses secure some of their power needs through solar energy, and cuts fuel consumption by 30-60%. Gham Power has also developed a pipeline of business micro-grid projects ready to be funded which includes organizations like hospitals, banks, hotels, and factories that are incurring huge costs in running their diesel generators.

The micro-grids provide centralised power for local 'anchor' businesses to power appliances for productive end-use. Once the significant amount of anchor load is determined, the system is then extended. This way, Gham Power achieves individual system size large enough to sustain a dedicated local team to own and operate the micro-grid as an independent business or cooperative. The projects require local community investors to invest at least 10% of the system installation cost and raise the remaining capital through a mix of Gham Power investment, outside equity partners, debt and any applicable subsidy or grants. However, at the core of the business model developed by Gham Power there is a holding company which receives funds from local and international investors. The holding company acts as the investor and becomes the legal owner of the PV systems installed. Gham power is in charge to identify project, develop the system design, obtain permits, prepare contracts, construction of systems, and O&M of the system after commissioning.

The electricity consumers (businesses, village communities) are usually offered a lease-to-own model where they have the option to purchase the system for a nominal amount at the end of the lease term. The lease period is usually 10-years and runs parallel to a bank loan from Nepal's Clean Energy Development Bank (CEDB) which is the financing partner of Gham Power. CEDB finances maximum 70% of project cost, and the remaining 30% has to be provided by the holding company. The physical infrastructure is accepted as collateral. The lease payments are paid to the holding company which pays the interest of the bank loan, and pays Gham Power one-time fees for project development, and EPC services. For O&M, Gham Power is paid recurrent fees on an annual basis. Additional revenues can be created by selling carbon credits.

Case Study 4: Mosaic, USA

Mosaic has developed a unique crowd funding model to support and popularise solar projects in the USA.

Mosaic is one of the first platforms where people can directly invest in tangible projects. Projects are listed on Mosaic's website 'www.joinmosaic.com'. Interested people can create an account which allows them to browse through a list of investment projects. Each project is described in a Prospectus that is prepared in accordance with the Securities and Exchange Commission's disclosure requirements and contains all the important details. Once the projects are operational and generate revenues, the investors are paid back their capital over a certain period, plus interest. The minimum investment is US$ 25. The project sizes range from less than 50kW to more than 1MW.

The company functions like a virtual renewable energy bank, soliciting investments for solar projects and making loans to be paid back, typically, over about 10 years. Mosaic takes an upfront fee of 2% to 3% of the loan they offer and charge an annual fee of 1% on the principal of the investment, which means that if a loan is offered for 7%, the actual interest rate would be 6% net of fees.

The solar projects funded typically consist of rooftop or ground-mounted installations that either generate on-site electric power for small businesses or other organizations, or generate power for sale to an electric utility, or other "off-taker."

Mosaic provides the loans to Special Purpose Entities (SPEs), controlled by local developers. The SPEs are the formal owners of the solar power infrastructure. An SPE typically repays the loan primarily out of cash flow generated by the sale of electricity to the solar customer or off-taker and, in many cases, the sale of Solar Renewable Energy Certificates (SRECs) to local utilities or other purchasers. The loans are secured by the assets of the project owned by the SPE as well its contractual rights with respect to the sale of electricity or SRECs. The 'roof provider' has the option to buy out the SPE at the end of the lease agreement and thus, own and operate the infrastructure as long as the system lasts.

In addition to the commercial projects, Mosaic has recently launched 'Home Solar Loans' for residential roof top projects. Mosaic believes that the lease model with third party ownership will soon be passé and that residential customers prefer a loan model with personal ownership. To make such loans attractive, Mosaic offers zero down payments and a repayment period of 20 years.

Case Study 5: Solar Park, Rwanda

The Agahozo solar park in Rwanda set up in 2014 produces up to 8.5 MW of electricity, which is nearly 7% of the electricity produced. The government has signed a power purchase agreement to pay for that electricity for the next 25 years.

Agaahozo solar park has more than 28,000 solar panels and was built at a cost of US$ 23.7 mn. In its first year it produced an estimated 15 million kilowatt hours, sending power to a substation 9 km away.

The project brought together an international consortium of financing partners. Debt was provided by FMO (Netherlands Development Finance Company) and the London-based EAIF (Emerging Africa Infrastructure Fund); mezzanine debt provided by Norfund (The Norwegian Investment Fund for Developing Countries); equity from Scatec Solar ASA (who also served as EPC contractor and serves as O&M provider), Norfund and KLP Norfund Investments (a vehicle jointly owned by KLP, the largest pension fund in Norway, and Norfund). Grants were received from the United States Government via OPIC's ACEF (Africa Clean Energy Finance) grant and from Finland's EEP (Energy and Environment Partnership).

The solar power plant is having a strong positive social impact on the Rwandan people. The supply of clean electricity generated is sufficient to power approximately 15,000-18,000 additional households. Further, the number of households provided with electricity could multiply significantly if the country's electrification rate were to increase due to improvements and expansions over time in the transmission and distribution grid.

The project significantly reduces the amount of time and money that women and children must spend trying to gather fuels, allowing for more time to be spent on capacity building activities such as education, work or vocational training. It is estimated that the total time savings could range from US$ 10.95 - 13.29 million hours per year, and that there could be between US$ 834,000 - US$ 1.79 million of additional income or equivalent economic value per year due to the reallocation of time.

The project also increases economic empowerment of women and other disadvantaged or disenfranchised groups through the participation in and implementation of the project. Local engineers and technicians continue to benefit from training programs being implemented to teach them how to properly manage the solar field. Children benefit considerably from additional and enhanced reliability of electricity, allowing them to allocate more time to studious activities. It is estimated that there could be increased school performance for 35,550-43,100 school students. Furthermore, the orphanages in the Agahozo-Shalom Youth Village (ASYV)[4] benefits from the increased access to renewable energy services, and receives a steady flow of rental income from the land lease that contributes to the long-term sustainability of the orphan village and benefits its health and education programs.

[4]The Agahozo-Shalom Youth Village (ASYV) is a residential community in rural Rwanda. Its 144 acres are home to youth who were orphaned during and after the genocide in 1994. The Village is designed to care for, protect and nurture these young people. It is a place of hope, where "tears are dried" (signified by the Kinyarwanda word agahozo). Within Agahozo-Shalom's supportive and structured community, the rhythm of life is being restored, with the ultimate goal of equipping young people who have lived through great trauma to become healthy, self-sufficient, and engaged in the rebuilding of their nation.Having a solar field built into its farm has created a steady flow of rental income for the ASYV, increasing its sustainability and benefiting its health and education programs. Additionally, the 500 students at ASYV will have access to education in engineering and solar PV technology.

Case Study 6: M-Kopa, Africa

M-Kopa Solar is the market leader in pay-as-you-go energy for off-grid customers in Kenya. Since its commercial launch in 2012, M-Kopa has connected more than 300,000 homes in Kenya, Tanzania and Uganda to solar power, and is now adding over 500 new homes each day.

The home solar system features a battery, light bulb, phone charging facility and chargeable radio. Customers make a US$ 34 deposit, and pay off the balance over a 12-month period in daily usage credits of about US$ 0.50. Payments are made via mobile money. The company can process payments, monitor the system's functionality and tackle problems through its proprietary, patented technology platform called M-Kopanet. After one year, customers own the system outright and no longer have to make daily payments. GSM sensors in the equipment allow M-KOPA to regulate usage based on payments received. If a customer stops paying and runs out of credit, the system ceases to function.

An amalgamation of innovative technology, an effective rural distribution system, a compelling value proposition, and a strong emphasis on customer care has made M-Kopa a success. Mobile money technology combined with the latest solar systems have fuelled the rapid expansion and enabled the company to leapfrog east Africa's inadequate infrastructure. The company has raised about US$ 30m in equity and US$ 25m in committed debt. They also intend to expand the sales team to 3,000 people and increase production, most of which is done in China, to 10,000 units a week. M-KOPA hopes to introduce more products as its strive to expand its offering beyond solar energy. M-KOPA plans to reach over 1 million homes by end of 2017– or 4,500 new customers a week. The company is looking beyond its three current markets, having taken on a licensing partner in Ghana that is helping it assess whether a model of selling through other agents works.

5. SOLAR ENERGY: A FUNDING PERSPECTIVE

One of the major hurdles in exploiting the potential of solar energy is the availability and cost of capital. The inability of obtaining funds by firms for solar energy projects at competitive costs have often been cited as a strong deterrent to investments in solar energy projects in many countries around the world, especially developing and less developed economies. The main hurdle in investment in solar energy remains the high up-front costs, particularly for installing equipment.

To some extent, strengthening capacity building, promoting an enabling environment, developing suitable policy frameworks, and incentivizing demands for solar energy technologies can help in mitigating the steep transaction costs in underdeveloped economies. However, despite such initiatives, the up-front investment costs of solar energy projects may still remain higher than those of conventional technologies. Nevertheless, such initiatives if undertaken over prolonged period of time, are expected to reduce the cost of investments in the solar energy sector.

Globally, a well-designed policy support mechanism, including fiscal incentives by the Governments has been found to be crucial for the success of solar energy programs. Such mechanisms are required to help support shifting the investment paradigm of energy sector away from the undervalued investment costs of fossil fuels which typically do not factor in the economic and environmental costs associated with generating energy from fossil fuels. Given the barriers, innovative finance mechanisms can lead the way to increase the demand for investments in solar energy technologies, and generate a sustainable market for the deployment of the same.

However, it will not be out of place to assert that the success of the usage and the proliferation of solar energy technologies will only be possible through a two-pronged strategy – a sound financial support mechanism coupled with constructive policy initiatives which catalyses investments into the sector, both of which need to exist in tandem.

FINANCIAL SUPPORT MECHANISM

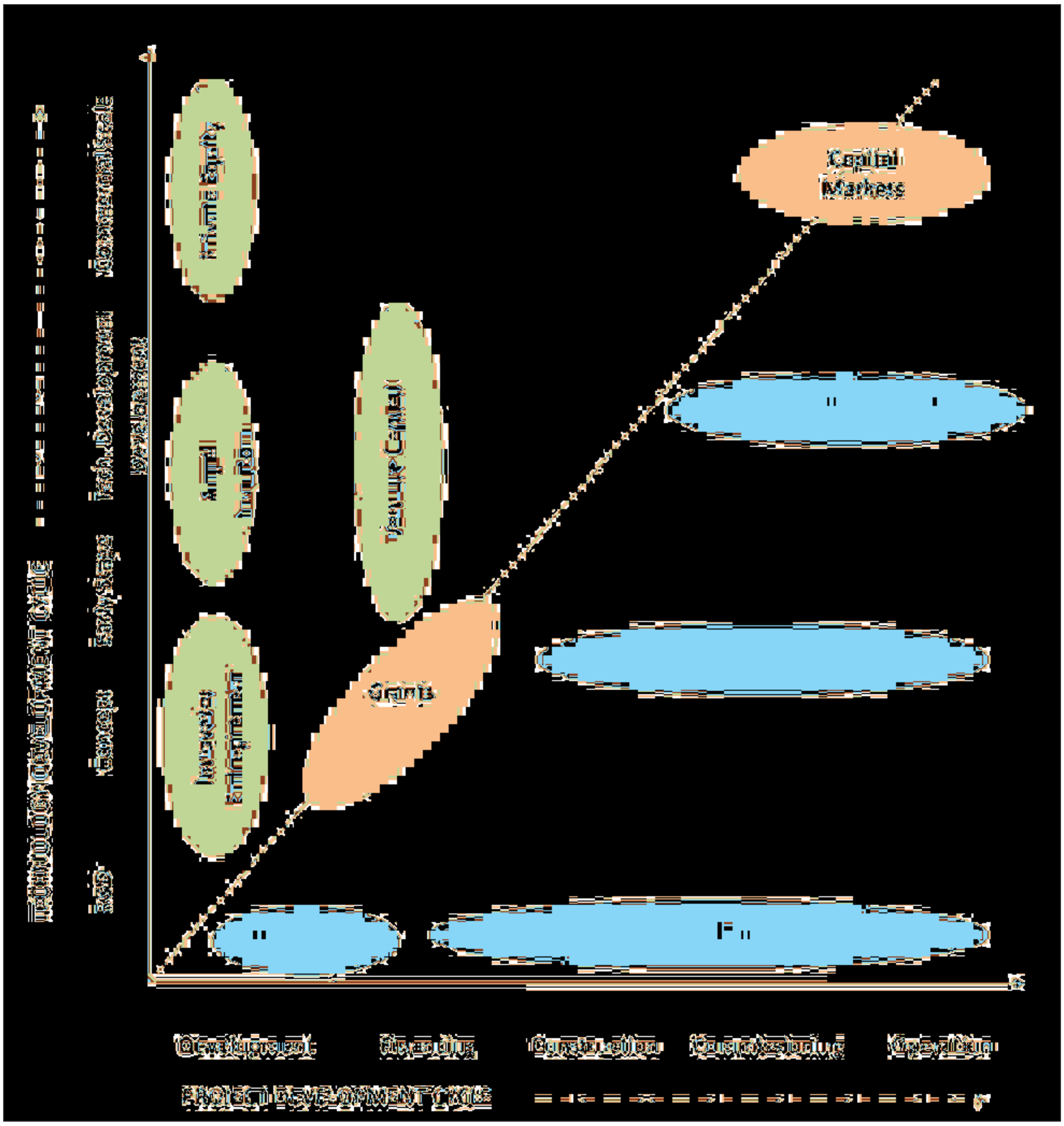
Financing of solar energy, which was at a very nascent stage in the early part of this century, has of late, become a mainstream financing activity with various financing modes introduced at different stages of the evolution of the solar energy, from concept to its commercial mass scale use. Financing methods in the solar energy sector mostly have been conventional debt and equity products.

Solar energy technologies still remain an expensive affair both at development stage and commercialisation stage – as significant costs are incurred at both the stages. Financing development of such technologies, especially when they are largely at their nascent stage with their state of commercial utilization still being uncertain, becomes a risky proposition. Equipment manufacturers, construction contractors, integrators/assemblers (those who bundle technologies together into an integrated package) and service providers are all critical players in the solar energy technology sector. Their innovations, expertise and performance are crucial in making solar energy technologies a commercially viable option. In spite of these deterrents, global players have been successful in devising means and mechanisms to finance their growth, at various stages of the technology and project development cycle.

Exhibit 16 illustrates the investor groups and their possible interventions at various stages of technology development, and the project development cycles, in the solar energy sector.

Understandably, solar energy technology firms are required to undertake a lot of R&D activities, and mostly the initial concept has an entrepreneurial genesis and

Exhibit 17: Solar Energy Technology Development Life Cycles and Funding Sources



Source: Exim Bank Research

can be termed as an '***innovator entrepreneur***'. R&D finds solution to specific technical problems and applies them to new technologies. After a lot of R&D the 'innovator entrepreneur' conceptualizes it and then takes it from the nascent stage forward with the help of other modes of financing to the next level. In most countries, including developing ones, business incubators have been set up, which are playing a crucial role in the clean energy sector in stimulating innovations in the laboratories, fostering firm-level growth, and aiding in the path towards commercialization. Led by academic and research foundations, organizations incubating clean energy companies are usually affiliated with universities, government facilities, subsidiaries of large corporations and charitable organizations.

There are ***developers*** in the project development stage as well, who seek to deploy their ideas / innovations once the fundamental technical barriers have been resolved and the commercial potential of a technology has been established. They basically undertake infrastructure projects and enter into mass scale of production and utilization, thereby playing an important role.

Once the R&D is done at the technological development stage, and the commercial viability of the project is established, venture capital and angel capital comes into the forefront. ***Angel investors*** are typically high net worth individuals that provide early stage capital to businesses, usually filling the capital gap between initial funding provided by developers/entrepreneurs and venture funds and other sources of capital. The principal difference between Angel Capital and Venture Capital funds has traditionally been that angel investors usually invest their own funds while venture funds are managed-pools of funds. Angel investors may support clean energy infrastructure projects if an appropriate instrument can be found to match with the investors with appropriately prepared projects, and returns can thereby be secured.

Venture capital (VC) invests in a relatively larger amount as compared to angel capital. VC funds provide both equity and risk capital to relatively new entrepreneurial ventures. Fundamentally, venture capitalists look for investments with significant growth opportunity and focus primarily on technology related investment. They are also involved actively with the management of the enterprise. VCs have played a significant role as enablers in commercializing solar energy technologies across the globe.

On the other hand, ***private equity*** firms prefer to enter the solar energy sector late in the technological or the project development cycle with a time horizon of around 3-5 years. The term 'private equity' refers to the manner in which funds are raised, the defining feature being that the fund is not listed in the market. These firms invest large chunk of capital and play an active role in management and focus traditionally on operating businesses that require expansion capital or a 'turnaround' that shows good prospects for an exit in the short period.

Mezzanine capital generally refers to unsecured or subordinated, high-yield debt or preferred stock. Mezzanine finance bridges the gap between equity and bank debt. The objective of using mezzanine capital is to minimize the equity commitment of the project sponsor, reduce the potential impact of dilution, and optimize the capital structure and weighted average cost of capital of the company. Mezzanine capital has traditionally been used to fund growth opportunities such as acquisitions or plant expansions. In contrast to conventional lenders, mezzanine lenders look favourably on stable, profitable mid-market companies, which, due to their lack of hard assets, require a cash-flow lending approach. Part of the attraction for such financing is the fact that it can be arranged fairly quickly. Moreover, because mezzanine capital is subordinated to the senior bank financing on the borrower's balance sheet, the company is able to optimize the amount of total leverage. Mezzanine financing has a number of advantages for companies compared to the other traditional financing methods. These include:

- Less expensive than equity financing;
- Avoids dilution of equity: Shareholders continue to operate more independently than would be the case if additional investors had rights to the capital;
- Cash flow based (as opposed to collateral based);

Table 7: Traditional Financing Mechanisms undertaken by Corporate Investors

Corporate financing	Involves the use of the internal company capital to finance a project directly, or the use of internal company assets as collateral to obtain a loan from a bank or other lenders.
Project Financing	This refers to financing structures wherein the lender has recourse, not only to the assets of the project, but also to the cash flows of the project for repayment. Such financing model will be "limited recourse" financing, when besides the project cash flows' the lender has some recourse to the balance sheet of the promoter by way of issuance of corporate guarantees. 'Non-recourse finance' is used when there is no recourse to the balance sheet of the promoter and therefore the lender takes a higher interest and/or puts stricter norms in place.
Lease Financing	Lease financing involves the supplier of an asset financing the use and possibly also the eventual purchase of the asset, on behalf of the project sponsor. Assets which are typically leased include land, buildings, and specialized equipment. A lease may be combined with a contract for operation and maintenance of the asset.

- Ideal for smaller-size companies who have limited access to financing;
- Easy to implement and quick to execute which makes it attractive for smaller-size companies.

The most common and conventional mode of solar energy funding is however by the ***corporate investors.*** They are generally present at all stages of the project development cycle. Historically, corporate investors have concentrated activity on conventional energy transactions. Of late, they have evinced increasing interests in solar energy technology projects, with few of them having a dedicated team looking after the requirements of this sector. However, corporate investors investing in solar energy technologies tend to be selective in undertaking project development risk, with most of them expressing their interests for projects only after commissioning.

Raising capital through ***capital markets*** has assumed far greater importance today. As firms either in the technology development cycle or in the project development cycle mature, they have the option of entering the capital market for raising funds by issuing shares and going ahead with their expansion plans. However, firms entering the capital market generally do so at advanced stages with the main objective of diversification and liquidity. They generally require an operating track record too.

POLICY SUPPORT MECHANISM

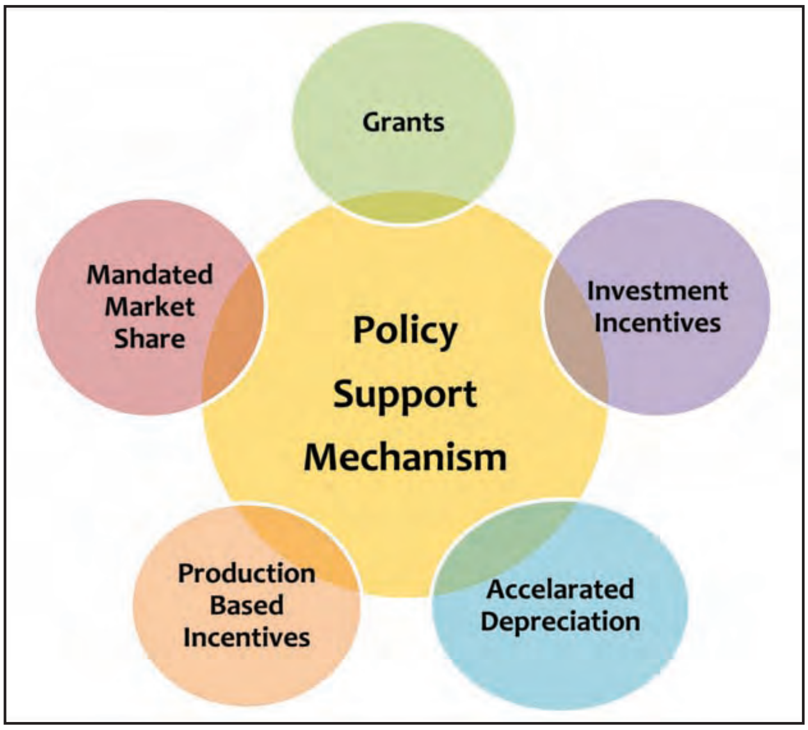
Policy initiatives are the backbone to the success of solar energy technologies. As the sector requires huge amount of capital, a conducive policy oriented ambience is necessary to encourage greater investments into the sector. In emerging and less developed economies of ISA member countries, which are highly value-conscious mass market, public is unlikely to pay substantial premiums for goods/services tagged "clean", at least in the near future. In such a scenario, clean energy projects such as solar technologies cannot sustain without government support which could also be in the form of capital infusion.

This could be done in a number of ways, from sanctioning grants (reduces initial investments costs), introducing tax credits (to reduce capital or operating costs), including low interest loans and grants (lowers capital recovery requirements), to introducing green purchasing targets (which may help to create a market-pull by committing to buy green power for their operations) in the country (Exhibit 17).

Grants

A grant is an amount of money provided by a party to a project, person or an organization that contributes to the objectives of the party concerned. Grants may be convertible to loans or equity if the project achieves commercial success (if so, this will be stated in the terms and conditions of the grant). Grants are typically provided by government organizations, although they cover only a portion of the project costs. For example, the United States Department of Agriculture (USDA) offers grants for up to 25% of total project costs and loan guarantees for up to 75% of total project costs for renewable energy systems including solar and energy efficiency improvements. The maximum grant amount is

Exhibit 18: Various Policy Mechanisms in Solar Energy Promotion



Source: Exim Bank Research

US$ 500,000, and the maximum loan amount is US$ 25 million per applicant. Eligible participants are agricultural producers with at least 50% of gross income coming from agricultural operations, and small businesses in identified rural areas.

Investment Incentives

Investment Tax Credits

Tax credits are one of the instruments for encouraging solar energy financing, especially when these credits are given for performing certain actions, such as installing solar panels to generate electricity. Investment tax credits (ITC) for solar energy directly reduce the cost of investing in solar energy systems and reduce the level of risk by allowing investors to reduce their tax liability in direct proportion to the amount of tax credit they have earned. For businesses, tax credits may be in the form of no taxes for a specific number of years or a certain percentage of tax offset, making this money available for investment into solar energy projects instead.

In USA, tax credits are offered for both individuals and businesses that choose to make a switch to solar energy sources, helping to lower the cost of energy projects that do not use fossil fuels. The federal ITC is perhaps one of the most important solar policy in the USA to promote the use of solar technologies. The 30% tax credit has spurred the growth of solar energy since its implementation in 2007 and has turned solar into an economically viable alternative. But the ITC is authorized at 30% only through 2016 before falling to 10% thereafter (for non-residential systems). This credit is applicable to solar space heating, solar water heat, solar thermal electric, solar thermal process heat, photovoltaics, solar hybrid lighting, and direct use geothermal.

Instead of tax exemptions for solar, some governments have implemented energy taxes on fossil fuels. Similar taxes are emission-related taxes, such as CO_2 or SO_2 taxes[5]. These taxes are meant to correct a market failure that does not incorporate the external costs of fossil energy sources in the heat and electricity sectors. A tax on these lines was introduced by the Indian Government

[5]As prevalent in Nordic countries

Table 8: Policy Interventions for Energy Efficiency and Solar Energy

Policy area	Energy efficiency and demand-side Management Interventions	Solar Energy Interventions	Barriers to be Addressed
Economy-wide	– Removal of fossil-fuel subsidies – Tax (fuel or carbon tax) – Quantitative limits (cap-and-trade) – Fuel taxes – Congestion tolls – Taxes based on engine size – Insurance or tax levies on vehicle miles travelled – Taxes on light trucks, SUVs		– Environmental externalities not included in the price – Regressive or demand-augmenting distortions from subsidies for fossil fuels
Regulations	– Economy-wide energy-efficiency targets – Energy-efficiency obligations – Appliance standards – Building codes – Industry energy-performance targets – Fuel economy standards	– Mandatory purchase, open and fair grid access – Solar portfolio standards – Low-carbon fuel standards – Technology standards – Interconnection regulations	– Lack of legal framework for solar independent power producers – Lack of transmission access by solar energy producers – Lack of incentives and misplaced incentives to save – Supply-driven mentality – Unclear interconnection requirements
Financial incentives	– Tax credits – Capital subsidies – Profits decoupled from sales – Consumer rebates – Time-of-use tariffs	– Feed-in tariff, net metering – Green certificates – Real-time pricing – Tax credits – Capital subsidies	– High capital costs – Unfavourable pricing rules – Lack of incentives for utilities and consumers to save
Institutional arrangements	– Dedicated energy-efficiency agencies to promote energy efficiency – Independent corporation or authority – Energy service companies (ESCOs)	– Independent power producers	– Too many decentralized players
Financing mechanisms	– Loan financing and partial loan guarantees – ESCOs can also finance solar projects apart from installing, owning and operating solar systems – Utility energy-efficiency, demand-side management program, including system benefit fund	– System benefit fund – Risk management and long-term financing – Concessional loans	– High capital cost, and mismatch with short-term loans – ESCOs' lack of collateral – Perceived high risks – High transaction costs – Lack of experience and knowledge
Promotion and education	– Labelling – Installing meters – Consumer education	– Education about solar energy benefits	– Lack of information and awareness – Loss of amenities

Source: Adapted from World Development Report in the 2010-11 budget whereby Rs 50/tonne (around US$1) was levied on production/import of coal and the amount so collected was to be used for funding research and innovation projects through the 'National Clean Energy Fund'. Such taxes make it easier for (usually somewhat more expensive) solar energy to compete in the marketplace, and tax revenues so generated could also be used to support solar energy technologies.

Technology Transfer through Trade

China had announced the "Medium and Long-Term Development Plan for Solar Energy" in 2007, to establish a basic system for solar energy technologies. As early as 2003, the Chinese authorities mandated local content requirements, amounting to 40% in the context of the concession programme, and subsequently raised it to 70%.

Recently in 2015, investors from Kenya and China have launched a technology transfer and training centre to promote the assembly of solar lighting systems in the East African nation. The China-Kenya Solid State Lighting Technology Transfer Centre was launched by the Kenyan solar company Sunyale Africa Limited along with a host of Chinese investors, and is based in an industrial park near Nairobi. The Centre is expected to spur the growth of a home-grown solar industry in the country. This partnership is expected to help Chinese firm facilitate the establishment of local assembly plant for solar products in Kenya, while also training Kenyan technicians on the latest solar solutions. China also plans to train the technicians to assemble solar panels imported from their country by Kenya. The intention is to supply affordable and high quality solar lighting systems to households, schools, hospitals and business premises in the country so as to tap the energy available from the sun.

Accelerated Depreciation

Accelerated depreciation allows the solar energy investors to receive their tax benefits sooner than under standard depreciation rules. It allows the investors in solar energy facilities to record depreciation in plant and equipment at a faster rate, thereby reducing stated income for purposes of income taxes. Since solar, is generally more capital intensive than other forms of electricity production, accelerated depreciation has a significant effect on post-tax profitability of solar investment. In the United States, businesses can recover investments in solar projects by depreciating them over a period of 5 years, than the 15 - 20 year depreciation lives of conventional power sector investments.

PRODUCTION BASED INCENTIVES

Production Tax Credits

Production tax credits (PTC) provide the investors with a tax credit based on the amount of electricity actually produced from solar energy sources and fed into the electric grid. They increase the rate of return and reduce the payback period for solar energy projects, while rewarding producers for actual generation of energy. However, it is to be noted that PTC should be introduced as long term initiatives and any policy inconsistency and uncertainty created by the Government in dealing with the extensions of the PTC would result in inconsistent and uneven growth in the solar energy sector.

Mandated Market Share

One strong measure that the member Governments of the ISA can consider is to develop a solar market through mandated market share (MMS) policies. MMS policy requires that a certain quantity or proportion of a country's energy be generated from solar energy sources by instituting a purchase obligation or creating strong incentives for solar energy at some point along the energy supply. Mandated market shares for solar energy can be created by instituting any one of three following policies, or a combination of them:

– Feed-in Tariffs (FiT) is one mechanism that gives the government a provision to set a price for solar energy and guarantee that all solar energy produced will be purchased and fed to the grid at the specified price for a specific period of time. Many European countries have been offering very attractive support scheme, under which the PV system owner can valorise the electricity he produces himself at the same price as the electricity he consumes traditionally from the grid. If, over a time period, there is an excess of electricity fed into the grid, the PV system owner gets a credit (unlimited in time) for the value of the excess of electricity fed into the grid. This measure is very attractive for the residential, public and commercial sectors. On top of the valorisation of the electricity itself, the PV system owner also gets a premium FiT on the total electricity produced by the PV system.

– Renewable Portfolio Standards is another approach whereby the government stipulates that all electricity utility organisations to produce a certain amount of renewable energy annually, or buy tradable credits for that amount of energy. For example, many countries, including USA, have adopted Renewable Portfolio Standards (RPS), which enables electricity utility organisations or providers to supply a certain quantity of their delivered energy from renewable energy sources such as PV. In June 2009, the US House of Representatives passed the American Clean Energy and Security Act, which mandates a 20% renewable energy to be sourced by 2020.

– Tendering systems is another method which is a combination of the previous two policies, which allows energy suppliers to competitively bid for renewable energy obligations.

However, in general, production incentives are preferable to investment incentives because they promote the desired outcome of generating electricity from solar energy. In addition, production incentives are most likely to encourage the investors to purchase the most reliable systems available, or to maintain them and produce as much energy with them as possible. Thus, production incentives are more likely to lead to optimum performance of the installed systems and a sustained industry.

Property Tax Incentives

Property taxes are generally based on the installed cost or the improvements made to a property. Therefore, if taxed with the same formula, properties with installation of solar energy systems, which have higher investment costs but no (or very low) fuel costs, would pay higher property taxes. More than 40 States in United States have property tax exemption for installation of solar energy systems. These are generally implemented in any of the three ways: a) solar energy property is partially or fully excluded from the property tax assessment; b) solar energy property value is capped at the value of an equivalent conventional energy system providing the same service; and c) tax credits are awarded to offset the investment cost.

MULTILATERAL FINANCING MECHANISMS

It may be noted that much before the commercial banks took interest in this sector, many multilateral financial institutions across the globe have taken steps to facilitate investments and promote solar energy by providing special credit lines and funds. There are several multilateral programmes of cooperation that aim at increasing the utilization of solar energy in the context of climate change mitigation.

Today, all major multilateral agencies are incorporating environmental consideration in their programmes. Although the extent of financial assistance from these institutions is not as big as bilateral aid or private sector investment, they can play a pivotal role in promoting international cooperation in the new emerging mechanism. Demand is increasing for multilateral financing because these institutions offer loans for a longer period (Islamic Development Bank offers loans with maturities of up to 15 years), while a typical commercial bank would offer a loan with a maturity of no more than 5-7 years.

Almost all multilaterals, including regional development banks across the world have devised programs addressing the need for financing energy efficiency and renewable energy projects, including solar.

6. THE INTERNATIONAL SOLAR ALLIANCE: FORGING PARTNERSHIPS FOR EFFECTIVE IMPLEMENTATION

ISA as a platform would need to share the collective ambitions to reduce the cost of finance and technology that is needed to deploy solar power widely. This would require generation and storage technologies that could be adapted to the individual countries' needs. Among the tasks that the Alliance could undertake is to forge a strong and a concerted partnership amongst its members within a specified timeframe. This chapter envisages to broadly categorise these partnerships under three broad mechanisms, namely financial cooperation, technological collaboration, and capacity building.

FINANCIAL COOPERATION MECHANISM

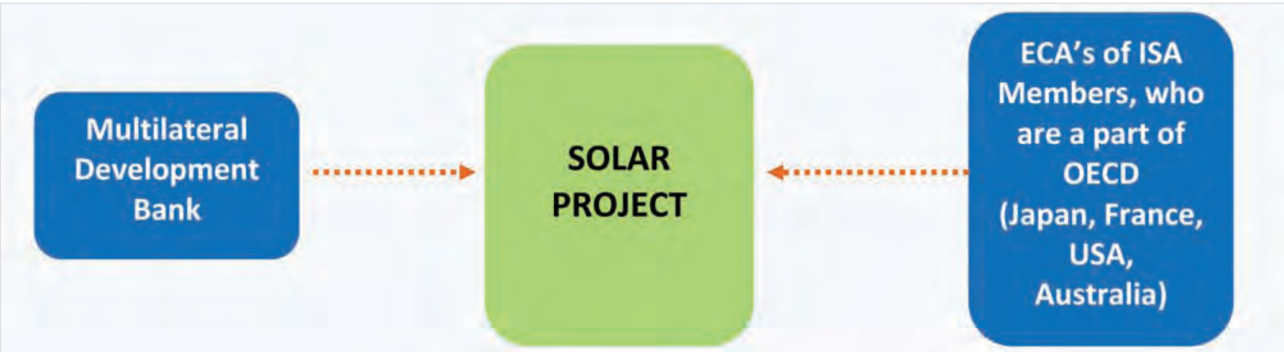
Solar PV technology requires substantial upfront capital expenditures. Declining prices for PV panels over the past few years have mitigated this problem to some extent but the basic problem remains and that is the cost. Virtually, the whole energy costs for the lifespan of a PV system must be prepaid at the time of an investment which reaps the benefits only over the next 10-20 years. These high upfront costs are and will remain one of the main challenges which need to be overcome to achieve a faster and wider deployment of PV technology, particularly in emerging and developing regions where large-scale subsidy programs are usually absent.

It has to be appreciated that the driving forces in the energy sector are not technologies alone but the business models. Innovative business models and financing mechanisms are therefore needed to achieve a greater deployment of PV technology in emerging regions, and reduce cost of capital. Stronger partnerships with and within various multilateral/regional development banks and financial institutions are needed to develop innovative financial mechanisms to access low cost, long tenure financial resources. This section makes an effort to draw out a few financing mechanisms where member countries of ISA can collaborate through their respective financial institutions, with additional support from multilateral and regional development banks. In these models, the underlying assumption is that the sovereign entity is responsible for land availability/ concessions and power purchase agreements (PPA).

Model 1

Co-financing is an important instrument of multilateral development banks (MDB). It allows MDBs to mobilize additional financing in cooperation with third parties, and to optimize the cost-effectiveness of programmes and projects. MDBs along with the Export Credit Agencies (ECA) of those ISA member countries who are part of OECD

Model 1



Source: Exim Bank Research

(viz. Japan, France, USA, Australia) can come together to co-finance large scale solar projects. The OECD countries follow OECD guidelines for export credit and tied aid and are in a position to match the financing terms of MDBs.

Model 2

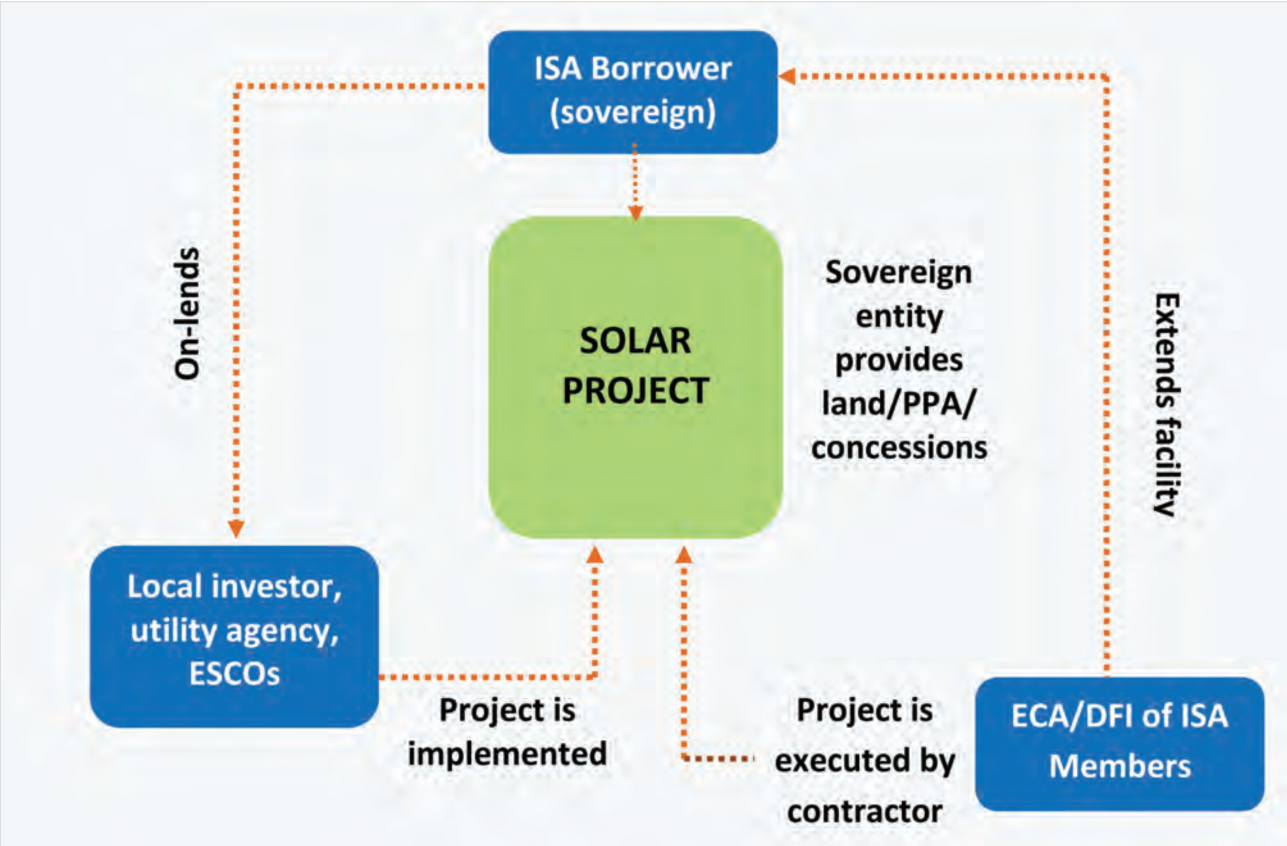
In this case, a local investor, utility agency, etc puts up a project for which it requires funding assistance. The ECA (or a development financing institution - DFI) of another ISA member country can extend a facility to the borrower (a sovereign entity) of the ISA country where the project is proposed to be set up. The sovereign borrower then on-lends to the local investor, utility agency/ Energy Service Company (ESCO), etc for implementing the project. The local investor, utility agency, etc may draw revenue either from the cash flow of the project or pay in tranches as agreed upon, to service the debt received from the sovereign entity.

Model 3

Under this model, the overseas buyer/importer, i.e., an investor, utility agency, or ESCO in an ISA member country can directly avail of a financing facility from an ECA/DFI of another ISA member country from where goods and services are imported. Most ECAs or DFIs have a tied loan to offer, wherein a certain percentage of the procurement has to be undertaken from the country financing the project.

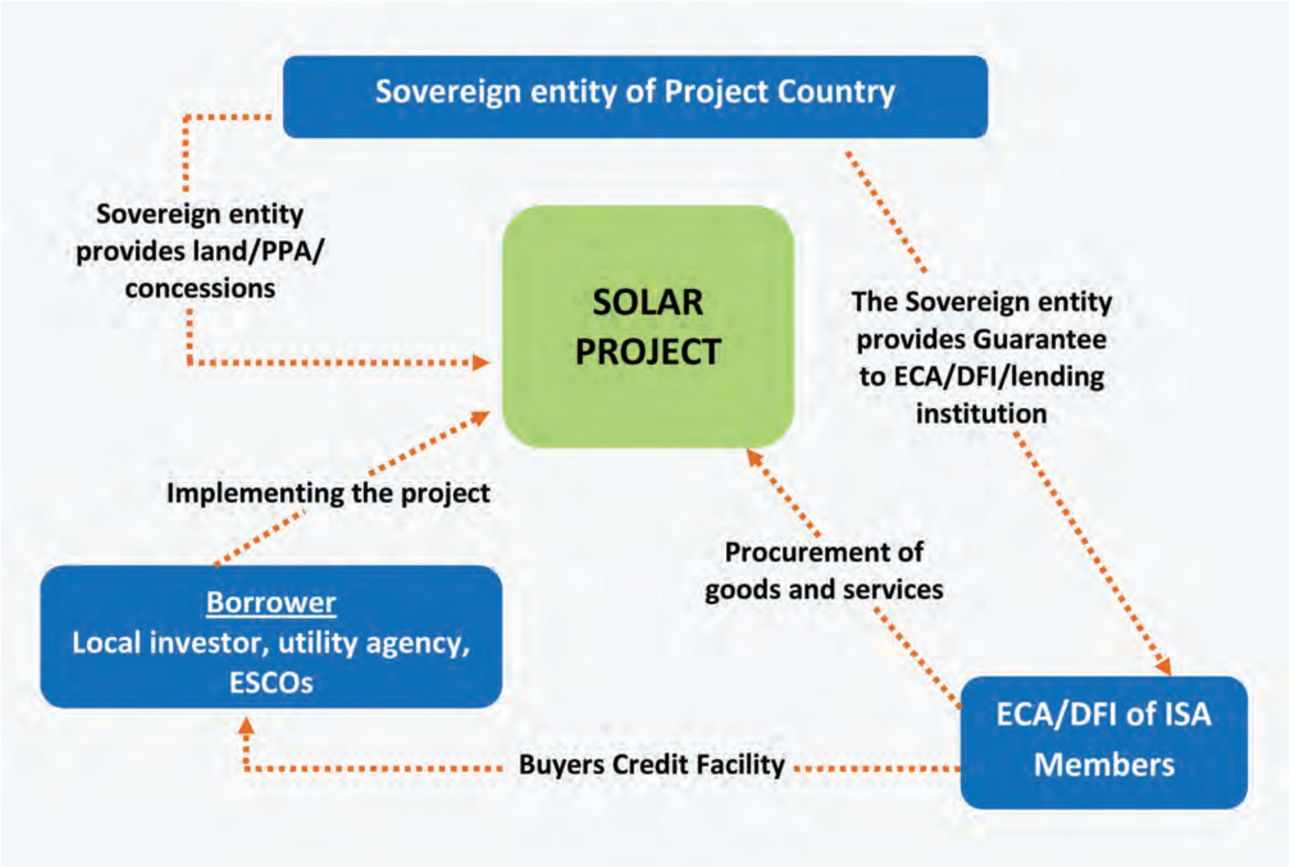
In order to make the project bankable and mitigate risk, a sovereign entity from the project country can provide a guarantee on behalf of the investor, utility agency, or ESCO. The facility can be made available for development, upgrading or expansion of solar facilities as also for financing of new public or private solar projects.

Model 2



Source: Exim Bank Research

Model 3



Source: Exim Bank Research

Model 4

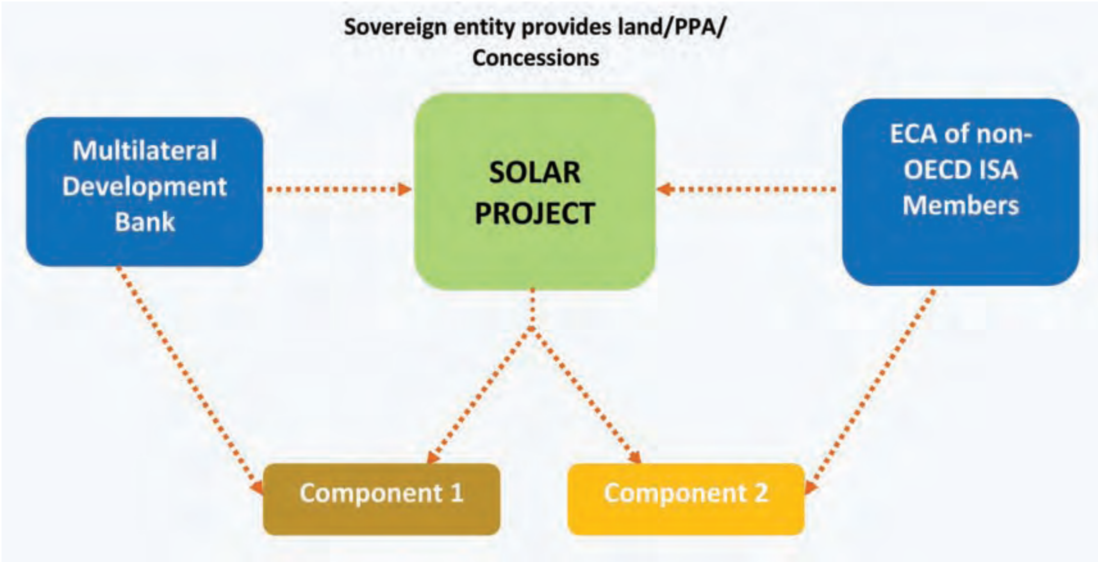
Co-financing can either be parallel-financing or joint-financing. When the financial institution funds a project on a parallel basis (which refers to several components or contracts of a project) with other financiers, the financial institution's rules and procedures for procurement apply to its specific component or contract. Hence in parallel financing, various combinations of separate lines of official development assistance, official export credits, and private commercial credit, not combined into a single package but with a varying set of financial terms, to finance exports is used.

In this model an MDB and an ECA/DFI from a non-OECD country may take up different parts of the project at varying terms with the objective being to execute and complete the solar project.

Model 5

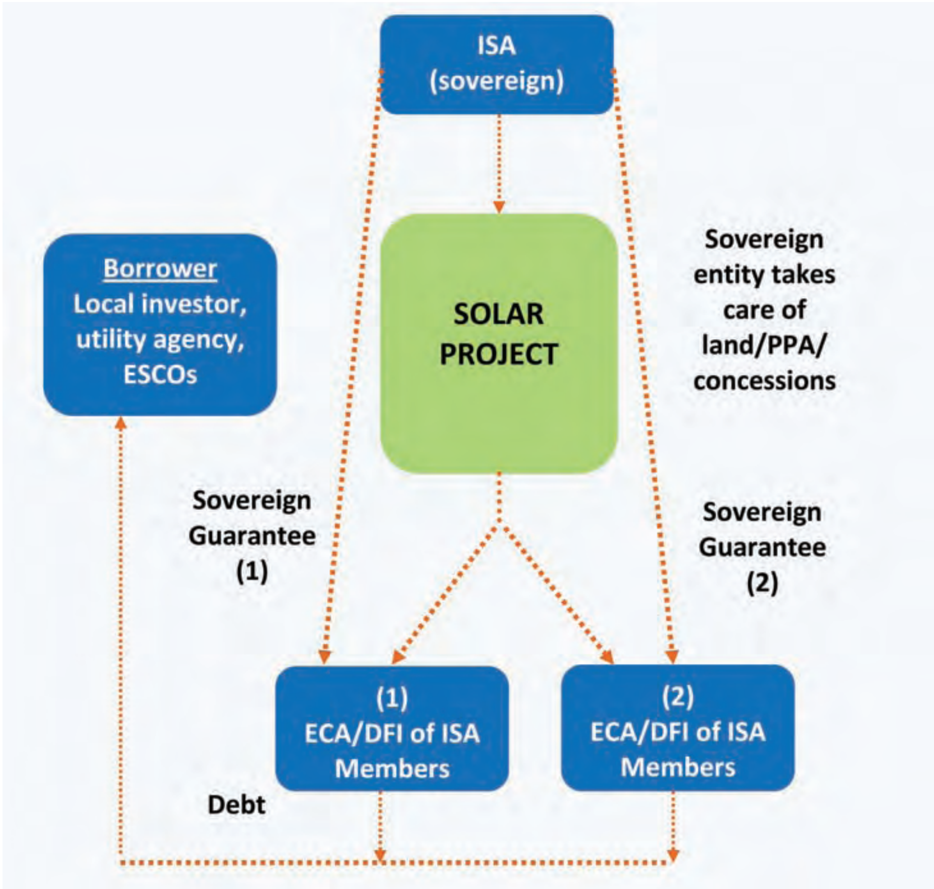
Two ECAs/DFIs of ISA member countries join hands to fund a solar project, either in a third ISA member country or in one of the two countries from where the ECAs/DFIs belong. The financing facility is extended to local investors/utility agency/ESCOs of the project country, based on the comfort of a sovereign guarantee of an entity in the project country. As has been the case in the previous models, the sovereign entity arranges for land, power purchase agreements and concessions, and provides the requisite guarantee to each of the funding agencies.

Model 4



Source: Exim Bank Research

Model 5



Source: Exim Bank Research

Model 6

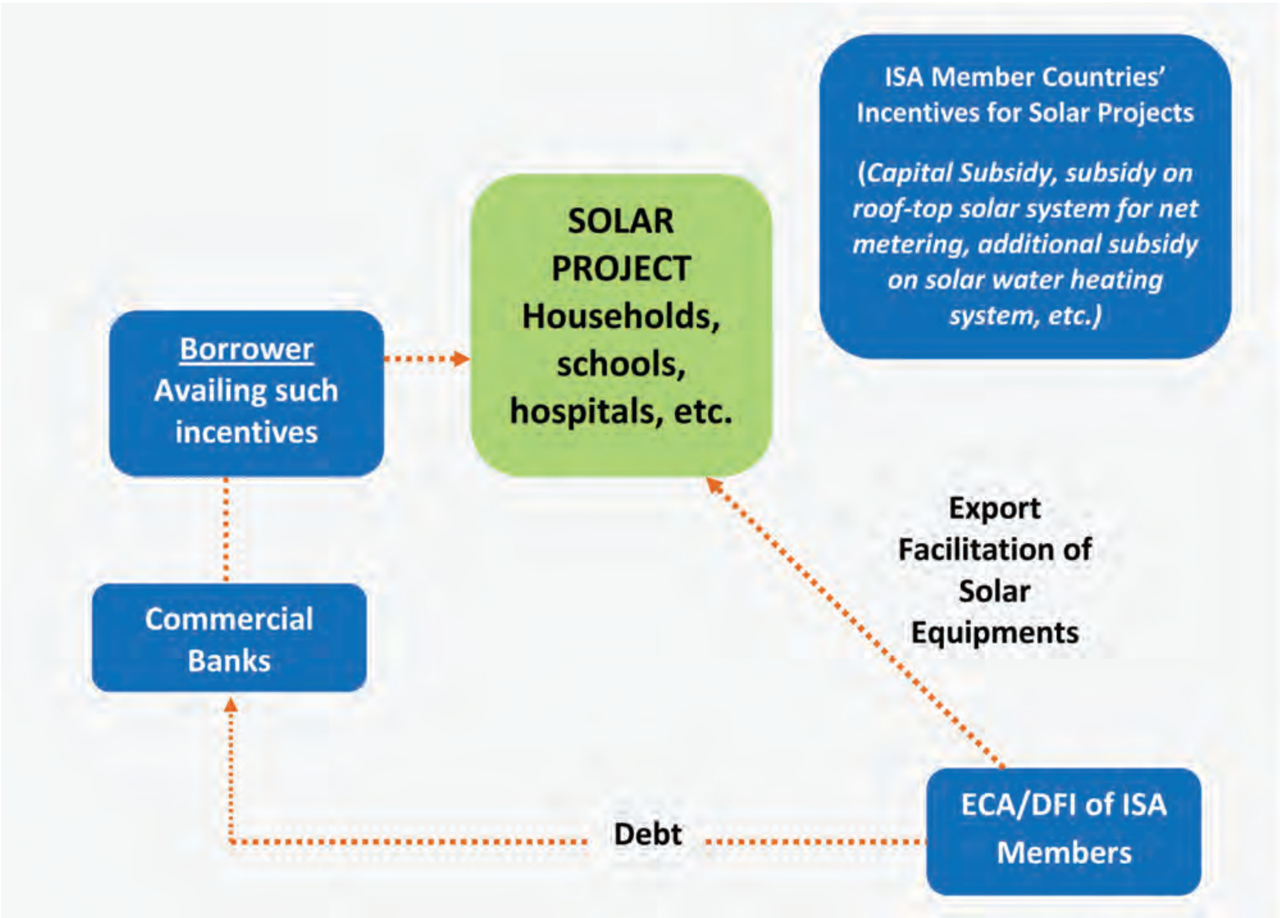
This model is essentially for rooftop solar financing which can be more popular with households, schools, hospitals, and other public facilities. In this model, the firm or institution executing the project considers the incentive schemes available from the Government in terms of reimbursement or subsidy, etc. The borrower approaches the commercial banks for debt. The commercial banks in turn, are refinanced by ECAs or DFIs of one of the ISA member countries which exports goods and equipment. In this model, the borrower not only benefits from the financial and fiscal concessions available from the government of the project country but also gets credit at competitive terms because of the refinance available from ECAs/DFIs.

TECHNOLOGY COOPERATION

Sharing of Technology by developed countries

There is a pressing need to accelerate not only the development of advanced solar energy technologies but also simultaneously share the existing technologies among the ISA member countries in order to address the global challenges of clean energy, climate change and sustainable development. As was highlighted earlier, the ISA members are at different stages of development and hence their ability to adapt, draw and generate solar energy remains different. There is a need for ISA as an institution to encourage the developed member countries to volunteer to provide the developing and less developed member countries with the necessary

Model 6



Source: Exim Bank Research

technology know how so as to equip them to harness energy from the sun on commercially sustainable basis. For this to happen, it is important for the ISA countries to create an ecosystem that is conducive for catalysing foreign investment such as improving the ease of doing business and strengthening domestic intellectual property laws. In the process to share technology, ISA may also facilitate foreign investments from developed to developing countries in new technology areas.

Promote R&D in Solar Technology

Solar installations do not require any fuel to operate, and thus do not have a recurring cost that fossil fuel-fired energy generation has. This unique feature which is increasingly being realised by countries across the globe is poised to further enhance the popularity of solar in the years to come. In an attempt to give a boost to new and innovative technologies in the field of solar energy applications and realize low cost operations, ISA could promote joint R&D efforts in the field of solar energy. This could include facilitation in the development of new and renewable energy technologies, processes, materials, components, sub-systems, product and services at par with international specifications, standards and performance parameters. Production of solar energy is not uniform throughout the day and is generally the highest around noon and absent during the night. New solutions will therefore have to be developed that can deliver consistent electricity to meet demand. Since the storage of solar energy is critical, R&D in this area needs to be vigorously pursued. It is also important for R&D to be directed towards application and deployment. Only then solar energy will be able to improve the lives of people.

CAPACITY BUILDING

Setting up a Guarantee Fund

Taking cognizance of the fact that the 121 sovereign member countries are at varying stages of adapting to solar technology, ISA could consider creating an institutional mechanism to facilitate implementation of solar projects in member countries, especially in countries that are relatively less developed. This institutional mechanism can perhaps take the form of a corpus of fund which could, inter alia, be used for providing guarantees for specific solar projects with a view to render them commercially bankable. Contributions to the Fund could be solicited both from member countries (based on pre-defined formula contingent upon the stage of development of the member as also on the size of the economy, among others) and also from non-member developed countries for whom climate change mitigation serves an important strategic objective. The Fund could be managed by an independent agency based on the consensus of member countries of ISA. The Fund could also be used for covering specific soft expenses such as preparation of a detailed project report for ascertaining the commercial viability of solar projects. The Fund needs to be sufficiently capitalised for it to be effective in providing guarantees for solar projects.

Exploring Feasibility of Solar Park Financing Vehicle

The solar park is a concentrated zone of development of solar power generation projects, developers are provided an area that is characterized by proper infrastructure and ease of facilitation for the necessary approvals so that the risk of the projects can be minimized.

Multi-developer utility-scale solar parks have the potential to deliver transformative change in the solar sectors in the ISA member countries. In India for example, both Gujarat and Rajasthan have made solar parks a priority for delivering their solar goals.

In this regard, creating a Solar Park Financing Vehicle (SPFV), backed by sovereign governments from the major ISA member countries, could be explored, which would allow parks to channelize new sources of capital, and issue bonds as well. This SPFV could act as a debt aggregator for a series of individual projects across the ISA countries.

[6]FITs guarantee a fixed compensation for electricity produced from solar PV facilities for a period of 20 years. The program requires that transmission system operators purchase all the power produced from these PV systems. Transmission system operators in turn sell the power on wholesale markets.

Reducing the cost of capital through a viable SPFV which is backed by a sovereign entity, would reduce the cost of capital and drive down the cost of electricity generated from the sun. This entity could issue solar bonds and raise funds from the domestic and international debt markets at lower costs by virtue of it having the backing of various sovereigns from the ISA countries. A viable SPFV can access new pools of institutional capital, even during its initial stage, especially if it can collaborate with multilateral development agencies through a credit-enhancement mechanism, which could enable it to get a sufficiently high investment credit rating and thereby issue bonds at competitive pricing.

Mobilizing Government Support

It is but a proven fact that the growth of solar energy across the world has taken place due to the support it received from their respective Governments. Support received helps in enhancing market access, and provides a regulatory framework. As the sector requires provisions of long term credit, a conducive policy oriented ambience is necessary to encourage greater investments into the sector. This could be done in a number of ways, from sanctioning grants (reduces initial investments costs), introducing tax credits (to reduce capital or operating costs), including low interest loans and grants (lowering capital recovery requirements), to introducing green purchasing targets (which can help in creating a market-pull by a commitment to buy green power for their operations) in the country.

For example, in Germany feed-in-tariff (FiT)[5] has been the key instrument responsible for propagating and facilitating the use of solar energy in the country, apart from tax incentive and market based incentives. It is also observed that unlike in the USA, where solar power is primarily from large-scale solar power plants, in Germany solar power is primarily from rooftop solar power on residents' homes.[7]

Taxes also help determine or discourage uptake. In some countries, like the Netherlands, solar PV consumption is tax-exempt. The retail electricity bill often does not include large fixed elements, like a capacity fee for access to the grid, which would reduce the price differential between solar PV and retail electricity.

ISA as a platform dedicated to harnessing energy from solar, could advocate with the Governments to reach financially optimized frameworks, in order to support sustainable development of their country's solar resources. A relatively small investment in this crucial 'public good' can lead to much larger commercial investments in solar capacity and can lower the costs.

Encourage Decentralized Solar Capacity Creation

The ISA member countries are spread across the globe. However, as was highlighted in an earlier chapter, there are large parts in these countries which do not have access to the grid. Even where grid access is available, it may not be reliable. It may be noted that unlike other forms of renewable energy (wind, biomass and hydro), solar energy has a unique characteristic that it can be consumed right at its points of production.

Stand-alone systems are the original preserve of solar PVs, which are straightforward to install and benefit from low operating costs. A key opportunity for solar power lies in decentralized and off-grid applications. In remote and far-flung areas where grid penetration is neither feasible nor cost effective, solar energy applications are cost-effective and commercially viable options. Implementing such options would ensure that people with no access to light and power, move directly to solar, leapfrogging the fossil fuel trajectory of growth.

In many ISA countries, where there are no local power grids, these autonomous stand-alone power systems can be expanded, and could form a driving force in rural electrification as well. In fact, PV plants installed in areas where power grids exist but supply is erratic, are also something of a specialty, where they can operate in parallel to the grid and then bridge periods when the power fails. Successful models of such an option already

[7] Cleantechnica.com

exist as was highlighted in an earlier chapter (for instance the case of Omnigrid Micropower Corporation in India).

Exchange of Best Practices

ISA could consider conducting annual forums to share the best practices in solar technologies, and application of energy from solar power. Such information dissemination programs can also be simultaneously organized through focus group discussions with various stakeholders by ISA in various countries under its umbrella. This could be further strengthened by designing appropriate training programs for personnel engaged in solar energy policy and executing such projects across member countries. It is important to facilitate knowledge management and information sharing amongst ISA member countries to make the alliance better equipped with changing technology.

Encourage Participation from Private Players

Governments across ISA member countries need to take the private sector on board. Private sector is the key stakeholder which will execute the solar projects and their involvement remains crucial to the success of the objectives of ISA. Discussions on crucial aspects of execution of projects by developers will benefit in undertaking a more practical discourse during any knowledge sharing or interactive sessions.

ISA can also position itself as an advocacy representing key-private sector stakeholders (solar industry, financiers, energy leaders and large consumers) in the dialogue with the Governments and international organizations to upscale solar based technologies and catalyse faster implementation of a global common market of affordable solar power generation worldwide.

SUM UP

After the IT boom in the 90's, the world is poised to witness the next round of euphoria in the solar energy technology arena. Climate change presents humanity with a significant challenge. At the same time, investments in clean energy and low carbon alternatives, presents business and capital with an opportunity, which may become one of the largest commercial opportunities of the current era.

Solar installations have increased phenomenally in the last couple of years. World solar PV installations have shot up from a mere 3.4 GW in 2004, to touch 179.6 GW as in 2014. This meteoric rise of solar installations is a testimony to the determination of countries across continents, including the emerging and developing countries, to transform this need to have energy from solar to an opportunity for green investment.

Appropriate mechanisms need to be created to overcome barriers at the early stage of solar project development, while simultaneously creating enhanced deal flow for later stage private and foreign institutional investors.

It is estimated that the newly-installed capacity from solar sources in the world as a whole could increase significantly in a couple of years. This could be achieved through innovative financing and incentive mechanisms. While favourable policies are already in place in many countries, however, to maintain the upward trend in solar energy growth, policy efforts need to be taken up to a higher level. This is where the role of the ISA gains significance. ISA has the potential to encourage massive scale up of solar technologies across the world through forging fruitful partnerships.

Annexure 1: Trends in Installed Solar Capacity in the World (MW)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	1225	**1330**	**1630**	**2342**	**3427**	**4878**	**6472**	**9090**	**15072**	**23147**	**40045**	**70674**	**99870**	**139303**	**179638**
Germany	114	195	260	435	1105	2056	2899	4170	6122	10566	17554	25039	32643	36337	38238
China	19	24	42	52	62	70	80	101	140	284	864	2934	6501	17461	28061
Japan	330	453	637	860	1132	1422	1708	1919	2144	2627	3618	4914	6632	13643	23300
USA	595	459	457	681	751	881	1099	1439	1618	2086	3373	5642	7804	13365	19921
Italy	19	20	22	26	31	34	45	87	432	1142	3475	12778	16425	18425	18811
Spain	12	16	20	27	37	60	180	750	3450	3770	4653	5501	6646	7016	7022
France	7	7	8	9	11	13	15	26	80	263	1030	2803	3953	4625	5600
United Kingdom	2	3	4	6	8	11	14	18	23	27	94	994	1747	2780	5228
Australia	25	29	34	39	46	52	61	73	85	108	402	1397	2435	3258	4139
India			2	3	4	4	5	4	10	12	37	568	1283	2324	3290
Belgium			1	1	1	2	2	20	62	386	904	1391	2581	2912	2977
Greece		1	1	1	1	1	5	9	12	46	202	612	1536	2579	2595
Republic of Korea	4	5	5	6	9	14	36	81	357	524	650	730	959	1467	2384
Czech Republic	0	0	0	0	0	1	1	4	40	465	1727	1913	2022	2064	2067
Canada	7	9	10	12	14	17	21	26	33	95	221	497	766	1210	1710
Thailand							30	32	32	37	49	79	382	829	1304
Romania												1	41	761	1219
The Netherlands	13	21	26	46	49	51	52	53	57	68	88	145	365	739	1123
Switzerland	16	18	20	22	24	28	30	37	49	80	125	223	437	756	1076
Bulgaria										2	25	154	1013	1036	1038
South Africa	8	9	10	12	13	14	16	17	18	20	23	67	72	147	922
Ukraine											3	188	372	748	819
Chinese Taipei	0	0	0	1	1	1	1	2	6	10	22	118	223	392	776
Austria	5	7	9	23	27	30	36	40	49	71	154	317	363	626	766
Israel						1	1	2	3	25	70	190	237	420	670

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Denmark	2	2	2	2	2	3	3	3	3	5	7	17	402	571	603
Slovakia											19	496	513	588	590
Portugal	1	1	1	2	2	2	3	24	59	115	134	172	238	294	391
Chile												4	6	8	368
Slovenia									1	4	12	57	142	187	260
Reunion						1	3	6	10	43	89	131	153	156	167
Bangladesh				1	2	3	5	9	14	23	39	63	83	140	163
Malaysia							6	7	9	11	13	14	35	73	160
United Arab Emirates										10	11	20	20	133	133
Mexico	14	15	16	16	16	16	16	19	19	25	29	36	53	67	131
Luxembourg			2	14	24	24	24	24	25	26	29	41	75	95	110
Peru													80	80	96
Sweden	3	3	3	4	4	4	5	6	8	9	11	16	24	43	79
Hungary						0	0	0	1	1	2	4	12	35	77
Puerto Rico										4	4	4	7	58	73
Lithuania									0	0	0	0	7	68	71
Guadeloupe										11	22	29	60	67	67
Cyprus						1	1	1	2	4	7	10	17	35	65
Kenya	7	8	8	9	10	10	11	12	12	13	15	18	34	50	60
Martinique										14	26	38	56	61	60
Turkey	0	0	1	1	2	2	3	3	4	5	6	7	12	18	58
Malta							0	0	0	1	5	9	18	31	57
Pakistan								0	1	3	6	9	20	30	40
Morocco	7	7	8	8	9	10	11	12	13	13	34	34	35	36	40
French Guiana										1	22	32	34	34	38
Egypt	0	1	1	1	1	1	1	1	1	1	15	35	35	35	35

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Croatia												0	4	20	34
Singapore									0	2	4	6	10	15	33
Philippines						1	1	1	1	1	1	1	1	1	31
Algeria	2	2	2	2	2	2	2	2	2	2	2	27	27	27	27
Ecuador						0	0	0	0	0	0	0	1	1	26
Saudi Arabia													19	25	25
French Polynesia	1	1	1	1	1	2	2	2	3	3	7	10	13	22	22
Poland												1	1	2	21
Uganda	0	1	1	2	2	3	5	8	12	14	15	16	17	19	20
Mauritius													1	3	18
New Zealand														8	18
Iran									0	17	17	17	17	17	17
Indonesia											0	1	4	9	15
Mauritania														15	15
Brazil												1	4	6	15
Mayotte														13	13
Norway	6	6	6	7	7	7	8	8	8	9	9	10	10	11	13
Macedonia										0	0	2	4	7	12
Tanzania						0	0	0	1	1	1	3	5	8	11
Finland	3	3	3	3	4	4	5	5	6	7	8	8	9	10	10
Cabo Verde											8	8	8	9	9
Jordan			0	0	0	0	1	1	1	1	1	1	1	3	9
Argentina												1	6	8	8
New Caledonia	0	0	1	1	1	1	1	2	2	2	6	7	7	8	8
Senegal	1	1	1	1	2	2	2	2	2	3	3	5	6	7	8
Burkina Faso	1	1	1	1	1	1	1	2	2	3	4	6	6	6	7
Barbados		0	0	0	0	0	0	1	1	1	1	2	2	3	7

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Cuba													3	6	6
Mali		0	0	0	1	1	1	1	2	2	2	2	4	6	6
Tunisia	0	0	0	1	1	1	1	1	1	1	2	3	4	5	6
Niger	1	1	1	1	1	1	1	1	1	1	2	3	4	5	6
Serbia						0	0	0	1	1	1	2	3	5	6
Cambodia	0	0	0	0	0	1	1	2	2	2	2	4	5	6	6
Guatemala															5
Libya				0	1	1	2	2	3	3	4	4	5	5	5
Mongolia				0	0	0	0	0	4	4	5	5	5	5	5
Zimbabwe					1	2	2	2	2	2	3	3	4	4	5
Namibia	0	0	0	0	0	0	0	1	1	1	1	2	2	3	5
Jamaica		0	0	0	0	0	0	0	1	1	1	2	2	2	4
Bosnia and Her-zegovina				0	0	0	0	0	1	1	1	1	2	3	4
Dominican Re-public														2	4
Venezuela											2	2	2	2	3
Madagascar					0	0	0	0	1	1	2	3	3	3	3
Qatar													3	3	3
Samoa									0	0	0	0	0	0	3
Tonga			0	0	0	0	0	0	0	0	0	1	2	2	3
Uruguay								0	0	0	0	0	1	2	3
Kazakhstan													3	3	3
Panama															2
Burundi						0	0	0	0	0	1	1	1	2	2
Nicaragua														1	2
Ghana														2	2
Zambia		0	0	0	0	1	1	1	1	1	1	1	1	2	2

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Bolivia															2
Guyana	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2
Kiribati	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
Cameroon				0	0	0	0	0	0	1	1	1	2	2	2
Nepal	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Mozambique												0	0	1	1
Benin	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
Brunei Darus-salam											1	1	1	1	1
Maldives												0	1	1	1
Ireland						0	0	0	0	1	1	1	1	1	1
Solomon Islands										0	0	1	1	1	1
Cook Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
El Salvador														1	1
Costa Rica													1	1	1
Afghanistan														1	1
Tokelau	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Palau	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
Malawi								0	0	0	0	0	0	1	1
Albania		0	0	0	0	0	0	0	0	0	0	1	1	1	1
Marshall Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Azerbaijan								0	0	0	0	0	0	1	1
Micronesia								0	0	0	0	0	0	1	1
Bahamas								0	0	0	0	0	1	1	1
Togo			0	0	0	0	0	0	0	0	0	0	1	1	1
Fiji	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Belize														1	1
Lebanon													1	1	1
Botswana													0	1	1

Source: Data derived from IRENA; Exim Bank Research

Annexure 2: Countrywise Access to Electricity

	Country	Access to Electricity (percent of population)	
		2010	2012
1	Algeria	98.00	100.00
2	Angola	31.06	37.00
3	Antigua & Barbuda	85.41	90.88
4	Argentina	92.35	99.80
5	Australia	100.00	100.00
6	Bahamas	96.10	100.00
7	Bangladesh	32.00	59.60
8	Barbados	85.41	90.88
9	Belize	95.16	100.00
10	Benin	25.40	38.40
11	Bolivia	66.00	90.50
12	Botswana	39.56	53.24
13	Brazil	97.40	99.50
14	Brunei	69.36	76.16
15	Burkina Faso	6.90	13.10
16	Burundi	3.90	6.50
17	Cambodia	16.60	31.10
18	Cameroon	46.20	53.70
19	Cape Verde	58.60	70.56
20	CAR	6.00	10.80
21	Chad	2.30	6.40
22	Chile	98.80	99.60
23	China	98.00	100.00
24	Colombia	97.00	97.00
25	Comoros	44.80	69.30
26	Congo	20.90	41.60
27	Congo DR	6.70	16.40
28	Costa Rica	98.00	99.50
29	Cote d'ivoire	51.40	55.80
30	Cuba	97.00	100.00
31	Djibouti	46.16	53.26
32	Dominica	87.70	92.67

	Country	Access to Electricity (percent of population)	
		2010	2012
34	Ecuador	94.00	97.20
35	Egypt	97.70	100.00
36	El Salvador	87.00	93.70
37	Equatorial Guinea	61.03	66.00
38	Eritrea	32.20	36.08
39	Ethiopia	12.70	26.56
40	Fiji	52.53	59.33
41	France	100.00	100.00
42	Gabon	73.60	89.30
43	Gambia	34.30	34.53
44	Ghana	45.00	64.06
45	Grenada	85.41	90.88
46	Guatemala	78.00	78.50
47	Guinea	16.40	26.20
48	Guinea-Bissau	53.50	60.61
49	Guyana	74.50	79.47
50	Haiti	31.40	37.90
51	Honduras	67.00	82.20
52	India	62.30	78.70
53	Indonesia	87.60	96.00
54	Jamaica	86.00	92.63
55	Japan	100.00	100.00
56	Kenya	14.50	23.00
57	Kiribati	52.53	59.33
58	Laos	46.30	70.00
59	Liberia	0.56	9.80
60	Libya	99.80	100.00
61	Madagascar	11.40	15.40
62	Malawi	4.80	9.80
63	Malaysia	96.40	100.00
64	Maldives	96.36	100.00
65	Mali	16.70	25.60
66	Marshall Islands	52.53	59.33
67	Mauritiana	14.66	21.76

	Country	Access to Electricity (percent of population)	
		2010	2012
69	Mexico	98.00	99.10
70	Micronesia	52.53	59.33
71	Mozambique	7.10	20.20
72	Myanmar	47.00	52.36
73	Namibia	36.50	47.26
74	Nauru	-	-
75	Netherlands	100.00	100.00
76	New Guinea	-	-
77	New Zealand	100.00	100.00
78	Nicaragua	72.00	77.90
79	Niger	6.70	14.40
80	Nigeria	44.90	55.60
81	Oman	90.90	97.70
82	Palau	52.53	59.33
83	Panama	85.41	90.88
84	Paraguay	93.25	98.20
85	Peru	72.86	91.20
86	Philippines	71.30	87.50
87	Rwanda	6.20	18.00
88	Samoa	89.45	100.00
89	Sao Tome & Principle	52.90	60.46
90	Saudi Arabia	90.90	97.70
91	Senegal	36.80	56.50
92	Seychelles	99.40	100.00
93	Sierra Leone	8.56	14.20
94	Singapore	100.00	100.00
95	Solomon Islands	15.70	22.81
96	Somalia	25.91	32.71
97	South Africa	66.10	85.40
98	South Sudan	0.00	5.06
99	Sri Lanka	80.70	88.66
100	St. Kiits & Nevis	85.41	90.88
101	St. Lucia	85.41	90.88
102	St. Vincent & Grenadines	70.94	75.91

	Country	Access to Electricity (percent of population)	
		2010	2012
104	Suriname	99.62	100.00
105	Tanzania	8.80	15.30
106	Thailand	82.50	100.00
107	Timor Liste	34.46	41.56
108	Togo	16.97	31.46
109	Tonga	85.80	95.86
110	Trinidad & Tobago	94.86	99.83
111	Tuvalu	37.46	44.56
112	UAE	90.90	97.70
113	Uganda	8.60	18.16
114	UK	100.00	100.00
115	USA	100.00	100.00
116	Vanuatu	19.10	27.08
117	Venezuela	99.00	100.00
118	Vietnam	89.10	99.00
119	Yemen	41.30	48.41
120	Zambia	17.40	22.06
121	Zimbabwe	34.20	40.46

Source: Data derived from World Development Indicators, World Bank; Exim Bank Research

ANNEXURE 3: INDICATIVE LIST OF FINANCIAL INSTITUTIONS IN ISA MEMBER COUNTRIES

	COUNTRY	SELECT COMMERCIAL BANKS	SELECT FOREIGN BANKS	REGIONAL DEVELOPMENT BANKS	ECAs	DFIs
1	Algeria	Banque Exterieure D'Algerie (BEA) / Banque Nationale D'Algerie (BNA)	BNP Paribas / Citibank	AfDB / IDB		Banque Algérienne de Développement
2	Antigua & Barbuda	Antigua Commercial Bank / Global Bank of Commerce	Scotiabank	CDB		Antigua & Barbuda Development Bank
3	Angola	Banco Angolano de Investimentos / Banco BIC Angola	Standard Bank	AfDB		Banco de Poupanca E Credito
4	Argentina	Banco de la Nacion Argentina / Banco Provincia	HSBC Bank Argentina / Citibank Argentina	CAF / IADB		
5	Australia	Commonwealth Bank Group / National Australia Bank	ANZ Banking Group / HSBC Bank Australia	ADB	EFIC	
6	Bahamas	FirstCaribbean International Bank Bahamas	Scotiabank Bahamas	CDB / IADB		
7	Bangladesh	Islami Bank Bangladesh	Standard Chartered / HSBC	ADB		
8	Barbados	FirstCaribbean International Bank	Standard Chartered / HSBC	CDB		
9	Belize	Atlantic Bank / Belize Bank	Scotiabank / FirstCaribbean International	CDB / IADB		
10	Benin	Banque Régionale de Solidarité / Financial Bank	Societe Generale	AfDB / EBID		
11	Bolivia	BAB	Bank of America	CAF / IADB		Banco Industrial / Banco de Financiamiento Industrial
12	Botswana	Barclays / Standard Chartered	Standard Chartered / Barclays	AfDB		Bank Gaborone / African Banking Corporation of Botswana
13	Brazil	Itaú Unibanco Holding / Banco do Brasil	HSBC Bank Brasil / Citibank Brazil	CAF / IADB / NDB		BNDES
14	Brunei	Baiduri Bank / Bank Islam Brunei	Citibank / HSBC	ADB		Baiduri Finance / Brunei Economic Development Board

	COUNTRY	SELECT COMMERCIAL BANKS	SELECT FOREIGN BANKS	REGIONAL DEVELOPMENT BANKS	ECAs	DFIs
15	Burkina Faso	Bank of Africa / Banque Atlantique Burkina Faso	Societe Generale	AfDB / BOAD / EBID		Central Bank of West African States
16	Burundi	Interbank Burundi / Banque de Crédit de Bujumbura	Ecobank	AfDB / PTA BANK		Banque Nationale de Développement Economique
17	Cambodia	ACLEDA Bank PLC / CIMB	ANZ Royal Bank / BOC	ADB		BIDC / Rural Development Bank
18	Cameroon	UBC / Afriland First Bank	Citibank / Standard Chartered	AfDB		
19	Cape Verde	Banco Comercial do Atlantico / Banco Cabo-Verdiano de Negócios	Ecobank	AfDB		
20	CAR	Banque Internationale pour le Centrafrique / Banque Populaire Maroco-Centrafricaine	Ecobank	AfDB		
21	Chad	Banque de Développement du Tchad / Banque Tchadienne de Crédit et de Dépôt (BTCD)	Ecobank	AfDB		
22	Chile	Banco Santander Chile / Banco de Chile	Scotiabank	CAF / IADB		
23	China	ICBC / Bank of China	HSBC Corp China / Standard Chartered Bank China	ADB	China EXIM	China Development Bank
24	Colombia	Bancolombia / Banco de Bogota	Citibank Colombia	CDB / CAF / IADB		
25	Comoros	Exim Bank Comores SA	Not Available	PTA BANK		Banque de Développement des Comores
26	Congo DR	Advans Banque Congo / Procredit Bank	Barclays Bank / Citibank	AfDB		Fonds de Promotion de l'Industrie
27	Congo	Advans Banque Congo / Trust Merchant Bank	Ecobank / Citibank	AfDB / PTA BANK		
28	New Zealand	ANZ Bank New Zealand / Westpac New Zealand	Rabobank New Zealand	ADB		
29	Costa Rica	Banco Popular / Banco Nacional de Costa Rica	Citibank / Scotiabank	CAF		
30	Cote d'Ivoire	Atlantic Bank Group /	Standard Chartered / Citibank	AfDB / EBID		Banque de l'Habitat de Côte d'Ivoire / Banque Nationale d'Investissement
31	Cuba	Banco de Crédito y Comercio / Banco Internacional de Comercio	BNP Paribas / ING Vyasa	Proposed to join CAF		

	COUNTRY	SELECT COMMERCIAL BANKS	SELECT FOREIGN BANKS	REGIONAL DEVELOPMENT BANKS	ECAs	DFIs
32	Djibouti	Banque Indosuez Mer Rouge / Banque pour le Commerce et l'Industrie - Mer Rouge	International Commercial Bank	AfDB / PTA BANK		Fonds de Développement de Djibouti
33	Dominica	National Bank of Dominica / FirstCaribbean International Bank	The Bank of Nova Scotia	CDB		
34	Dominican Republic	Banco Popular Dominicano / BanReservas	Scotiabank	CAF / IADB		
35	Ecuador	Grupo Financiero Pichincha / Banco del Pacifico	Citibank	CAF / IADB		
36	Egypt	National Bank of Egypt / Banque Misr	Barclays/ Citi /HSBC	AfDB / IDB / Afriexim Bank / PTA BANK		Industrial Development and Workers Bank of Egypt
37	El Salvador	Banco Agricola	Scotiabank / Citibank	IADB		
38	Equatorial Guinea	Afriland First Bank / BGFIBank Equatorial Guinea	Not Available	AfDB		
39	Eritrea	Commercial Bank of Eritrea	Not Available	AfDB		
40	Ethiopia	Awash International Bank / Commercial Bank of Ethiopia	National Bank of Egypt	AfDB		Development Bank of Ethiopia
41	Fiji	Colonial Development Bank	Westpac / ANZ	ADB		Fiji Development Bank /
42	France	Crédit Agricoie / BNP Paribas	HSBC Bank France /	EIB	Compagnie Francaise d'Assurance pour le Commerce Exterieur	
43	Gabon	BGFI Bank	Ecobank / Citibank	AfDB		Banque Gabonaise de Développement
44	Gambia	Access Bank / Prime Bank	Standard Chartered / Zenith Bank	AfDB		
45	Ghana	Prime Bank / First International Bank	Barclays / Standard Chartered	AfDB / EBID		EXIMGUARANTY Company Ghana Ltd / National Investment Bank

	COUNTRY	SELECT COMMERCIAL BANKS	SELECT FOREIGN BANKS	REGIONAL DEVELOPMENT BANKS	ECAs	DFIs
46	Grenada	Grenada Cooperative Bank	Scotia Bank	CDB		
47	Guatemala	Banrural	Citibank	IADB		
48	Guinea	Orabank	Ecobank	EBID		
49	Guinea-Bissau	Banco da Uniao / Banco da Africa	Ecobank	BOAD / EBID		
50	Guyana	Globe Trust Investment Bank	Scotia Bank	CDB / IADB		
51	Haiti	Banque de Leunion	Not Available	CDB / IADB		
52	Honduras	Banco Ficosha / Banco Ficensa	Llyods Bank	IADB		
53	India	State Bank of India / ICICI Bank	Standard Chartered / HSBC	ADB / NDB	EXIM BANK	SIDBI/NABARD
54	Indonesia	Bank Mandiri / Bank Rakyat Indonesia	RBS / Citibank	IDB	INDONESIA-EXIM	
55	Jamaica	Pancaribbean Merchant Bank	Nova Scotia / Fist Caribbean International Bank	CDB / CAF / IADB	National Export-Import Bank of Jamaica Ltd	
56	Japan	Mitsubishi UFJ Financial Group / Sumitomo Mitsui Financial Group	Citibank Japan /	ADB	JBIC	
57	Kenya	Kenya Commercial Bank / Equity Bank	Citibank / Standard Bank	AfDB / EADB / PTA		IDB Capital Ltd / Industrial and Commercial Development Corporation/EADB
58	Kiribati	Development Bank of Kiribati	ANZ	ADB		
59	Laos	Lao Development Bank	Standard Chartered	ADB		
60	Liberia	Global Bank Liberia	Ecobank	AfDB		Liberian Bank for Development and Investment
61	Libya	National Commercial Bank	Mediterrnean Bank	AfDB		Libyan Foreign Bank
62	Madagascar	Otiv Sava	Societe Generale	AfDB		
63	Malawi	Indebank / Fdh Bank	Nedbank / Standard Bank	AfDB		Export Development Fund

	COUNTRY	SELECT COMMERCIAL BANKS	SELECT FOREIGN BANKS	REGIONAL DEVELOPMENT BANKS	ECAs	DFIs
64	Malaysia	Maybank / Public Bank	HSBC Bank Malaysia / Kuwait Finance House Malaysia	ADB	Export-Import Bank of Malaysia Berhad	
65	Maldives	Bank of Maldives / Maldives Islamic Bank	Habib Bank	ADB		
66	Mali	Bank of Africa, Banque malienne de solidarite	Ecobank	BOAD / EBID		
67	Marshall Islands	Bank of Marshall Islands	Not Available	ADB		
68	Mauritania	Banque pour Le Commerce	BNP Paribas	AfDB		
69	Mauritius	MCB Group / State Bank of Mauritius	Barclays / Standard Chartered	AfDB		Development Bank of Mauritius
70	Mexico	Grupo Financiero BBVA Bancomer / Grupo Financiero Banamex	JP Morgan / Citibank	CDB / CAF / IADB	Banco Nacional de Comercio Exterior	
71	Micronesia	Bank of Federated states of Micronesia	Not Available	ADB		Federated States of Micronesia Development Bank
72	Mozambique	Opportunity Bank Mozambique	Barclays Bank / Standard Bank	AfDB		GAPI SARL
73	Myanmar	Hana Bank / Asian Yangon International Bank	ANZ Bank / ABN Amro	ADB		Myanma Foreign Trade Bank
74	Namibia	Bank of Namibia / First National Bank	Nedbank / Standard Bank	AfDB		
75	Nauru	Toca Bank Corporation	Not Available	ADB		
76	Netherlands	ING Bank / Rabobank Group	Merrill Lynch / Bank of Tokyo Mitsubishi	EIB		
77	Nicaragua	Bac Nicarahua / Bancentro	Citibank / Banco Procredit	IADB		
78	Niger	Bank of Africa Niger / Banque atlantique Niger	Sterling Bank / Fidelity Bank	AfDB / BOAD / EBID		
79	Nigeria	Zenith Bank / First Bank of Nigeria	Standard Chartered / Citibank	AfDB / EBID	NEXIM	Bank of Industry Ltd / Federal Mortgage Company Bank
80	Oman	BankMuscat / National Bank of Oman	HSBC Bank Oman			
81	Palau	Asia Pacific Commercial Bank	Bank of Hawai	ADB		

	COUNTRY	SELECT COMMERCIAL BANKS	SELECT FOREIGN BANKS	REGIONAL DEVELOPMENT BANKS	ECAs	DFIs
82	Panama	BAC Panama / Banco General	BNP Paribas / Scotia Bank	CAF / IADB		
83	New Guinea	Bank of South Pacific	Not Available	ADB		National Development Bank
84	Paraguay	Banco Amambay / Interbanco Sa	ABN Amro / Citibank	CAF		
85	Philippines	BDO Unibank /Bank of the Philippine Islands	China Banking Corporation / Rizal Commercial Banking Corp	ADB	PHIL-EXIM	
86	Peru	Banco de Credito del Peru / BBVA Continental	Scotiabank Peru	CAF / IADB		
87	Rwanda	Bank of Kigali / Commercial Bank of Rwanda	Kenya Commercial Bank	AfDB / EADB / PTA BANK		Development Bank of Rwanda / EADB
88	St. Lucia	1st National Bank of St Lucia	United Bank Limited, European Commerce Bank	CDB		
89	St. Kitts & Nevis	Caribbean Banking Corporation	Royal Bank of Canada / Bank of Nova Scotia	CDB		
90	St. Vincent & Grenadines	Caribbean Banking Corporation	Not Available	CDB		
91	Samoa		ANZ	ADB		
92	Sao Tome & Principle	Banco Equdor / Island Bank	National Investment Bank			
93	Saudi Arabia	Al-khabeer Capital / Muscat Capital	UBS / Citibank / Barclays			
94	Senegal	Banking Company of West Africa	ICB Banking Group / Citibank	AfDB / BOAD		Caisse Nationale de Crédit Agricole du Sénégal
95	Seychelles	MCB Group Limited	Bank of Ceylon / Barclays Bank	PTA BANK		Development Bank of Seychelles
96	Sierra Leone	Guaranty Trust Bank / Rokel Commercial Bank	Access Bank / Ecobank	AfDB / EBID		National Development Bank
97	Singapore	DBS / Bank of Singapore	Standard Chartered / Bank of Tokyo	ADB	ECICS Credit Insurance Ltd.	
98	Solomon Islands	Bank of South Pacific	ANZ / Westpac			
99	Somalia	Salaam Somali Bank	Not Available	AfDB / PTA BANK		

	COUNTRY	SELECT COMMERCIAL BANKS	SELECT FOREIGN BANKS	REGIONAL DEVELOPMENT BANKS	ECAs	DFIs
100	South Africa	Standard Bank / FirstRand	Barclays Africa Group /	AfDB / NDB	DBSA	Industrial Development Corporation
101	South Sudan	Ivory Bank / Nile Commercial Bank (	Commercial Bank of Ethiopia	AfDB		
102	Sri Lanka	Bank of Ceylon / Commercial Bank of Ceylon	HSBC / Citibank	ADB	Sri Lanka Export Credit Insurance Corporation	
103	Sudan	Bank of Khartoum / Family Bank	African Bank for Trade & Development	AfDB / PTA BANK		
104	Suriname	Finabank / VCB Bank	Not Available	CDB / IADB		
105	Tanzania	Exim Bank / Akiba Commercial Bank	Diamond Trust Bank / Standard Chartered Bank	EADB / PTA BANK		TIB Development Bank Ltd / East African Development Bank
106	Thailand	Bangkok Bank / Siam Commercial Bank	Bank of Tokyo Mitsubishi / Standard Chartered	ADB	EXIM -Thailand	
107	Timor Liste	Banco General	ANZ Bank	ADB		
108	Togo	Ecobank Transnational	Not Available	BOAD / EBID		
109	Tonga	MDF Bank	ANZ Bank / Westpac	ADB		Tonga Development Bank
110	Trinidad & Tobago	Republic Bank / First Citizens Bank	Scotiabank Trinidad and Tobago / ING Bank Turkey	CDB / CAF / IADB		
111	Tuvalu	National Bank of Tuvalu	Barclays / UBS			
112	Uganda	ABC Bank / Imperial Bank Uganda	Barclays / Citibank	AfDB / EADB / PTA BANK		Uganda Development Bank / East African Development Bank
113	UAE	ADCB	Barclays / Citibank	IDB		
114	UK	HSBC Holdings / Barclays	Citibank / Bank of NY	EIB		UK Export Finance
115	USA	JPMorgan Chase & Co / Bank of America	HSBC / Barclays		US-EXIM	
116	Vanuatu	Pacific Private Bank	ANZ	ADB		
117	Venezuela	Mercantil Servicios Financieros / Banesco Banco Universal	Ecobank	CDB / CAF / IADB		

	COUNTRY	SELECT COMMERCIAL BANKS	SELECT FOREIGN BANKS	REGIONAL DEVELOPMENT BANKS	ECAs	DFIs
118	Vietnam	VietinBank / Agribank	Standard Chartered / HSBC	ADB		Vietnam Development Bank / Bank for Investment and Development Bank
119	Yemen	Saba Islamic / Rafidan Bank	Calyon Credit			
120	Zambia	Access Bank Zambia / First Alliance Bank Zambia Limited	Citibank / Standard Chartered	AfDB / PTA BANK		Development Bank of Zambia / Zambia State Financing Company Ltd.
121	Zimbabwe	BancABC / CBZ Bank	Standard Chartered / Barclays	AfDB / PTA BANK		

Source : Exim Bank Research

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