Unleashing Bangalore Roof Top Solar Potential

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1.Executive Summary:

In this analysis, I propose that Bangalore can be a 1GW solar city by 2020. This may sound bold when compared to the reality of existing solar installation in leading cities such as Berlin (98 MW), New York (14 MW) or San Francisco (23 MW) or the overall achievement of 2.5 GW in India as a whole until mid-2014. However, it is not so bold, if we assume that the landscape of power supply is changing fundamentally: Grid power prices continue to rise and the power supply deficit in India is widening. Given the dramatic fall in the cost of solar power (by as much as 50% in the last two years), solar has moved into the mainstream and become a viable option. Theoretically, the total land area on which Bangalore is built could support 60 GW of solar PV. Therefore, 1 GW requires only 1.6% of the city's land. My case does not rest on government subsidies. Instead, I look at parity between the levelized cost of solar photovoltaic (PV) systems and consumer grid prices. Assuming a fairly conservative 5% p.a. reduction in the cost of solar power and a 6% p.a. increase in grid prices, parity has already reached in some states and in other states parity will be reached in all the tariff segments by 2018-19. Solar will be a smart investment choice for consumers as well as for third party investors. What is needed is, above all, a level playing field. For this, grid connectivity of rooftop solar will be the key. I arrived at 1 GW target for Bangalore by combining three perspectives. I first looked at the available rooftop space to reach a geographic potential. Then, I looked at the economic viability of solar for different tariff groups and system sizes. Lastly, I assessed how much grid-connected solar power the grid could handle. For the geographic potential, data was difficult to come by, so I used different mapping sources "the Bangalore Master Plan 2021, Bangalore Development Authority data" and geo-modelling of samples "individual buildings and colonies based on Google Earth, Google Maps and the Eicher map of Bangalore" and extrapolated from that based on assumptions.

The grid perspective is complex and there is hardly any reliable information available. As per my knowledge, there has been no detailed study on the ability of the Bangalore grid to handle distributed, intermittent power sources. Even in countries such as Germany or the USA, where studies have been conducted, there is no clear indication of what a grid of specific characteristics can handle. A frequently read estimate is that 15%-20% of distributed, intermittent power in the grid is not harmful (it might even stabilize the grid).

In 2013, Germany has seen days when renewable power made up more than 50% of overall power and the grid has taken it well. In my analysis, we have not considered storing of solar power. Given currently available technology, stored solar power would be economically attractive only after 2020. In my roadmap, I suggest that 1 GW of solar power on the grid would be reached by 2020. Solar power would not exceed 20% of the load expected on the grid by 2020. So, storage is perhaps not necessary, from a grid perspective. However, more research should be conducted on understanding the effect of large-scale solar deployment on the grid. It is also reasonable to assume that over the next years, new technologies and the experiences of grid operators across the world will provide new solutions.

Economic and demographic growth in Karnataka capital Bangalore has been accompanied by a significant expansion of the city's infrastructure. The Karnataka government has been committed to improving energy supply. In recent years, Bangalore has achieved a very high availability of power. Blackouts have become rare. However, given India's growing power deficit, the rising cost of power and Bangalore's rapidly growing power demand, it will be difficult to maintain this level of supply stability in the years to come. Solar, as a locally available, environmentally friendly and increasingly viable source of power can provide Bangalore with an attractive long-term power supply option, reducing the city's reliance on power imported from other states and fossil fuels. I believe that going solar is not so much a choice but inevitability for Bangalore. It will be driven by the increasingly favourable economics of solar and by customer demand. Entrepreneurs will develop business models to serve Bangalore's power consumers as long as there are no regulatory hurdles placed in their path. The other stakeholders, the regulators, the utilities and the financing community should help to actively shape this change and make it their success, too.

A good starting point for the Bangalore government to show that it wants to lead and is ready to embrace a paradigm change in the way electricity is generated, distributed and consumed, is to state higher, but still perfectly achievable solar RPO targets. We believe that they can be at least 0.50% in 2014 and 9.75% in 2020 without requiring significant extra investments from the government, the utilities or the power consumers.

2.About Bangalore

Bangalore being the capital city and the largest city of the Karnataka, is popularly known as the 'Silicon Valley of India's has become one of Asia's fastest growing.
The growth of IT in the city, which is the largest contributor to India's software experts, is now regarded as a high-tech city with office or development centres of number of mega software companies having wholly owned subsidiaries or joint ventures in Bangalore, including IBM, Hewlett-Packard, Texas Instruments, Oracle, Novell, Fujitsu, and Digital Equipment. Bangalore is also headquarters to a larger number of Indian software companies. In a short time, Bangalore has experienced rapid growth and international recognition in the field of software development. This has resulted in placing the city at a promising position in the international market for software. Presently with area of just 741 sq.Km, the city offers the opportunity of lesser travel time and travel distance but at the same time offers opportunities similar to Delhi or Mumbai.
The city also attracts people from all over the world for its excellent schools and universities, such as the Indian Institute of Science, National Institute of Mental Health and Neuro-Physics, the Indian Space Research Organization, Indian Institute of Management and Indian Institute of Aero-physics. Bangalore is even gaining the status of the 'Floriculture Capital' due to the present boost of the flower export from the city. Due to the rich stone resources Bangalore is also known the 'Stone City', especially for its granite deposits. The city is also known as the aviation/aerospace hub with large number of aviation and precession engineering companies preferring Bangalore as their headquarters.
Bangalore city has IT-ITES sector, knowledge based sectors and other industries as key economics drivers, which have been witnessing healthy growth over last decade and expected to continue to improve over the coming years. Further, Bangalore city is dotted with several educational institutes, research colleges, etc., which are resulting in large immigrant white collar population to the city, this large influx of working population has opened avenues for many real estate developers to build large scale developments across the city-commercial, residential, retail, hospitality, etc. to cater to the growing demand.

In the last decade, Bangalore has gained a special significance in the real estate market. With IT-boom supporting the overall city development, the city planners now feel that it will be one of the international metropolitan cities in the next 5-7 years. Other than IT and ITES, other sectors like bio-tech, aerospace, automobile, garments, finance, and real estate also have shown phenomenal growth in the past 5 years. The growth in the commercial sector has led to growth in residential, hospitality and retail sector too. The spur of activities led to increase in spread of city catchment. The Bangalore real estate market is one the fastest growing markets in India with a greater stress on quality developments. The market is seeing exponential growth with the support from the growth of IT-ITES and other knowledge based sector. In a nutshell, Bangalore real estate market is fast emerging as one of the sustainable markets, compared to all the cities in South India.

3.Power situation in Bangalore:

Over recent times, there have been reports about power shortage in the Bangalore city, Bangalore Electricity Supply Company (BESCOM) had contemplated power cuts for industries, but later changed the plan when rains started. Currently, the city has shortage of around 100 MW daily, which is only less than 5% of its total requirement. The shortage for entire BESCOM area is up to 600 MW. The shortage cannot be quantified, but varies from 0-600 MW through the day depending on wind and other sources. Bangalore's daily power demand is about 2300 MW (Mega Watt). That is, 2300 MW of power is transmitted throughout the day to the city on average (there are sharp differences in peak and non-peak hour consumption though). Bangalore consumes about one-third of the state's total power. Karnataka's average demand is 6000 MW per day. Overall, Bangalore consumes 46.6 Million Units (MU) energy per day, as opposed to state's 150 MU. The transmission of 2300 MW through the day, leads to consumption of 42 MU of energy.

• BESCOM disparity in power allotment between Urban and Rural Consumers:

Bangalore city is indeed the pampered capital. The number of hours of disruption in power supply in Bangalore city barely goes beyond three hours; while the rural areas are lucky if they get more than nine hours of power supply. Conceding this fact, Bangalore Electricity Supply Company (BESCOM) spokesperson and Chief General Manager (Corporate Affairs) Anand Naik said that this was because the government had directed galore. This government order has been upheld by the Karnataka Electricity Regulatory Commission (KERC). Consumers "That apart, around 50 per cent of BESCOM's 81 lakh consumers are from Bangalore. Industrial and commercial consumers in Bangalore pay a different tariff rate compared to the rural consumers, thus cross subsidizing the rural consumers. That is why it is financially viable for BESCOM to supply electricity 24 hours to Bangalore," he said. The city is allotted 2000 MW. If the demand goes above 2000 MW, then BESOM overdraws up to 100 MW from the grid. BESCOM does not draw from the allocation of the rural areas.

- **Industrial situation in BESCOM:**

Around 1.7 lakh industries in the State, around 1.56 lakh are in Bangalore, approximately 10,000 on the city's outskirts and roughly 2,000 in the rural areas fed by BESCOM. As much as 48 per cent of power is consumed by industries alone. Most industries are on express feeders and get 24-hour supply. Those on rural feeders get only three hours of supply in the day and nine hours in the night. If there is no shortage, another three hours of supply is added. However, according to BESCOM's tariff filings for 2013-14 before the KERC, the estimated energy requirement is 25,387 million units, of which the industrial consumption is around 5,600 million units.

- **What are our power sources?**

Bangalore is powered by the same grid that supplies to the entire state - there are no specific sources for Bangalore alone. The sources include hydel, thermal and non-conventional sources like wind and solar. The state also gets power from Central Generating Stations (CGS) like Neyveli Lignite Corporation, Kaiga Atomic Power Station in North Karnataka etc. Together, the sources have the maximum capacity to produce 12,000 MW of power, but actual generation is about 6000 MW and the extent of generation from each source varies through the day. Major sources are the state's own hydel and thermal power stations.

- **Hydel power:**

The state has over 15 hydel power stations - Shivanasamudra, Sharavathy and Bhadra are some of them. Though hydel power is a major part of state's power, BESCOM gets only a small share of it. The amount of hydel power allocation is fixed for ESCOMs (Electricity Supply Companies).

BESCOM gets 12% of state's hydel power for its entire area which also includes Tumkur, Chitradurga, Davanagere etc (not just Bangalore). Because of this low dependency on hydel power, poor monsoon rains do not hinder power supply to Bangalore as much

- **Thermal power:**

Thermal power comes from coal, gas and diesel stations. Raichur and Bellary Thermal Power Stations (RTPS and BTPS), and Yelahanka Diesel Generating Station (YDGS) are the state's major thermal stations. Unlike hydel power, thermal power is stable as long as there is no shortage of coal/diesel. BESOM gets majority of its power from this sources.

- **Central Generating Stations (CGS):**

CGS is thermal/nuclear stations. The stations are maintained by central government, and each state gets a specified share of the power generated. The state, in which the station is located, will get majority of the power while neighbouring states will get a smaller share. Karnataka gets about 1000 MW from CGS, on average.

- **Non-Conventional Energy Projects (NCEPs):**

This power is produced not by government agencies, but by Independent Power Producers (IPPs). NCE sources mainly are wind, solar, biomass etc. Wind generation is a major part of NCEPs, but depends on wind availability. While IPPs like Tata BP Solar exclusively generates solar power, much of NCE is generated in factories as by-product.
For instance, in sugar and steel factories, while production process goes on, power can be generated simultaneously. The factories use part of this power for themselves, and sell the excess to the state. Udupi Power Corporation Ltd (UPCL), a major IPP, produces power from imported coal.

- **How power reaches Bangalore?**

Three agencies are involved in the procurement, transmission and supply of power, before it reaches consumers. Karnataka Power Corporation Ltd (KPCL) is the state agency that gets power from different generating stations. KPCL also buys power from other states when required. Another agency, Karnataka Power

Transmission Corporation Ltd (KPTCL) is in charge of transmitting power to different ESCOMs, including BESCOM. Once it gets the power from KPTCL, BES COM's local network supplies it to consumers. All of this is co-ordinated by KPTCL's State Load Despatch Centre (SLDC). ESCOMs inform SLDC about their power requirement forecast for the next day, 24 hours earlier. Similarly, KPCL informs SLDC of its generation forecast, a day before. Depending on this, the total power is distributed among each ESCOM for the next day. Demand and supply varies through the day, and SLDC maintains real-time data on this.

4.Integration of solar PV with the grid

Integration of a rooftop solar PV system with the grid is not a technical requirement as it could also provide a purely captive solution, where the entire power generated could either be consumed immediately or stored for later use at the site of generation. However, grid connection can be a key driver for rooftop PV as it allows systems to avoid storage (which can increase system costs by 25% or more) and offers more off-take options (i.e. the grid through, for example, net-metering or FITs). Power grids were originally designed for the one-way supply of power from a central source of power generation to the consumers. The security, con trol, protection, power flows and earthing of the network were based on this centralized generation model. Distributed generation technologies, such as solar PV systems, when connected to the larger distribution network of the grid create a two way supply of power, from the grid to the consumer and from the consumer to the grid. This requires a re-thinking of the way the grid is regulated and managed.

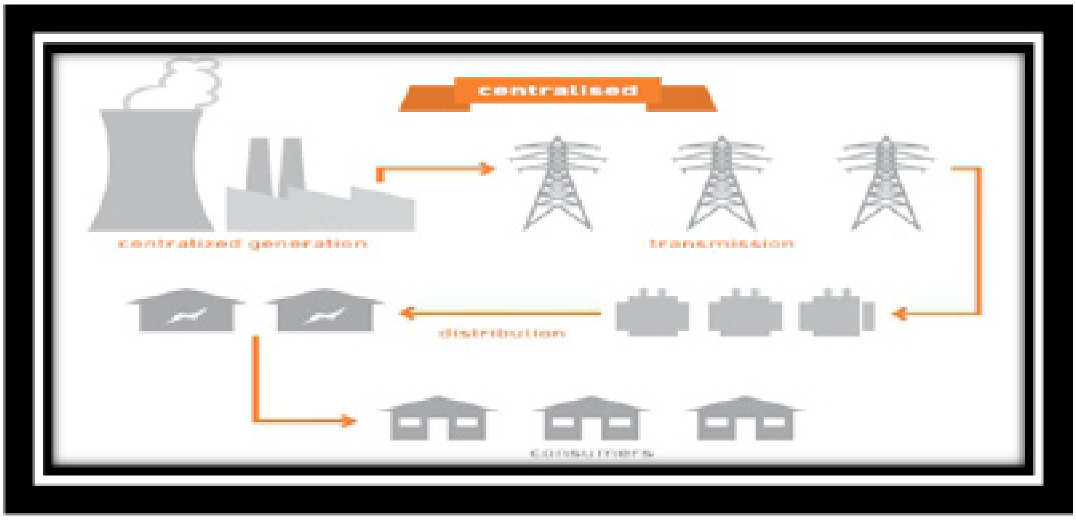
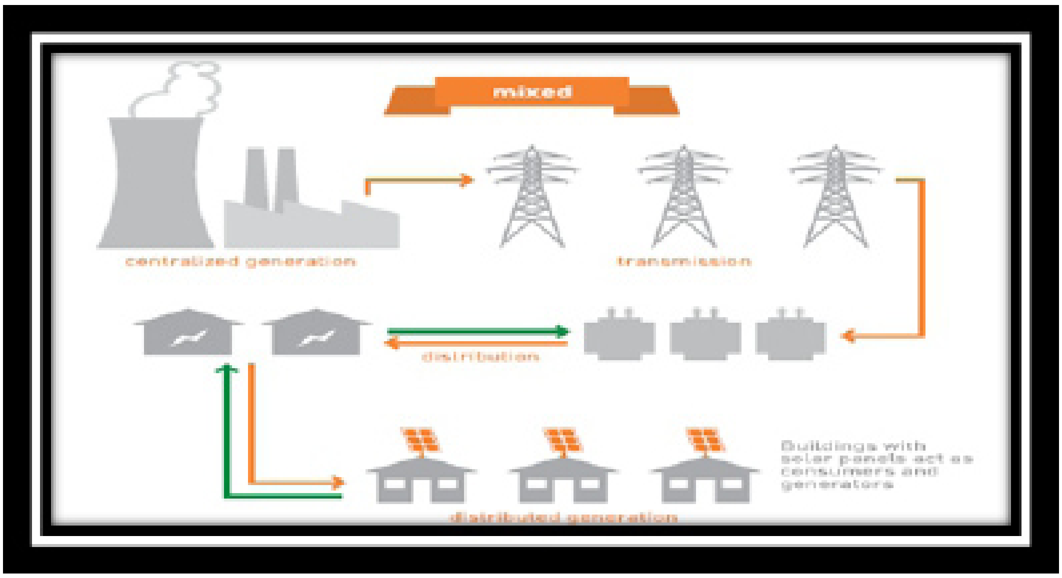


Fig: Centralized vs. mixed (centralized and distributed) power generation



Traditional grids are not designed for a two way supply of power. Beyond a certain limit of PV penetration, traditional grids can be destabilized due to e.g. the intermittent quality of solar power, reverse power flow (when a PV system at the consumers end generates more power than the consumer can use) and voltage imbalances. Decentralized PV systems can alter the load profile of the network as the power from such systems can be consumed on site as well as injected in to the grid.

High on-site PV consumption by consumers could reduce the load on the network during the day, while increasing it at night (because of an absence of PV generation). Further, the load on the grid can also fluctuate as PV generation is highly weather dependent and can drastically drop in the case of a cloud cover. High levels of grid-connected decentralized PV penetration can present a significant load management challenge for the DISCOMS.

. As per estimates, a traditional grid can accommodate up to 15% of the peak load from distributed solar PV without being destabilized, while managing load fluctuations easily. This places a "grid limit" on the rooftop solar PV capacity in Bangalore that can be connected to the grid. However, this "grid limit" is recognized as being conservative. Simple, low-cost measures like introducing specific standards for PV inverters, guidelines for grid connectivity and better load forecasting and planning can make a difference in the amount of PV penetration possible in Bangalore. In the future, the grid's capacity for PV can be increased drastically if the grid is upgraded with smart grid management/ monitoring solutions (including advanced forecasting, scheduling and load management) and centralized or decentralized storage. Countries like Germany, with an already advanced grid infrastructure, have reached 40% of decentralized PV in the power mix by adding in telligent transformers and storage devices that regulate the quality of power and stabilize the grid. Such solutions increase the hosting capacity of the grid, but require significant investments. In my analysis below I have assumed that the grid infrastructure will be improved.

5.The Bangalore viability of Rooftop Solar:

The total area of Bangalore is 741 km2. If such an area were unused and exclusively available for solar installations, it could support 60 GW of installed capacity which, at peak power production, would be more than 20 times Bangalore expected peak power demand of 2.3 GW for 2014. 50% or 350 KM2 of Bangalore total area is built-up and theoretically available for rooftop PV systems. Based on my analysis in this report, I have estimated that of the350 km2 of built-up space in Bangalore considering all residential, commercial, Industrial, Government, public & semi-public facilities and transport in which 10 km2 or 3% of Bangalore rooftop space is actually available for PV systems. This much space gives Bangalore a geographic solar potential of 1000 MW.

By utilizing the large potential for solar energy, Bangalore could drastically reduce its dependency on external power sources as well as its vulnerability to the kind of massive grid failures. Further, Bangalore now enjoys near constant availability of power. This comes at the cost of rising electricity prices. They have increased by an average of 20% across consumer groups in the year 2012 alone. Price hikes will likely continue as the demand in the city increases. Solar installations on the other hand, last 20 years or more, with the cost of power remaining unchanged for the entire lifetime of a plant. By switching to solar, the city can hedge against future increases in grid electricity prices.

Solar resource availability for Bangalore:

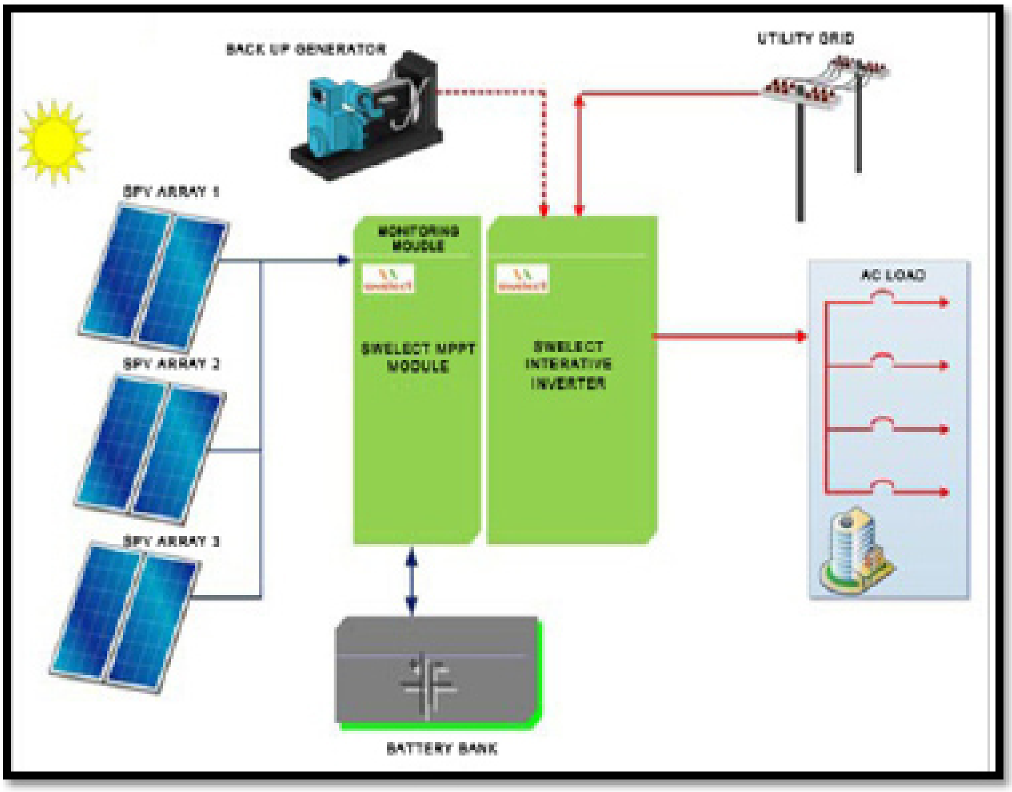
Solar irradiation is the amount of radiant solar energy available per unit area and is usually expressed in terms of kilowatt-hours per square meter per day (kWh/m2/ day). As sunlight streams through the atmosphere, only some of it reaches the ground, with the rest being reflected, absorbed and scattered. The amount that actually reaches the ground depends on a number of factors such as latitude, season, time of day, air quality and other atmospheric conditions (e.g. clouds, aerosol particles, etc.). This can be used to generate power by way of technologies such as solar PV systems.

Months	Solar Radiation Kwh/m^2/day
Jan	5.36
Feb	6.06
Mar	6.56
Apr	6.38
May	6.03
Jun	4.84
Jul	4.5
Aug	4.47
Sep	5.03
Oct	4.63
Nov	4.5
Dec	4.74

Source: Nasa data

The average solar irradiation of Bangalore according to synergy environ is around 5.6 kWh/m2/day and optimum angle is 15 degrees.

6.Rooftop Concept:



The primary source will be solar followed by grid (secondary source); if grid is not available then if DG(tertiary source) is available the DG set will supply the power to the load.

7.Bangalore's existing rooftop solar policy highlights:

Grid connected solar rooftop projects and metering.
The Government of Karnataka shall promote grid connected solar rooftop projects on public buildings, domestic, commercial and industrial establishments through net metering and gross metering methods based on tariff orders issued by KERC from time to time. Net metering arrangements are proposed (at multiple voltage levels) to focus on self-consumption of energy generated from rooftop PV. The concept is a combination of captive consumption and exchange of power with the utility. In case of solar rooftop PV systems connected to the grid of a distribution company on a net basis, the surplus energy injected shall be paid by the ESCOMs at a tariff determined by KERC from time to time. Currently the rate is Rs 7.20/Unit. Metering shall be in compliance with the CEA (installations and operation of meters) Regulations 2006, the Grid code, the metering code and other relevant regulations issued by KERC/CERC from time to time. ESCOMs will define specific guidelines on the standards for connectivity to the network. The scheme shall be administered by respective ESCOMs (including registration, approval, metering protocols,

safety protocol, and standards).Fiscal benefits by the way of state and MNRE subsidies shall be through nodal agency. The meter reading taken by the distribution licensee shall form the basis of commercial settlement.

Site Requirement & Interconnection voltage:
The project site I installation locations may be decided based on the total energy requirement at the premises and the usable area available for installation of rooftop Solar PV system.
ESCOM approved export I import meters shall be installed for net metering purpose.
Inter connection voltages:

System capacity	Voltage level	Remarks
Up to 5 KWp	240 V/Single Phase	As per KERC guidelines
5 KWp to 50 KWp	3 Phase/ 415 V	
> 50 KWp	11 V	

Other initiatives.

• The Government of Karnataka encourages energy – efficient design standards for energy generation, maximizing natural light entry, options that provide heat insulation including grid tied building integrated PV (BIPV) based building architecture.

• Government of Karnataka contemplates to a mend building bye laws in respect of FAR (Floor Area Ratio) in co-ordination with BBMP I local bodies and urban development department to exempt FAR in respect of additional floor area created under solar PV panels with light roofing.

8.Estimation of Potential for RTPV Systems:

The total installed capacity of rooftop PV feasible in Bangalore is estimated to be the order of 1000 MWp, based on the overall space assessments in urban and rural Bangalore. Small scale PV-based generation from rooftop systems play a potential role in Demand Side Management (DSM) and peak load reduction for urban areas. Similarly, decentralized PV-grids may provide an opportunity for providing energy supply at desired levels of service in areas with willingness to pay.

Some of the key initiatives to incentivize investment in small scale PV generation are identified below:

• Initiate pilots to evaluate success of rooftop PV generation

• Provide incentives similar to green certificates based on consumption of green energy. i.e. incentivize generation from rooftop systems in addition to installation

1. Revise current Feed-In-Tariff (FIT) for rooftop solar in line with current costs

• Enable participation of group owners of rooftop PV systems in REC mechanism

• Define and implement connectivity guidelines/standards for interconnection through a technical committee consisting of ESCOMs and solar system installers.

Bangalore power consumers can be divided into four categories: Residential buildings, Industrial & Office buildings, commercial, public & semi-public building, Hospital and educational building. An attempt to estimate the potential of cutting down on diesel use in commercial establishments using RTPV was made for Bangalore, one of India's major cities. Table below calculates the percentage of abatement possible using the total commercial space available and office electrical intensity in Bangalore.

Estimation of Potential for RTPV Systems in Bangalore

Total land area available in Bangalore	741	SqKms
Total roof top space available in Bangalore*	21820,01,918	Sq Ft
Residential	18127,90,464	Sq Ft
Industrial/Office	3021,31,744	Sq Ft
Commercial	421,06,853	Sq Ft
Hospitality	249,72,857	Sq Ft
Total roof top space available in Bangalore	2027,88,282	SqMts
Total space in Bangalore (million m2)	203	Million SqMts
FSI** considered	5	
Total rooftop available (total commercial space/FSI)	40.556	Million SqMts
Rooftop available for solar PV (%)	25	%
Total RTPV area	10.139	Million SqMts

Office electrical intensity	130	(kWh/m2)***
Total electricity consumption	26361.4	(million kWh)
Diesel consumption (%)	5	%
Units of diesel power (million kWh)	1318	(million kWh)
RTPV unit area required	10	Sq Mt/Kwp
Total installed capacity feasible for Bangalore	1013.9	MWp
Energy generated by 1 MW Solar power plant in annum	1.664	(million kWh)
Total potential solar energy generation per annum	1687.1296	(million kWh)
Capacity utilisation factor for RTPV (%)	19	%
Annual electricity generation from PV	1687	(million kWh)
Diesel use abatement possible	121	%

Notes:

Data:

Primary Data: Bangalore Development Authority (BDA), Bangalore Metropolitan Rural Development Authority (BMRDA), Bangalore Corporation Office, Google Map, Village Maps.

Secondary Data: Wikipedia, Bangalore mirror, village maps, Bangalore Master plan

** The floor area ratio (FAR) or floor space index (FSI) is the ratio of the total floor area of buildings on a certain location to the size of the land of that location, or the limit imposed on such a ratio.

***Average EPI as specified in BEE bandwidth document.

Building Types	Residential	Industrial and Office	Commercial
BESCOM Tariff	(0-30)units-Rs 2.70/Unit	(0-100,000)Units- Rs 5.75/Unit	(0-100,000)Units-Rs 7.35/Unit
	(31-100)Units-Rs 4.00/Unit	(Above100,000) units- Rs 6.15/Unit	(Above 100,000) units-Rs 7.65/Unit
	(101-200)Units- Rs 5.25/Unit		
	(Above 200)Units- Rs 6.25/Unit		
Solar Potential	842 MW	140 MW	20 MW
Tentative energy generated through solar(Kwh)/Annum	14010,88,000	2329,60,000	332,80,000

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Financial Viability:

Crystalline Technology without REC- INR 7.5/Unit
Thin Film Technology without REC- INR 6.8/Unit

Assumptions:

1) Residential power consumption: 500 units
2) Commercial power consumption: 200,000 units
3) Industrial power consumption: 200,000 units
4) Annual increase in power charges year on year 6%

Category	Consumption	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Residential	500	5.5	5.9	6.2	6.6	7	7.4	7.8
Industrial	2,00,000	6	6.3	6.7	7.1	7.5	8	8.4
Commercial	2,00,000	7.5	8	8.4	8.9	9.5	10	10.6

- Grid Parity for Residential customer is in 2019-20 for crystalline technology and 2017-18 for thin film technology.
- Grid parity for commercial customer is in 2014-15 for crystalline technology and thin film technology is already reached in 2013-14.
- Grid parity for industrial customer is in 2018-19 for crystalline technology and 2016-17 for thin film technology.

9.Conclusion:

Bangalore Geographic Potential for Solar Rooftop Installations:

Bangalore has the potential to build around 1GW of solar PV on its rooftops. I have only assessed rooftop space for solar PV panels. Other technologies, such as building-integrated PV (BIPV) could additionally make walls of buildings available for solar power generation, but are still too far from commercial viability to be considered here. Bangalore's residential buildings represent 83% of the solar potential. They are followed by industrial and office buildings with 13% of the potential, commercial buildings with 2%, Government buildings, and public and semi-public facilities with 1% of the total potential, respectively. Green stretches, water bodies, historical buildings and public utilities have been excluded from the analysis.

Residential buildings:

Such buildings have a solar potential of 842 MW, the largest among all other buildings types. Residential buildings include those under the jurisdiction of Bangalore Development Authority (BDA), Bruhat Bangalore MahangaraPalike (BBMP), Bangalore Metropolitan Rural Development Authority (BMRDA). The total built area available for rooftop solar installations is around. The solar suitable rooftop space is around 453 million Sq ft. To arrive at this number, the solar suitable rooftop space was assumed to be around 25% of the total rooftop area.

This percentage is based on samples and discounts for the space occupied and shadows created by water tanks, ventilating shafts, dry clothes lines and storage units that occupy most of the area on a typical residential rooftop.

Viability of rooftop solar PV for Residential consumers

Residential consumer's tariff for electricity is as high as Rs 6.25. Based on their load requirement, commercial consumers fall into four tariff categories. Upto 30 units consumers pay Rs 2.70/unit, 31-100 units the consumer pay Rs 4/unit, 100-200 units the consumer pay Rs 5.25/unit and above 200 units consumption consumer has to pay Rs 6.25/unit. With financial indicator of EIRR as 18% and PIRR of 14%, INR 7.50 /unit for crystalline technology and INR 6.80/unit for thin film technology make project financially viable. Grid parity for residential customer is in 2019-20 for crystalline technology and thin film technology is already reached in 2017-18.

Industrial & Office buildings:

Industrial and office buildings have a solar potential of 140 MW. Industries, Factories, Workshops, Research & Development Centres, Industrial Estates, Milk dairies, Rice Mills, Phova Mills, Roller Flour Mills, News Papers, Printing Press, Railway Workshops/KSRTC Workshops/Depots, Crematoriums, Cold Storage, Ice & Ice-cream mfg. Units, Swimming Pools of local bodies, Water Supply Installations of KIADB and other industries, all Defence Establishments. Hatcheries, Poultry Farm, Museum, floriculture, Green House, Bio Technical Laboratory, Hybrid Seeds processing Units, Stone Crushers, Stone cutting, Bakery Product Manufacturing Units, Mysore Palace illumination, Film Studios, Dubbing Theatres, Processing, Printing, Developing and Recording Theaters, Tissue Culture, Aqua Culture, Prawn Culture, Information Technology Industries engaged in development of Hardware & Software as certified by the IT & BT Department of GOK/GOI, Drug Mfg. Units, Garment Mfg. Units, Tyre retreading units, Nuclear Power Projects, Stadiums maintained by Government and

local bodies, also Railway Traction, Effluent treatment plants and Drainage water treatment plants owned other than by the local bodies, LPG bottling plants, petroleum pipeline projects, Piggery farms, Analytical Lab. for analysis of ore metals, Saw Mills, Toy/wood industries, Satellite communication centers, and Mineral water processing plants / drinking water bottling plants, all government and private office buildings considered. The total built area available for rooftop solar installations is around 302 million Sq ft. The solar suitable rooftop space is around 75 million Sq ft.

Viability of rooftop solar PV for Industrial consumers

Industrial consumer's tariff for electricity is as high as Rs 6.15. Based on their load requirement, commercial consumers fall into two tariff categories. Upto 1 lakh units consumers pay Rs 5.75/unit and above 1 lakh unit consumption consumer has to pay Rs 6.15/unit. With financial indicator of EIRR as 18% and PIRR of 14%, INR 7.50 /unit for crystalline technology and INR 6.80/unit for thin film technology make project financially viable. Grid parity for Industrial customer is in 2018-19 for crystalline technology and thin film technology is already reached in 2016-17.

Commercial:

Commercial, public and semi-public buildings have a solar potential of 20 MW. Cinemas, hotels, clubs, boarding & lodging, airport, multi-storied, yards and amusement parks considered. The total built area available for rooftop solar installations is around 42 million Sq ft. The solar suitable rooftop space is around 10 million Sq ft.

Viability of rooftop solar PV for commercial consumers

Commercial consumer’s tariff for electricity is as high as Rs 7.65. Based on their load requirement, commercial consumers fall into two tariff categories. Upto 1 lakh units consumers pay Rs 7.35/unit and above 1 lakh unit consumption consumer has to pay Rs 7.65/unit. With financial indicator of EIRR as 18% and PIRR of 14%, INR 7.50 /unit for crystalline technology and INR 6.80/unit for thin film technology make project financially viable. Grid parity for commercial customer is in 2014-15 for crystalline technology and thin film technology is already reached in 2013-14.