Green TDR

Solar Green House

Green Retrofits for existing PV Power Plant

Solar Human Resource Capacity Building.

Neighborhood Solid waste to power plant.

Solar PV Modules globally competitive made @ India.

SMART URBAN RETROFITS FOR AN UNSMART CITY BANGALORE

Smart City Investment Trust (SMIT).

Urban Morphology Studies for planned future.

Energy Smartness.

Smart Urban System – Virtual Health City and Smart City broadband network.

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Introduction

A Civil Engineer & Town Planning professional since 1995, passionate about integration of renewable energy systems with real estate & urban development projects.

Over the years gained experience from involvement in design development & execution of large townships of all size, shape and management system. One of the Greenfield project had gross area greater than 3000Ha. Portfolio of work also includes non-township urban and industrial infrastructure projects like layouts, IT SEZ, Mechatronic warehouse based logistics hub, Industrial Estates/ Eco Industrial Parks.

Therefore I can conceptualise & design-develop projects in start-up environments within fixed timeline and budget.

How the ideas evolved

At Regional Institute of Technology Jamshedpur, I started tinkering with the idea of low cost, sustainable and quality structures during my undergraduate days. To test these ideas, I started participating in undergraduate design competitions at national institutes of repute like IIT-Delhi (TRYST-92), BITS-Pilani (APOGEE-92). By the time I got BS Engineering (Civil) Degree, I had a publication titled Mud Construction- A New Technique; Institution of Engineers (India); Journal of Architectural Eng.; Vol. 74, March 1994.

The years 1988 to 1993 were politically turbulent period in our country's history. We used to get lots of holidays to avoid political unrests and these holidays gave us opportunity to read and experiment beyond undergraduate curricula. HOD & Faculty of civil engineering were broadminded enough to involve us formally in faculty consultancy works and other extra-curricular works like accompanying the geotechnical rig, traffic counting gun…

I enjoyed studies at graduate school – School of Planning, CEPT Ahmadabad. The curriculum gave more importance to studio works (13 credits out of total 25 credits), usually sponsored and done by a group of students.

1st Quarter studio work involved studying the process of industrialization, rural urban interface & development dynamics, followed by design of an industrial estate. Though I was in a group, I had a different thought. I felt that industrial activity and its relationship to the place of establishment should be like a honey bee and a flower. The honey bee pollinates the flowers while extracting honey from flowers, benefiting both. I also proposed cluster formation and rural infrastructure up gradation to create housing stock for migrants by residents.

2nd Quarter studio work was fun while working hard for a month at Gangtok, Sikkim. We studied the development mechanism and urban morphology of hill stations and towns. GIS was in its infancy, there was limited computer facility in the form of desktops. We prepared the first detailed land use map of Gangtok and undertook land suitability analysis manually. Development strategy included retrofits and new projects, appreciated by urban local body and our sponsor.

Third Quarter studio work involved design of a Slum up gradation plan, focusing on infrastructure improvement by urban local body and housing stock improvement by residents self-help groups. We deliberated and tried ideas like cross subsidization of infrastructure capital cost through sale or lease of developed commercial property along road frontage; formation of self help groups for employment generation; DEWAT's to play the role of decentralised sanitation needs and group ownership of housing stock to prevent gentrification. The slum pocket was along River Sabarmati and the development model became the basis for work on large scale project in the 4th Quarter Studio Work.

Sabarmati River Front development strategy was the outcome of joint effort of students of all the three departments of School of Planning, CEPT Ahmadabad in the year 1994. The study was sponsored by Ahmadabad Municipal Corporation.

I was team leader working on slum networking sub component. The slums covered were along the Sabarmati riverfront i.e. on its bank/beds, along the tributaries passing through Ahmadabad urban areas. General development and utility networking strategies were prepared with case studies of some pockets. The project also included chawls /chawli in the down town areas.

Funding and development models were developed based on stakeholder analysis, this included cross subsidization of utility cost with some commercial developments where it's possible.

Process & Options of slum relocation, redevelopment and up gradation were studied and documented. The interesting outcome of the study was realization that the river front needs to have water throughout the year, therefore we had to propose resection of the river bed, to generate land for new river banks, designed these banks to be accessible and functional (the sewer line below it connected the proposed gentrified slums & erstwhile river outfall, before transferring the same to east bank sewage treatment plants, after the downstream weir)

In February 1995, I graduated from School of Planning, CEPT – Ahmedabad. The first job was six months tenure as Research Associate with Public Systems Group, Indian Institute of Management, Ahmadabad. I realised the need to change job and experience the process of urban infrastructure project conceptualization.

I relocated to Kolkata and joined a public sector technical consultancy organization called WEBCON (December 1995 to April 2005). I was mostly deployed on projects requiring urban planning & infrastructure development management inputs. I also learned while working Project Finance in appraisal of project status, preparation of TEFR and proposals for assessment by Financial Institutions.

WEBCON deployed me between 1999 and 2002 to work as an associate town planner (Engineer Planner), for New Town Project – Kolkata of West Bengal Housing Infrastructure Development Corporation (WBHIDCO). NTP Kolkata is now called Jyoti-Basu Nagar and its in the Post take-off Stage. Today New Town Project of WBHIDCO is working towards revised goal to become a Brownfield SMART CITY.

In the year 2003, NTP had an area of around 3075 Ha and was meant to become urban node of Kolkata. The Project Cost estimated in the year 2001 was around Rs 3000 Cr.

NTP was designed to have physical & functional attributes of a traditional neighbourhood, a human scale settlement and hierarchy of amenity. We did this even before years before Transit Oriented Development & LEED Traditional Neighbourhood Design guidelines of Congress for New Urbanism became available, referring "A Pattern language" of Christopher Alexander and UDPFI Guidelines of Government of India.

I looked after the physical planning & utilities detailing of Action Area I. Action Area 1 is spatially 1/5th of total area and its estimated budget was more than 1/3 rd of the total budget as we had to provide for trunk utility sources at the project take-off itself. Being a patient team player, I prepared weekly MIS & monthly project status. Working with other business verticals in preparation of project status reports, updating MIS needed for transmittal to investors, preparation of TEFR or investment term sheet for next phase of development was a learning experience for me. Some interesting sub-products that made me aware of mitigation requirements of Project Affected People (PAP) including non-statutory CSR are PAP Rehabilitation Cost Optimized Housing and business plan of the "Building Centre". Building Centre became an important effort to integrate the PAP with the development process of NTP. New Town Project of WBHIDCO provided valuable firsthand experience in urban planning and design process of a Greenfield urban node of

metropolitan city, i.e. Kolkata. Thereafter I could conceptualise, design infrastructure as well as utility and holistic approach for their integration as a system.

I became known for out of box solutions while undertaking Techno Economic Feasibility studies, Area Planning exercises, preparation of Master/ Development Plan, Development Control Rules & regulation, PAP rehabilitation schemes. In a Public Sector development management organization, a civil engineer had to be part of team driving vendor & contract management - local practices & FIDIC.

Learning experiences of around a decade in Public Private Partnership ended when I joined Jurong Consultants India on 25th April, 2005. Jurong Consultants India did master planning jobs with limited scale, mainly driven by the need to maximize revenue with lesser priority for project functionality. At Jurong I realised the need to change job with focus on project development and Implementation, rather than a consultancy.

End of 2005, I joined Indian operation of TISHMAN SPEYER (TS), founding member of US & Indian Green Building Council. TS is a global company with an eye for detail, quality of services and promoted iconic architecture. Its iconic skyscrapers in NY and other global cities might be decades old, but has smart retrofits to qualify for LEED certifications.

TISHMAN SPEYER is a company with matured in-house development management professionals supported by world renowned and best local consultancy teams. I found the in-house team open to lateral thinking, innovation and implemented new product ideas. I was responsible for technical due diligence of land even before acquisition. In the year 2006, at TS I was working on concept of a Greenfield Health City. I also realised that with IOT applications, it's possible to create a Virtual Health City by linking the existing facilities, consumers and service providers

At TS there was an increase in awareness about sustainability issues that affect the real-estate business, I also learnt the use of Building Energy Modelling & Simulation tools, progressed towards use of tools like Solar Adviser Model, HOMER and PVSYST, for preliminary design of Solar PV Power plants. This helped me to start a second career in development of Solar PV Power Plants.

I left TS in the third quarter of 2008, spent some time in project take-off activities of QVC-Hills project developed by one of my mentor from TS.

ATUT (start-up owned by me) came into existence in the 1st Quarter of 2009. ATUT focused on offering services like "Technical Due diligence and pre acquisition test fit based feasibility studies. The sub-prime crisis of US also affected the Indian real-estate market after the last quarter of 2008, flow of FDI in real-estate market ebbed. I could sustain operations for eighteen months, i.e. till end of 2nd quarter, 2010.

Beginning of 3rd quarter of 2010, I joined solar business unit of ICOMMTELE as head business development. ICOMMTELE is one of the oldest PV Module manufacturer of India, products were made using quality components and it's EPCC offerings were cost competitive. Like any other midsized multiple business vertical Indian companies, working capital was a scarce resource. It used to get either diverted to business with more ROI or were hijacked by business units, executing public sector project and having higher return on investment. Therefore Solar Business Unit could not take up solar EPCC (mostly 1 to 2 MWp JNNSM 1st phase projects), being developed by entrepreneurs with financial limitations.

Even after securing EPCC for 2 x 1 MWp capacities and a 2 MWp EPCC, we lost the 2 x 1 MWp due to lack of support for mobilization and 2 MWp EPCC for lack of available

bank guaranty limits. Therefore I decided to call off and restart my venture ATUT in the 3rd Quarter of 2011.

Work on GREEN TDR and Green Retrofits for existing solar PV Power plants, a SMART URBAN RETROFIT was formally shared for public consumption in the 3rd quarter of 2011. Today the LinkedIn Group GREEN URBAN RENEWAL IN INDIA has a dedicated group of 219 members – students, peer and other professionals.

ATUT in its second phase of operation concentrated on helping project developers to bid for PV power plant capacity and execute. I was adviser to UTL, an Indian telecom manufacturer based out of Bangalore.

UTL won 2 x 3 MWp capacities (in phase 1 & phase 2 bid) in Karnataka, India. While executing the 1st project, we realised that due to lack of entry barrier, there were about 300 EPCC players in India, in the 3rd Quarter of 2012. There were few projects executed in India, but all the 300 + EPCC players claimed to have a beak in the 100 MWp Indian pie. We even came across claims by MNRE accredited channel partner to be associated with a project at Charanka, Kutch, Gujarat that has surrendered the allocated land.

In the 3rd Quarter of 2012, UTL was looking for competent EPCC to take-up the job for the 3 MWp (1st Phase KREDL) and identify EPCC for the second 3 MWp capacity. We came across plants not built to last, the developers seem to interested in early exit like investors. We found that there were multiple EPCC claimants for successfully executed operational PV power plants in our country. At that time the country's Solar PV Power plant inventory included plants executed during Phase 1 of National solar mission and those by Govt of Gujarat but there were more than 450 EPCC claimants including the developers. It became difficult for UTL to differentiate the principal EPCC from the sub-contractors of components. UTL had to introduce a rigorous Technical Prequalification process. We also realised the need for capacity building and guild formation similar to the lines of shipping and aviation sector.

UTL issued around 48 Technical prequalification documents to 300 + EPCC players with operations in India. Out of 48 pre qualified EPCC, around 12 responded by the end of 3rd quarter of 2012. RFP was issued to these 12 players for their best offer and the project got executed in the 2nd quarter of 2014. This delay was due to procurement of mortgage able land for the project.

Since December, 2012, I am working as VP-Infrastructure at Vittal Innovation City (VIC), an upcoming urban node complementing the functions of Bangalore Metropolitan Area, India.

VIC is going to an eco-industrial park promoting industrial cluster formation and sustainability of clusters & people working in it. The Urban Node Core will be around 645 Acres (eco industrial park and residential township) , the non core area will be around 1955 Acre. There will be multiple solar parks aggregating 460 MWp, to take care of peak power peak power requirements of the core area. Each industrial cluster and residential neighbourhoods would be having dedicated finite SMARTMICRO GRIDS, having well synchronised loads, decentralised energy sources and imported energy to meet the deficits.

This work is a compilation of work and experiences mentioned above. It's dedicated to the loving memory of my late mother and support of my extended family (wife, son, in-laws, relatives and colleagues).

15th April, 2015 **ANIRBAN CHOUDHURY**
Bangalore

PART A
UNSMART CITY

Citizens initiative to make his city SMART

Citizens initiative to make his city SMART

1 Our cities are UN-SMART

Economic development in India is dependent on urbanization and carbon based industrialization. We are only aware of urban centric economic development and our citizens aspire to be part of urban areas. Estimation of think-tanks and government agencies expect a 100 % rise in India's urban population in the coming three decades. It's expected to be around 590 Million in 2030 AD and 700 Million by 2050.

Urban India is in a CATCH-22 situation. There is a need for urban population growth rate of 18% CAGR to foster annual economic growth but its not sustainable. Existing urban ecology consisting of urban utility & environmental resources has limited ability to grow while maintaining the current level of service, human and urban ecology balance.

Today our cities are UN-SMART, i.e. less efficient in fulfilling existing anthropogenic needs of its citizens. Cities are not run as a system, not efficient in distribution of resources, utility & infrastructure in a JUST and EQUTABLE MANNER.

> Sectors needing immediate attention neither generate adequate revenue nor segments that needs affirmative action pays tax, both the Tax payers as well as defaulters are unhappy in our cities.
>
> There are Functional Verticals in the city administration, hierarchy of administrators, jobs and resource infusion. There are also overlaps of roles & responsibilities and most of the time it's not well defined. This leads to either duplication of efforts resulting in lower productivity or no efforts due to confusing command structure.
>
> Secondly these verticals in the current format can't be run like a business with well defined revenue, actions and business plan to grow. Where there is a well defined revenue source, these verticals have failed to either work independently as a business unit or had negligible growth, i.e. negligible contribution as a STRATEGIC BUSINESS UNIT of city administration.

Today there is political leadership at ward level undermining the city administration at middle management level. The city administration top management has the power to act but is entangled in centuries old procedures, rules and regulation.

> Our cities have only ceremonial mayors with no authority to tax their citizens, plan a city's development and execute those plans. Our states have not implemented the 74th amendment in letter and spirit. The city mayors in most of the cities are not directly elected, have short tenure of around a year and the position is more ceremonial than real seat of power.
>
> City administration either plays safe or undermines the system. There has been citizen and city administration interface that has conceptually remained unchanged. Our city governments are bankrupt - unable to even pay the staff salaries and merely survive on state and central grants. This is the main cause for the mess our cities are in, which necessitated initiatives like smart cities.

Technology has penetrated only few revenue generating departments, property records though computerized are dated (not updated dynamically) and existing IOT applications are just computerization of dated administrative procedure with legacy of past rules & regulation. There has been few but effective transformation observed, these are due to isolated application of ICT.

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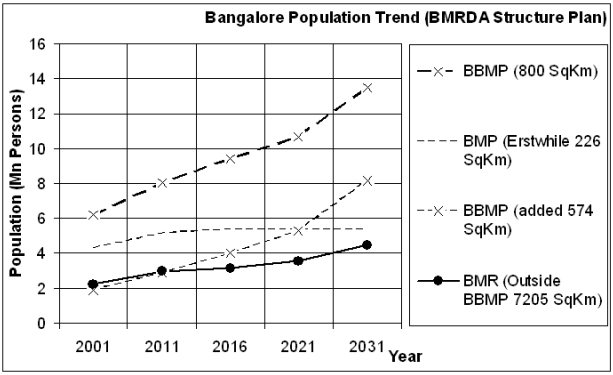
The situation is outcome of lack of foresight or more refined use of systems – Technology, Social Engineering, and Economic Process & Ecological approach.

Rapid population growth also restricts the ability of service providers to produce for increasing population from limited resources. Service levels & quality of life of urban residents reduced and decelerated the development process.

1.1 Urbanization of Bangalore & Pattern of Growth

Today Bangalore is India's 5th largest city and is also called the garden city of the country. It's also called Silicon Valley of India, popular with technically skilled migrants and younger population for the opportunity it provides. Since the beginning of the 1980s, the city benefited from strong globalization influences and rapid growth of information technology driven economy.

Rapid growth in area and population resulted in shortage of urban services management and governance. The city started feeling the pangs resulting from changing trends in urban context of the city after the late 70's, mainly due to migration of people from various parts of the country, when the trickle became flow. The pensioner's paradise transformed into a booming urban form becoming more and more complex and disparate. There has been a reservation about it being a MODEL OF GRWOTH due to the city's inability to maintain Quality of life, mitigating the negative impacts of population & economic growth.



The city primarily grew around 2 nuclei; 1 being the old city on the western side and the new cantonment on the eastern side.

1537- Magadi Kempe Gowda found the settlement of Bangalore with construction of a modest mud fort.

1605- Kempe Gowda II expands the fort and demarcates the limits of Bangalore through decorated pillars.

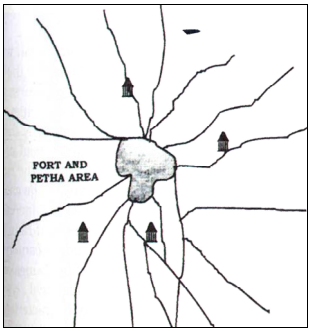
1758- With the decline of the Mughals, Hyder Ali leads and controls south India from Srirangapatnam, reducing Mysore rulers to subsidiary of British rulers.

1759- The weakened Wodeyars gifted Bangalore to Hyder Ali, started expanding the mango orchards at Lalbagh into a garden, presently a Botanical garden.

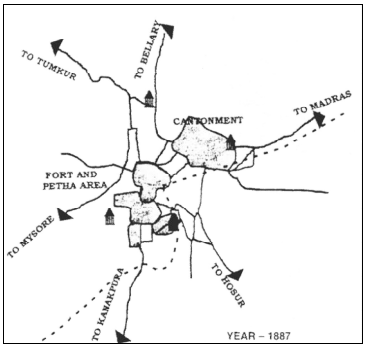
1791- Tipu Sultan, S/o Hyder Ali extends and fortifies the Bangalore fort.

1799- With the death & defeat of Tipu Sultan the British formalized an estate of 75.4 sqM. area

1809- A British cantonment including a garrison near Ulsoor Lake is developed in the eastern fringes of petta.



Bangalore – 1537 AD



Bangalore – 1887 AD

1812- St Mark's Cathedral inaugurated as a focus of the cantonment, laid out as low density, emergence of garden city with racecourse, parks & large open spaces.

1831- The British established direct rule in the state from Bangalore.

1834- Bangalore gets connected by road with all district & headquarters

1853- Bangalore and all the important cities of India were connected gets connected by Telegraph.

1856- Public Works Department created for construction & maintenance of public buildings and roads

1859- Work commences on bringing Bangalore within the railway system.

1949 – Twin parts of the cities - Old city / Petta and the cantonment merged to form the present city after the British left.

1956 (1st November) - Bangalore became the capital city when princely state of Mysore joined the Indian union, serving the political, economic and social hub for the entire state of Karnataka

The city of Bangalore is slowly losing its scale, character and ability[1] to maintain a sense of continuity, of fundamental values and security to exist in a good living environment.

The city has failed to maintain settlement character due to reduced harmony between the built environment and the people, necessary for a balanced community of the various socio-economic groups. Co-operation within, lack of fraternity & tolerance has reduced self-help process within community.

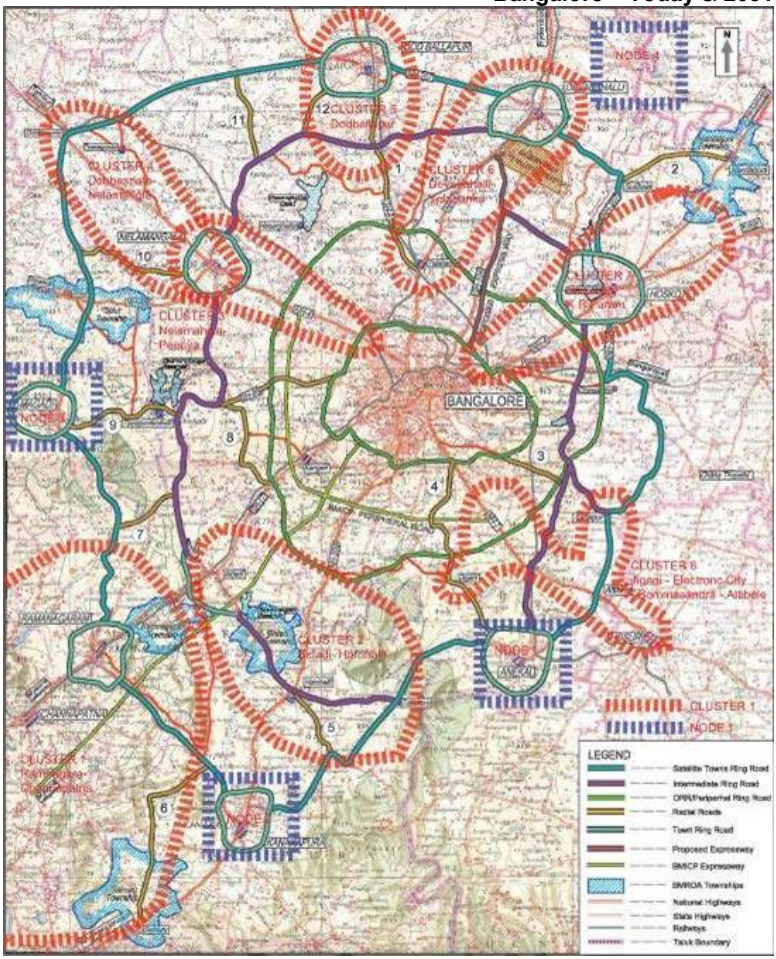
The city is in need of a framework within which there will be an opportunity for incremental physical development, within existing legal, economical and organizational framework.

The BMRDA Structure plan prefers the erstwhile BMP to have population growth as per the revised master plan of 2015 (RMP 2015), i.e. maximum density of 236.37 persons/Ha.

[1] Aranya Low-Cost Housing Indore, India; Architect Vastu - Shilpa Foundation - Balkrishna V. Doshi; Project Owner - Indore Development Authority; Completed in 1989 and ongoing

RMP 2015 has planning interventions for steady growth in population density in BBMP added areas and BMR region excluding BBMP.

Bangalore – Today & 2031



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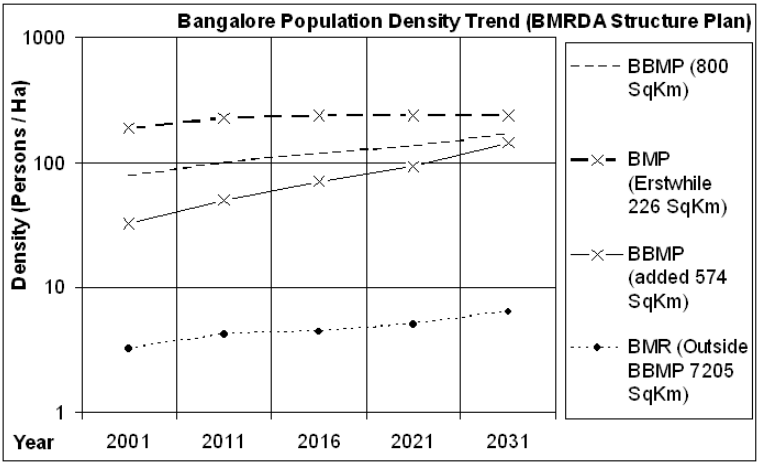

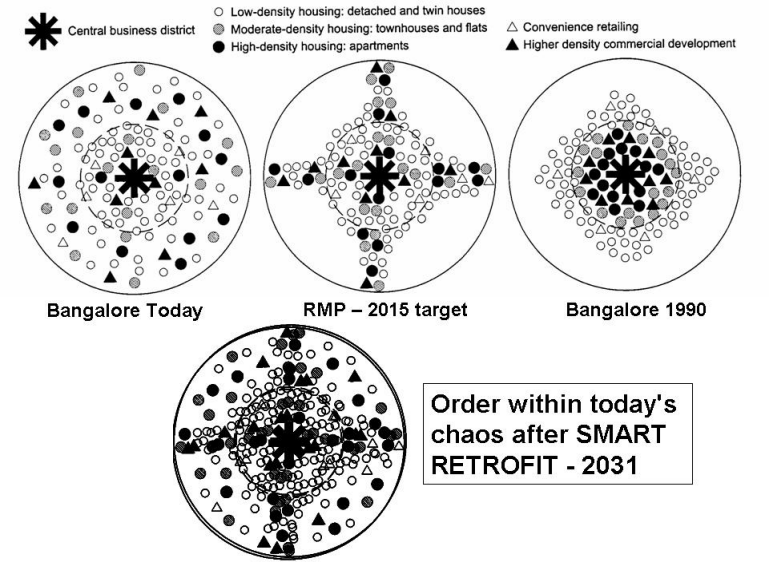

Citizens initiative to make his city SMART

1.2 UNSMART Bangalore - Issues needing immediate mitigation

Bangalore's economic success reflects the ability of cities to connect smart people to work together and generate wealth. However the development path adopted by Bangalore is neither sustainable nor equitable, it has led to widespread degradation of environment, having a lot of impact on GLOBAL CLIMATE CHANGE as well as pollution of water and unplanned urbanization at the local level. There are also other challenges that may decelerate its economic growth if they remain NOT MITIGATED. Issues that needs immediate mitigation are

(a) Air Pollution:

Respire-able suspended particulate matter (RSPM) levels are over four times the national permissible limit of 60 microgram/CuM in certain areas of the city.

RSPM was the worst kind as the particulate was extremely minute (usually about 2.5 microns) and could easily enter the body. "The particulate matter causes inflammation in various parts of the body, triggers asthma, leads to oxygen deficiency and cardio-respiratory diseases,"

> A year back Karnataka Pollution Control Board (KSPCB) observed RSPM of around 264 microgram/CuM (adjacent to AMCO Batteries area on Mysore Road, industrializing area's); RSPM of 164 microgram/CuM (beside Victoria Hospital in CBD). During this period KSPCB monitored air quality in 15 locations across Bangalore (covering industrial area, mixed urban area and sensitive areas such as hospitals and educational institutions). With the exception of two locations, RSPM level consistently exceeded the permissible limit in all the 13 locations.
>
> The transport sector is the biggest polluter, contributing around 44% of the total measured RSPM though the fuel used for these vehicles were clean. It implies that the pollution abatement equipments or systems within the vehicles are not working properly.
>
> Road dust, result of ill maintained or lack of sidewalks constitutes around 20% of total RSPM, followed by 14% contribution by industrial activities, 14 % due to construction activities and balance 7% due to decentralized diesel generator sets, that are also ill maintained.

Other major pollutants affecting safety health and environment like Sulphur oxides and Nitrogen Oxides were found to be within permissible limits of 50 microgram/CuM and 40 microgram/CuM respectively.

(b) Water Scarcity and underutilized Sewerage & silage system

Bangalore is not close to any large perennial water bodies. City's population of 5.69 million requires 840 MLD of treated potable water[2].

[2] Estimate of Bangalore Water Supply and Sewerage Board (BWSSB). BWSSB was established in the year 1964 to manage Bangalore's piped water supply. BWSSB is responsible for providing adequate water supply and sewage disposal for Bangalore on a "no loss no profit basis". BWSSB jurisdiction or service command are is around 800 Sq Km, divided into six maintenance operational divisions, 26 subdivisions and 106 service stations.

Until 1896, Bangalore residents used wells, lakes and kalyanies (temple wells) as water sources.

> In the year 1896, the first piped water supply came from Hesaraghatta lake, built across the river Arkavathi. Raw water was pumped to the city before treatment and distribution. Downstream of Hesaraghatta, about 26 Km west of Bangalore, Chamraja Sagar reservoir was built in 1933.
>
> Drawl of raw water from river Cauvery (over 90 Km distant in the early) started in 1970s. Today treated water sourced from river Cauvery is the main source of water supplied by BWSSB. The total water sourced from river Cauvery and Arkavathi is around 959 MLD, Arkavathi contributes a miniscule 59 MLD. BWSSB also supplies about 70 MLD of groundwater from over 7,000 bore wells.
>
> Water works to draw 360 MLD raw water from river Cauvery started in the year 1974. Within a decade in the year 1984, additional capacity of 135 MLD to the system. Successive stages added 135 MLD (1983) and 270 MLD (1993). After completion of Phase 1 of the fourth stage, the river Cauvery based water works supplies 900 MLD of water. A second phase of 4th stage river Cauvery water scheme aims to add 500 MLD to the BWSSB water works.

Bangalore city has become dependent on drawl of water from river Cauvery but “Cauvery River Water Disputes Tribunal Award” has limited city’s right to withdraw water to approximately 1,400 MLD, constraint on future expansion of Bangalore’s economy.

> Today maintaining adequate pressure in the city’s water distribution system (6,000 km of pipeline), water works requires use of 60 booster pumps, 52 balancing /storage reservoirs within in the city. The total energy consumed in the year 2011 was approximately 50 GWH/Month and annual energy bill paid was Rs 280 Cr @ around Rs 5.66/KWh.
>
> The cost of fossil fuel based conventional energy will escalate, leading to increase in cost of production and delivery of potable water in the future.
>
> BWSSB’s water supply service quality for domestic consumption is very low in the city’s periphery, especially the newer wards with younger and growing population. The gross water supply data provided by BWSSB claims to provide 110-120 LPCD, in par with national standard.
>
> The actual water that reaches customers is less than 2/3rd of 120 LPCD due to as much as 37% to 40% of water lost to leakage at various parts of the transmission and distribution network.
>
> Secondly the spatial distribution of potable water by BWSSB is not uniform. The peripheral wards that have grown much faster than the wards in the central city are also the wards that are least served by the public utility.
>
> These wards have vibrant economic activities that generate more revenue for BWSSB with respect to services provided by the utility. It is a case of a disproportionate financial burden of extending utility-provided piped water through the Greater Bangalore Water and Sanitation Project.

Around 40 % of the population of Bangalore is dependent on Groundwater due to inadequate supply of surface water though the

city's water treatment capacity of 810 MLD seems to be in synergy with its current potable water requirements.

Limited data on groundwater quality shows that some of the most contaminated sources correspond with areas in the city that are likely to depend most on groundwater.

Bangalore's sewage treatment and disposal system is underutilized (721 MLD, i.e. 50% of available sewage treatment plant capacity) due to inadequate sewage network.

BWSSB estimates waste water generation to be 1000 MLD, implies that balance untreated 279 MLD sewage is illegally discharged into rivers and lakes in the Vrishabhavathi, Hebbal and Koramangala – Challaghatta valleys, into waste sinks, nala's , that further percolates as basal flow from these water bodies, contaminating the depleting ground water resources of the city.

(c) Solid Waste including non-bridgeable :

Bangalore generates 2500 tones of solid waste every day, and this waste is often disposed off in a very unscientific manner in Sanitary & Secured landfill.

Existing landfills are operating in full capacity and not operated as per SOP (Standard Operation Procedures). Being outside the city fringe, transportation of solid waste to landfill requires a large fleet of transport trucks, undertaking long haul or un-economical trips a day.

Non-compliance of SOP in Landfills has lead to Health Hazards and NIMBY (Not in my backyard) attitude of inhabitants in the landfill's immediate neighborhood, further making it difficult to identify land for new landfills.

BBMP has made it mandatory to segregate waste at source. Biodegradable wastes are classified as WET WASTE and the rest into different classes of DRY WASTE. Aware & educated households follow the segregation requirements and the enlightened neighborhoods maintain the waste segregated at their TRANSFER STATIONS.

Doorstep collectors and contractors handling Solid are paid for the quantity of solid waste collected and transported. They bid for Ton-mile and the lowest bidder wins the bid. This is a disincentive to use factory made custom-built trucks and transporting the same segregated to 171 odd Dry Waste Collection Centers (DWCC) located in the city neighborhoods. Transporting the non-segregated solid waste to landfills located outside the city generates more annual revenue for transportation contractors. Contractor's employee sell illegally sorted recyclables during transportation to supplement their low wages.

There is no count of Functioning Neighborhood Level Sewage Treatment Plants other than those run by BWSSB. Housing complexes need to have consent to establish and operate STP under prevention of pollution (Air & Water) Act, there is no online instantaneous non-performance checks on its operation nor the maintenance log-books.

Independent houses in BDA and private layouts have rudimentary Septic Tanks in the absence of common STP. The septic tank sizes are also inadequate when there is encroachment of

building setbacks. Inadequately treated primary sewage is dumped into layout / neighborhood sewer lines. There is a need for rigorous system to validate the design, monitor construction and post construction operational status by Urban Local Bodies and BWSSB.

In Bangalore its mandatory for private gated community and neighborhoods to do tertiary treatment of sewage, have a separate plumbing to utilize the treated water, it's observed most of the time that quality of treated water is poor, unfit for even non-potable use of water.

Encroachment of mandatory building setbacks has reduced the available land to fully harvest rain water, even though percolation rate of water is high in Bangalore.

Sidewalks and surface water drainage system is inadequately or ill designed and executed. Design and executions does not reflect systemic approach.

The roads, sidewalks, surface water drains and other utility lines within the road carriage way are ill designed and shoddily executed. Thus, they seldom work as a system and do not achieve their functional objectives.

Today public utilities do not have control over capital cost as tenders are issued without project detailing (the system is not BIM compliant unlike Singapore) non-accountable operation & maintenance cost [3] and poor functioning of Utility & infrastructure added to the poor quality of life.

(d) Loss of GREENCOVER

Bangalore could soon become concrete city as it has already lost more than 50,000 trees to infrastructure development and nearly 300 for the Metro rail project.

Environmentalists and citizens fear that rampant felling could cost the city its 'green heritage' tag seen from the heaps of logs from axed trees and stumps, which dotted roads across Bangalore.

Irresponsible owners of commercial hoardings have also cleared tress with heritage value, to improve visibility. Commercial real-estate projects are also equally responsible for illegal tree felling and clearing the same at night.

The BDA City development Plan – 2005 has made provisions for maintaining the green covers around large lakes and water bodies, as there is no synergy with the revenue documents, the Green Objectives of the CDP 2005 has not been completely met.

Loss of GREENCOVER is responsible for formation of heat Islands within urban areas and change in MICROCLIMATE. Rainfall distribution within the city ceased to be uniform.

(e) Loss of LAKES, PARKS & OPENSPACES

Bangalore lost lakes due to encroachment by illegal buildings (54%), being fed by sewerage instead of surface water of its catchment area

[3] Bangalore with population and spatial coverage less than National Capital Region spends more money on Solid Waste Disposal.

(high as 66%); 14% of lakes are inaccessible as they are surrounded by slums and 72% showed loss of catchments.

Reclamation of lakes and their banks for various developmental activities has resulted in the loss of interconnectivity in Bangalore district, leading to higher instances of floods even during normal rainfall.

Lake catchments protected in the CDP-2005 got either encroached by illegal dumping of solid wastes and construction debris.

(f) Energy Deficit

BESCOM distributes more than 50% of total power distributed in the state of Karnataka, India.

Energy – Demand, Supply & deficit – Karnataka

PERIOD	PEAK DEMAND (MW)	PEAK MET (MW)	PEAK DEFICIT/ SURPLUS (MW) (-/ +)	PEAK DEFICIT/ SURPLUS (%) (-/ +)	ENERGY REQUI-RMENT (MU)	ENERGY AVAIL-ABILITY (MU)	ENERGY DEFICIT/ SURPLUS (MU) (-/ +)	ENERGY DEFICIT/ SURPLUS (%) (-/ +)
9TH PLAN END	5338	4428	-910	-17	19716	16684	-3032	-15.4
10TH PLAN END	6253	5811	-442	-7.1	40797	39948	-849	-2.1
2007-08	6583	5567	-1016	-15.4	40320	39230	-1090	-2.7
2008-09	6892	6548	-344	-5	43168	40578	-2590	-6
2009-10	7,942	6,897	-1,045	-13.2	45,550	42,041	-3,509	-7.7
2010-11	8,430	7,815	-615	-7.3	50,474	46,624	-3,850	-7.6
2011-12	10,545	8,549	-1,996	-18.9	60,830	54,023	-6,807	-11.2
APR-SEP,2012	10,124	8,264	-1,860	-18.4	32,406	27,997	-4,409	-13.6
SEP,2012	9,404	7,863	-1,541	-16.4	5,153	4,305	-848	-16.5
APR-OCT,2012*	10,124	8,264	-1,860	-18.4	37,699	32,607	-5,092	-13.5
OCT,2012*	8,957	7,601	-1,356	-15.1	5,293	4,610	-683	-12.9

Typical Energy consumption pattern of an Industrial Unit in BESCOM & Energy Bill

BESCOM Likely Energy Bill			Amount (Rs)
Demand Charges @ Rs 180/KVA/Month			**1371220**
Energy Charges - BESCOM			
Slab	No of Units	Tariff (Rs/Unit)	
Slab 1	100000.00	**5.35**	535000
Balance	3192380.00	**5.75**	18356185
Total	3292380.00		**18891185**
BESCOM Energy Bill Rs/kWh		**6.15**	
Electricity Tax- As per Notification No. 17 dated 31 March 2003 of the Government of Karnataka, the Electricity tax shall be levied at 5% on the electricity charges payable (excluding arrears) by all consumers except consumers under agricultural (IP sets upto and inclusive of 10 HP and BJ/KJ categories.			**68561.00**
BESCOM Energy Bill after Electricity Tax			**20330966.02**
BESCOM Energy Tariff after Electricity Tax (Rs/kWh)		**6.18**	
DG Energy Tariff after capitalization (Rs/kWh)		**29.00**	
DG Energy Bill after capitalization			**14140980.00**
Total Energy Bill (BESCOM + DG)			**34471946.02**
Average Energy Tariff (BESCOM+DG) (Rs/kWh)		**9.12**	

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Monthly Energy Bill of TKM consuming an average of 3.78 Million kWh / Month in BESCOM Distribution Command Area @ Rs 9.12/kWh [BESCOM and DG] will be Rs 3.45 Cr/ Month.

If the power deficit increases, the average cost of energy will also become more than Rs 9.12/kWh

Typical Energy consumption pattern of Commercial Unit in BESCOM & Energy Bill

LEED Gold Rated Commercial Building coming up on a 1200 SqM land abutting a major arterial road of "Right of way" more than 30 M in Bangalore Development Authority (BDA) Planning Jurisdiction. The allowable FAR is 3.25 and ground coverage is 40%.

Total Energy	3.58	Million Units /Month
Consumption	3584300	kWh/Month
No of SPV / Bill	1	Nos
	6138	KW
Avg Demand Load	6819	KVA
PF (KWh / KVAh)	0.9	
LF	0.8	
Energy Consumption		
Total	3584300	kWh/ Month
Deficit in availability	-12.90	%
BESCOM -after deficit.	3121925	kWh/ Month
Captive DG	462375	kWh/ Month

BESCOM Likely Energy Bill [TARIFF SCHEDULE HT-2(b)]			Amount (Rs)
Demand Charges @ Rs 200/KVA/Month			**1227500**
Energy Charges - BESCOM			
Slab	No of Units	Tariff (Rs/Unit)	
Slab 1	200000.00	**6.95**	1390000
Balance	2921925.30	**7.25**	21183958.4
Total	3121925.30		**22573958.4**
BESCOM Energy Bill Rs/kWh		**7.62**	
Electricity Tax- As per Notification No. 17 dated 31 March 2003 of the Government of Karnataka, the Electricity tax shall be levied at 5% on the electricity charges payable (excluding arrears) by all consumers except consumers under agricultural (IP sets upto and inclusive of 10 HP and BJ/KJ categories.			**61375.00**
BESCOM Energy Bill after Electricity Tax			**23862833.43**
BESCOM Energy Tariff after Electricity Tax (Rs/kWh)		**7.64**	
DG Energy Tariff without capitalization (Rs/kWh)		**20.00**	
DG Energy Tariff after capitalization (Rs/kWh)		**29.00**	
DG Energy Bill after capitalization			**13408866.30**
Total Energy Bill (BESCOM + DG)			**37271699.73**
Average Energy Tariff (BESCOM+DG) (Rs/kWh)		**10.40**	

Citizens initiative to make his city SMART

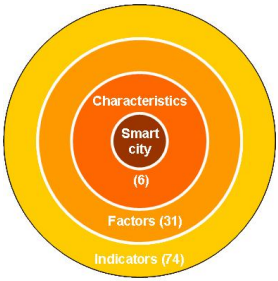
2 SMART CITY

2.1 What is SMARTNESS of a City.

The SMART CITY characteristics are significant and have definite measurable factors, relating to quality of urban life.

European Union expects SMARTCITY to address public issues, employing Information and Communication Technology (ICT) based solutions, on the basis of municipality driven multi stakeholder partnership.

EU countries expect the SMARTCITY to address key performance indicators that promotes economic growth, social and cultural development and a sustainable interaction of anthropogenic needs with the environment.



SMARTCITY STRUCTURE

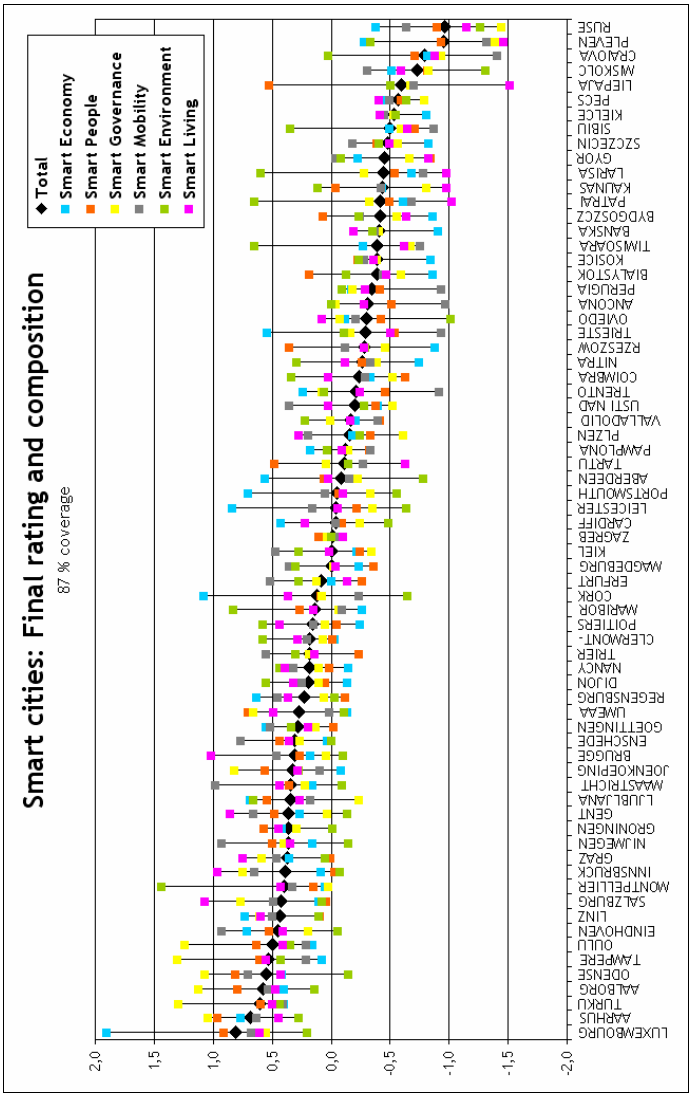
EU felt the need to strengthen or extend citizens participation in initiatives by Municipalities (democratic organizations at primary level), emphasized establishment of more refined and accessible governance structure.

Characteristics and factors of a SMARTCITY[4]

SMART ECONOMY (Competitiveness) # Innovative spirit # Entrepreneurship # Economic image & trademarks # Productivity # Flexibility of labor market # International embedded-ness # Ability to transform	**SMART PEOPLE (Social and Human Capital)** # Level of qualification # Affinity to lifelong learning # Social and ethnic plurality # Flexibility # Creativity # Cosmopolitanism / Open-minded ness # Participation in public life
SMART GOVERNANCE (Participation) # Participation in decision-making # Public and social services # Transparent governance # *Political strategies & perspectives*	**SMART MOBILITY (Transport and ICT)** # Local accessibility # (Inter-)national accessibility # Availability of ICT-infrastructure # Sustainable, innovative and safe transport systems
SMART ENVIRONMENT (Natural resources) # Attractivity of natural conditions # Pollution # Environmental protection # Sustainable resource management	**SMART LIVING (Quality of life)** # Cultural facilities # Health conditions # Individual safety # Housing quality # Education facilities # Touristic attractivity # Social cohesion

These characteristics and factors form the framework for the indicators of a smart city.

[4] Smart cities – Ranking of European medium-sized cities; the project was elaborated from April to October 2007. This report was edited by the Centre of Regional Science (SRF), Vienna University of Technology in October 2007.



Smart cities – Ranking of European medium-sized cities; The project was elaborated from April to October 2007. This report was edited by the Centre of Regional Science (SRF), Vienna University of Technology in October 2007.

British Government customized the EU SMARTCITY concept to make it more focused to develop core competencies and achieve part of its millennium goals. Therefore the Department of Business Innovation and Skill (BIS) wants the SMARTCITY to be an integrator of Physical, Digital and Human Systems

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in a BUILT-ENVIRONMENT to deliver sustainable, prosperous and inclusive future for its citizens.

In the year, 2011 EU opened its SMART CITIES & COMMUNITIES RESEARCH and earmarked funding of 420 Million Euro. EU's initial focus was integration of CITIZENS & GOVERNANCE using ICT. As most of the EU member states had some form of extended participation of its citizens in municipal governance, the focus shifted towards ICT Products driven by different Vendors and vendor driven protocol. During this time products, protocols and partnerships in public & private sector evolved.

In the next stage i.e. 2013, EU Innovation Partnership for SMARTCITIES focused on integration of ICT, Energy and Transportation management to evolve solutions. These solutions also had a multiplier effect, mitigated major ecological, social and health issues.

To overcome challenge to any innovation, quick but detailed demonstration project was developed. They also had cushion against failure, therefore, many of the EU demonstration projects concentrated on either URBANSYSTEMS or INFRASTRUCTURES development with low gestation. At the same time Public & private sector, linking of initiatives and pooling of resources also happened. This also resulted in CAPASITY BUILDING for FUTURISTIC PROJECTS and STRATEGIC PARTNERSHIPS.

2.2 Indian SMARTCITY Pre-Takeoff

Prime Minister, Mr. Narendra Modi announced in his maiden NATIONAL BUDGET that Indian Government would earmark Rs 7060 Cr to fund the development of a hundred SMARTCITIES. This proclamation is an important stage in the development of Indian cities as Indian Smart Cities have got an additional objective compared to that of EU and UK.

The focus of Government of India is wider i.e. EU focus is on Energy, Transport/ mobility and ICT, in India, there is an additional dimension of need for (i) economic development; (ii) employment generation (iii) adequate Water & efficient distribution (iv) Waste collection, treatment & disposal. This increases complexity and the risk of failure...There is an immediate need of SMART NEIGHBOURHOOD ERP, APPS, analytic's that is acceptable to the stakeholders (administrators) and in synergy with existing citizen's interface with administrators.

> Government of India believes that promotion of investments in SMARTCITIES, introduction of alternate approaches to investment and growth management by PUBLIC PRIVATE PARTNERSHIP. It's also expected to empower CITYMANAGERS to prioritize, focus on issues affecting quality of life, and empower citizens & the private sector to partner.
>
> SMARTCITIES would deliver more effective decision-making, efficient governance and more appropriate & innovative investment vehicles, leveraging on global experience, competencies and success of Indian ICT SECTOR.
>
> Government of India has further clarified that the BUDGET is to either fund conceptualization of new project / scheme or retrofit in existing projects or locations; it's not for total project capital grant. These projects are expected to have clear revenue streams, suitable for non-recourse funding.

BUDGET of Rs 70.70 Cr per city may appear insufficient for SMARTCITY Take-off, they will provide scope for planners and decision-makers to identify and prioritize areas they propose to invest in.

Once the city level Pre-takeoff Plans are ready and announced, it will further stimulate investment by engaging identified stakeholders i.e. ICT businesses, real estate developers, retail business, and transport operators to support PPP projects and actions.

The objective of Indian SMARTCITY initiatives is to increase the resilience[5] of the city.

The criterion to select 100 smart cities to be taken up in the first phase is being finalized by the Ministry of Urban Development (MoUD). There have been consultations with various stakeholders including urban development secretaries of the states, ministers and municipal commissioners.

Most of the states and cities have had the experiences of project-driven, Central government-funded schemes such as JNNURM, and their expectations were on similar lines. Unlike JNNURM, the government of India is not going to bankroll individual projects of identified SMARTCITIES.

Government of India expects competing cities to put their house in order by first preparing city comprehensive development plans, improve governance, establish a city's creditworthiness, explore alternate & conventional investment models for their projects and, finally, if selected, they may seek only viability gap funding from the Central government.

The MoUD is working on a city challenge where cities have to present their credentials and compete with other cities to be included in the sought-after list of 100 smart cities. As a concept this is a great idea as it fosters competition, brings discipline and would ensure that the vision of smart cities actually gets implemented on the ground.

Bloomberg Philanthropy conducts a 'Mayors Challenge' designed as a "competition for bold ideas from city leaders".

Today there is a shortage of trained work force to play the role of “Development manager”, working on bankable catalytic projects. These projects also require commitment of CITY MANAGERS.

2.3 CITY MANAGERS for Indian SMARTCITY

Planners in India become member of Institution of Town Planners India (ITPI) after passing out of Planning Institutes in India. Planning profession in India has not evolved as a guild in India, unlike council of architecture, a guild that got concurrence of the Indian parliament.

In states like Andhra Pradesh, Tamilnadu, Karnataka Maharashtra and Gujarat having cadres in urban development (includes planners) but have inadequate professionals. These states have forged ahead with modern and progressive initiatives like BRTS, e-governance, applications for service delivery, public disclosure, grievance handling mechanism, citizen-centric inclusive planning and PPP projects

Planners in private sector jobs and practices play negligible role in project development management.

Other states do not have an active cadre of planning professionals who gets deployed in different urban local bodies and has a fixed tenure. According to credit ratings of JnNURM 65 cities, top 20 cities happen to be

[5] 100 Resilient Cities (http://www.100resilientcities.org/resilience) defines resilience as "the capacity of individuals, communities, institutions, businesses and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience.
Simply put, resilience enables people to bounce back stronger after tough times, and live better in good times. What we have learned from our initiative work over the past several years is that, no matter what the city's conditions, resilient systems share and demonstrate certain core characteristics.

states with dedicated municipal cadres. JnNURM Reform Score Card of 2013 indicates that states with municipal cadre appear in the top 5 of 31 states & UTs, while the others are lagging behind.

The National Building Code 2005 states that any project developed on more than 5 Acre of land needs to be design developed by a multi disciplinary team including Town/ Urban planner.

NBC 2005 has also defined the qualification of a planner and their roles & responsibility in the urban / rural real estate projects. If we look at composition of project development team in public as well as private sector, there is negligible presence of planners.

Reserve bank of India (RBI) issued guidelines in the year 2005 that all projects with domestic debt funding has to comply the requirements of NBC-2005.

Today planners and planning bodies need to assert. Compliance of RBI guideline itself will improve the involvement of planners in real-estate projects.

Thereafter there has to be a guild of planners in each city, certified to interpret the city development control rules & regulations.

These planners with different level of competency or experience will check the compliance of project in a responsible manner.

If the planner fails to do his duty or believes in unprofessional conduct, the planner will be suspended and dismissed from the guild.

Ministry of Urban Development, GoI felt the need for establishment of Municipal Cadre in India.

2.4 Urban resilience –SMARTNESS objective

Urban resilience stands for the ability to adapt to a rapidly changing environment. It covers three closely related and interdependent issues:

- Climate resilient cities can adapt to the increase in the likelihood of weather-related natural disasters, such as floods and drought, or storms.
- Energy resilient cities are highly adaptive to increases and/or fluctuations in energy prices. Energy resilient cities are on a low dependency path to energy.
- Economic resilient cities are highly adaptive to real estate and financial markets fluctuations

Urban development process gets the structural resilience from nine Planning strategies detailed below-

(a) Create a neighborhood wise inventory of assets, liability, population and their interactive connections, that is benchmarked and the indicators are monitored.

Let's assume integrated projects for an Urban Fringe Neighborhood @ Whitefeild, Bangalore.

First we need to define the neighborhood. The neighborhood would have a definite neighborhood boundary. The neighborhood focus will be the inner Circle park, radial roads, heritage built areas between inner and outer circle.

We also need to define parameters like neighborhood population between 20000 to 30000 residents. At maturity threshold Global FAR >= 1.5, the minimum neighborhood Net residential Density is expected to be 450 Persons / Ha, reaching CDP / Structure Plan Target of 916 Persons/Ha in the year 2032.

In the Proposal Takeoff stage itself we need to define these neighborhood parameters based on (i) Map of the existing utility, infrastructure and physical survey; (ii) quality of life through House Hold Survey; (iii) integration of secondary information about existing utility and infrastructure on Map.

Secondly there has to be definite Terms of Reference (TOR) for APP's (software applications to generate data) to involve citizens participation in House Hold Survey and Validation of status of utility data generated and mapped.

Thirdly the neighborhood utility, infrastructure and quality of life benchmarks will be as per the requirements of the NBC2005 & UDPFI Guidelines.

We need to achieve the current level of service benchmarks and make it sustainable through initiatives like (i) Economic Development & employment generation; (ii) efficient & equitable distribution of water; (iii) Waste collection and scientific disposal (part of Swachta Mission); (iv) Sewage Collection (cost effective decentralized similar to Indore Slum Networking project that was used as template in Sabarmati River front development project) system; (v) Efficient and cost effective sewage treatment system (similar to DEWATS system used in Indore slum networking projects, promoted by Auroville CSR, BORDA e.t.c).

The most important input needed for any neighborhood level urban intervention / strategic plan preparation and implementation are energy & communication Master Plan and their convergence.

Business Models for the above mentioned Development Plan should also highlight Stake and stake holder assessments; Social Cost & Benefit Assessment and Carbon Footprint of the neighborhood.

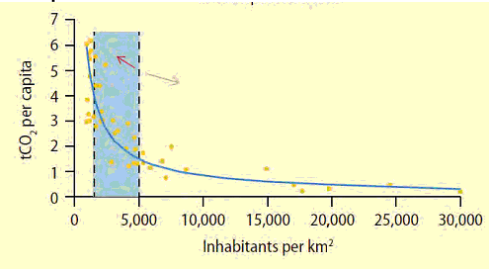
(b) Compact Densification

Density can measure a series of different urban parameters at different scales.

Measuring urban density requires first answering two questions (i) What is measured: population, jobs, activities, housings, legal entities, etc. and (ii) At which scale: city, district, neighborhood, block, plot or building. Population density at the neighborhood scale is the ratio of the number of inhabitants to the neighborhood area. Resilience of a city is directly proportional to the density of its population as shown in the following graphs

Urban Transport Co^2 emission per capita is inversely proportional to Gross density. Its due to reduction in no of trips and reduction in road network.

Transport Network

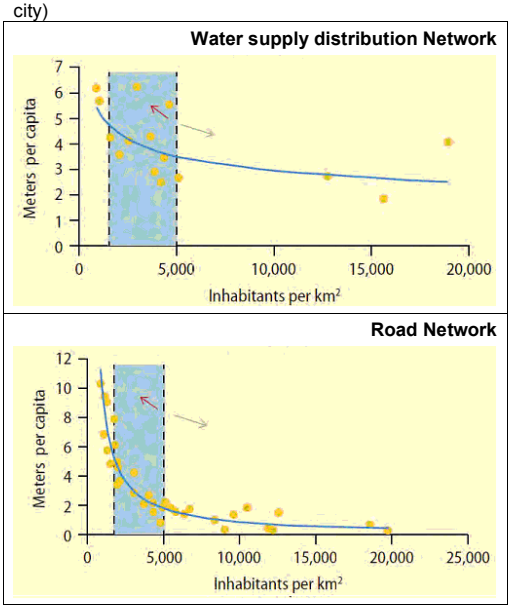


As the gross urban density increases, the coverage of no of resident per pipe or road length increases. In the case of water supply network, there is also increase in the distribution efficiency due to per capita pipe loss reduction.

In the case of reduction in per capita road length with increase in density, reduces CO2 emission as place of work & recreation is near to the residential areas.

We can conclude that gross density more than 100 Person/ Ha (Global FAR of 1, low rise mid density) represents sustainable urban typology. Urban areas with Gross density of 150 persons/Ha (global FAR > 1.5) is a low rise high density development.

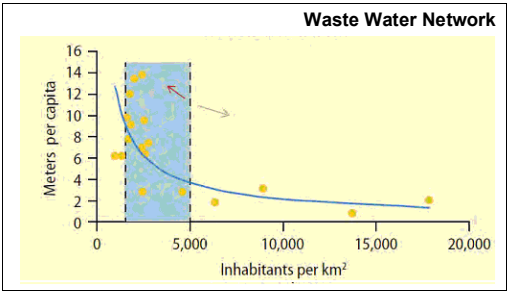
When the gross density exceeds 200 Persons/Ha (global FAR. 2), the attributes of livability increases but there might be reduction in affordability of housing stock due to increase of construction cost for high rise high density development. This may trigger the shift in location of job beyond the mono nuclei urban core, leading to take-off of urban sub-nodes (promoting multi nuclei city)



Compactness informs on how scattered and spread out an urban fabric is at the city scale. Compactness is measured in terms of gravity index of the city's neighborhoods.

Gravity Index is directly proportional to amount of resources available in the neighborhood, inversely proportional to the travel or distribution cost of particular resource within the neighborhood.

To increase the objectivity of Gravity Index measured resource wise for a neighborhood, each index is multiplied with its significance factor (to compare apples and oranges of various quality – raw to rotten, the significance factor can be their calorific value) and combined together to get Neighborhood Gravity Index.



(c) Scaling

In a traditional neibourhood or city, we find an hierarchical distribution of social, economic and cultural infrastructure, roads, parks and open spaces. Each sub pattern of streets at neighborhood and district scales presents the same distribution properties as the whole city.

In the resilient order of cities, one can observe, like in nature, the same level of complexity on several scales. The local and the global scales linked by a successive series of connections that show structure and organization at each scale.

> This is a scale-free structure where global order emerges from local orders; a complex web gets created due to bottom-up evolution of the small scale and its integration at higher scales.
>
> The spatial distribution and the intensity of connections in a resilient city obey a scale-free distribution. The more scale-free the city becomes, the more it can absorb and even build new structures, when it's subjected to constraints, without upsetting the stability of its structure.

A scale-free structure is rigid like a rock but flexible like a tree. The anthropogenic interactions with a scale-free structure are similar to a honeybee that suckles flower for nectar without destroying it.

Resilient cities present urban elements at all scales with a universal law characteristic of complex natural systems. This law links the frequency and the size of urban elements.

> Let's take roads of different right of way (significance) and length (magnitude). The smallest path of 3000 mm has the highest length at a neighborhood, followed by local streets of 12000 mm, collector street of 18000 mm and neighborhood connectors of 18000 mm. In mathematical terms, a Pareto distribution, or inverse power law, relates the large, the intermediary and the small in measurable ways

(d) Functional Flexibility

In functionally flexible cities, urban forms can easily adapt (with limited investment needs) to a redistribution of urban functions. A resilient urban form must have flexibility to get a third dimension without disturbing the availability and hierarchy of facilities, amenities and quality of life.

Community re-densification initiatives not limited to policy like Transferable Development Rights (TDR), issued in addition to normal Floor Area Ratio, increases the Community Global FAR. This initiative helps in protecting cultural or historical heritage, increasing the number of in-habitants, reducing per capita cost of utility distribution and increased access to utility.

(e) Fine Grain Diversity[6] –

In a resilient cities, where the whole is built from self - sustainable components leaves room for evolution. Modifying the urban whole from a technical blueprint involves destroying a great many components on very different scales.

Fine grain diversity refers to mixed use. At the neighborhood scale, it refers to a "smart" mix of residential buildings, offices, shops, and urban amenities. At the block and building scale, mixed use consists of developing small-scale business spaces for offices, workshops, and studios on the ground floor of residential blocks and home-working premises.

A person's life traverses several stages of growth – infancy to old age and a balanced community sustains the give and take of growth. People need support and confirmation from people who have reached a different stage in the life cycle and at the same time would need support from people who are at the same stage as they are.

To balance the community, the community pattern include a balance of people at every stage of the life cycle- i.e. from infants to the very old and support & contain a full slate of settings which best marks the ritual crossing of life from one stage to the next.

STAGE	IMPORTANT SETTING	RITES OF PASSAGE
INFANT-Trust	Home; Crib; Nursery; Garden	Birth Place, setting up the crib……out of the crib, making a place
YOUNG CHILD - Autonomy	Owns place, couples realm, children's realm, commons, connected play	Walking, making a place, special birthday
CHILD - Initiative	Play space, Own place, common land, neighborhood, animals.	First ventures in Town…… …….. .joining
YOUNGSTER - Industry	Children's home, school, own place, adventure play, club, community,	Puberty rite, private entrances, paying your way.
YOUTH-Identity	Cottage, teenage society, hostels, apprentice, town & region.	Commencement, marriage, work, building.
YOUNG ADULT - Intimacy	Household, couple's realm, small work group, the family, network of learning.	Birth of child, creating social wealth building.
ADULT - Generatively	Work community, the family, town hall, a room of one's own.	Special birthday, gathering, change in work.
OLD PERSON - Integrity	Settled work, cottage, the family, independent regions.	Death, funeral , grave sites within estate……. common sacred grooves… meditation.

6 Measurement of diversity in a balanced community or in the social, cultural and economic utility or infrastructure is done in terms of Simpson's or Shannon's diversity index.

(f) Highly Connected Networks

Stable urban systems are those that display an enormous number of geometric and functional connections structured in a scale-free manner. That means that connectivity exists at all scales with a distribution of connections adapted to the functional needs of each scale, but with no connective scale dominating the others.

> Resilient cities must have a full spectrum of streets of various lengths, width and spans adapted to different speeds and to different flows. hen some connections are cut, others are created to compensate for the cuts and maintain the urban system in operation.
>
> Social networks as well as street networks in resilient urban systems show characteristics such as a high level of clustering. Complex evolved street patterns show this small world property when a street is considered as a node and its intersection with another street as a link.
>
> Complex subway systems, such as the ones in Tokyo, London, Manhattan, tend to evolve with a long time and multiple decisions towards the same structure as social networks. From the "small world" properties a number of measures of efficiency can be derived such as characteristic path length, global and local efficiencies.
>
> These characteristics can be measured and assessed using metrics from graph theory like (i) Number of intersections per Sqkm; (ii) Distance between intersections; (iii) Cyclomatic number; (iv) Clustering coefficient and (v) Between ness centrality

(g) Synergy

High density and mixed use is key strategic assets of urban areas that help to use energy more efficiently through synergy approaches resting upon energy systems integration and compact energy-efficient housing.

> Increase in urban density and mixed use, infill redevelopment strategies make it possible to implement new strategies to decrease the energy and resource intensity of urban communities. The local diversity of building uses and building types induces a local diversity of demand loads.

A key issue in improving the efficiency of urban energy systems is an optimal matching of various energy-demand categories with energy-conversion processes.

> The power factor of a micro-grid catering to the need of a dense and diversified development tends to be at unity, leading to its optimal use and capacity enhancement.
>
> Synergy strategies increase the resilience of urban energy systems. Indeed, cascading and recycling energy flows according to their quality (electricity, mechanical, thermal) improves the stability and the resilience to unexpected events (flood, drought, storm, peak load, etc.) of energy networks.
>
> Another type of synergy is though development initiatives like neighborhood (i) solid waste to energy projects; (ii) effluent treatment plant treated water used for flushing the surface water drainage system and street cleaning during dry months; (iii) using the treated effluent, rich in nutrients for hydroponics food, grown in rooftop green houses.

(h) Greening And Water Recycling

Changes in extreme rainfall could cause the amount of sewage released to the environment from combined sewage overflow spills and flooding to increase by 40% in some cities.

Responses include but not limited to strengthening wastewater, storm water and runoff infrastructure.

Risks to freshwater resources due to draught, cause's shortages of drinking water, electricity outages, water-related diseases, higher food prices and increased food insecurity from reduced agricultural supplies.

> Responses include encouraging water recycling and grey water use, improving runoff management and developing new/alternative water sources; storage facilities and autonomously powered water management and treatment infrastructure.
>
> City's green infrastructure reduces GHG emissions, as they are carbon sink. Green's also enhance pedestrian and cycling environment, regulating energy consumption, enabling environmentally sustainable nutrient recycling and local food production. Greens of different hierarchy spatially distributed throughout the urban environs, improves resilience through flood mitigation, erosion control, and maintaining water availability.

(i) Urban-Rural Integration

Sustenance of urban lifestyles depends on food security, affected by climate change, including access to food, food utilization and price stability.

> Response by Urban local bodies include preserving arable land by limiting sprawl, increasing land use efficiency, support for urban and peri-urban agriculture, and immersion of compact urban nodes (less than 10 minutes walk) within accessible continuous green spaces.Maintenance of Urban Greening and Urban-Rural Integration initiatives succeeds when it becomes a tangible source of revenue rather than cost centers in most of the urban areas. This requires increasing the intensity of utilization and interactions with citizens from cluster – community – neighborhood of a city.

2.5 Third Industrial Revolution[7] – Road to URBAN SMARTNESS

In the last decades of 20th century, city administrators and planners in India tried to have control over the urban population and resultant pattern by relocation of industries far away from urban fringes.

> Instead of reducing the cost of expansion, it increased the per capita trips of urban work force. On the other hand, industrial activities and economy driven by Oil and other Fossil Fuel is spiraling into dangerous endgame. The price of energy and food is climbing, unemployment remains high, the housing market has collapsed after artificial buoyancy, consumer and government debt is soaring, and the recovery is slowing. Urban areas being the drivers of non service industry, is facing the prospect of a second collapse of the global economy. At the same time cities and its residents are desperate for a sustainable economic development into the future.

[7] **Jeremy Rifkin** is the author of The New York Times bestselling book, The Third Industrial Revolution, How Lateral Power is Transforming Energy, the Economy, and the World. Mr. Rifkin is an adviser to the European Union and to heads of state around the world. He is a senior lecturer at the Wharton School's Executive Education Program at the University of Pennsylvania and the president of the Foundation on Economic Trends in Washington, D.C.

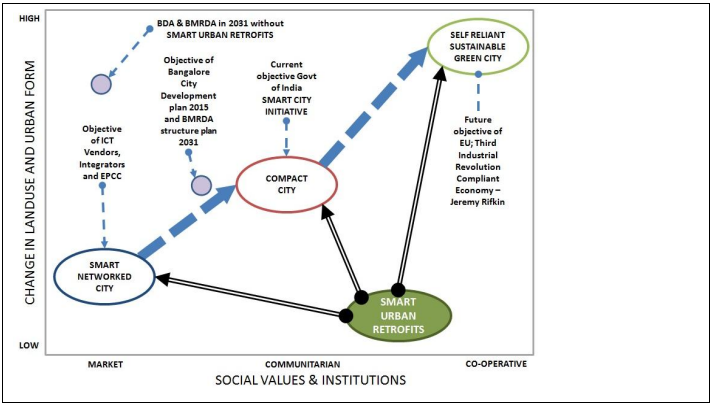
The Five Pillars of the Third Industrial Revolution will create thousands of businesses and millions of jobs, usher in a fundamental reordering of human relationships, from hierarchical to lateral power that will impact the way we conduct business, govern society, educate our children, and engage in civic life.

> The five pillars of the Third Industrial Revolution are shifting to **renewable energy**; transforming the building stock of every continent into **green micro–power plants** to collect renewable energies on-site; deploying hydrogen and other **storage technologies in every building and throughout the infrastructure to store intermittent energies**; using Internet technology to **transform the power grid of every continent into an energy internet** that acts just like the Internet (when millions of buildings are generating a small amount of renewable energy locally, on-site, they can sell surplus green electricity back to the grid and share it with their continental neighbors); and **transitioning the transport fleet to electric plug-in and fuel cell vehicles** that can buy and sell green electricity on a smart, continental, interactive power grid.

The Third Industrial Revolution evolved from realization that

> the sun shines on every part of the earth every day. The intensity may vary. The wind blows every where even if the frequency is intermittent. Everywhere below our feet is a geothermal core, deep underground. We all generate garbage in urban areas and there is also residual biomass in the form of agricultural & biomass waste. In the coast, where the density of population is higher, there are off-shore winds, tides and waves.
>
> These resources are at our doorstep and in easily harness able form. Fossil fuels and uranium are found form in few areas of the world and not available in ready to use. It has always nurtured monopoly, fed corruption and political immorality.

The SMART RETROFTS are immediate actions, specific to a city, needing immediate implementation. SMART RETROFITS are projects and initiatives that would lead towards the goals of THE THIRD INDUATRIAL REVOLUTION.



3 Smart Retrofit Projects for UNSMART Bangalore

SMART-RETROFITS are projects to mitigate major issues affecting urban resilience. These projects are catalytic in nature, effective, requires policy initiatives and some investments for pre-takeoff.

3.1 Green Transfer of Development Right (TDR)

Promote use of Solar Power without subsidy with extended participation of Energy, Revenue and Urban Development Department of Govt of Karnataka.

The solar parks developed within 50 Km from the perimeter of BESCOM command area but grid linked through National Transmission Line backbone of Power Grid Corporation of India. This has the potential to become the basis of regional level cooperation between Bangalore (Capital of Karnataka) and state governments of Andhra Pradesh & Tamilnadu.

The project objective is to increase the urban density, optimize per capita utilization of urban infrastructure and provide incentive to project developers to go for conventional energy bundled with minimum 40 % renewable energy, i.e. Energy Security, price stability.

3.2 Solar PV Greenhouse –

This project needs involvement of Bangalore Development Authority, Energy, Revenue and Urban Development Department of Govt of Karnataka.

Objective of this project is to customize the solar PV Power Plant module mounting structure and use the built space below it as a Green House. This project will help in maintaining green cover, stabilize micro grid at neighborhood level, produce organic vegetables and reduce neighborhood carbon footprint.

3.3 Human Resource capacity building

Development, operation and maintenance of PV Power plants and solar parks.

3.4 Neighborhood Solid waste to combined cycle decentralized power plant–

The main component is smokeless incinerator and Combined Cycle Organic Rankine Cycle thermal power plant. The technology mitigates issues related to disposal of mixed solid waste in urban landfills.

The power generated is dispatch able to neighborhood micro grid. This project needs involvement of Environment, Energy, Revenue and Urban Development Department of Department of Govt of Karnataka.

3.5 Solar PV Modules – Globally Competitive manufacturing @ India -

Promote entry of serious foreign direct investment and domestic manufacturing of Solar PV Modules and its components. The industry will also become globally competitive in terms of quality and price.

3.6 SMARTCITY Investment Trust (SMIT) –

Structure, source and mode of operation are

(a) **Solar PV Power Plants & Solar parks and Solid waste to energy projects, are** the projects to be promoted through non-recourse funding of projects.

SMIT will also fund domestic manufacturing of PV Module and its supply chain. Therefore strengthening of solid waste supply chain to

power plants by extended participation of citizens would also be its area of focus.

(b) HR capacity building –

Solar PV Power Plants & Solar parks project development, operation and maintenance personnel in peninsular India.

(c) **Urban Morphology Studies**-

The study of Bangalore's urban morphology should be done through extended participation of citizens.

The objective is to study the urban pattern, density and factors that helps the neighborhood of 30000 population. Thereafter divide the whole city into homogeneous neighborhoods, having utility as per national building code 2005.

There will be neighborhoods with deficit in infrastructure but has the potential to improve quality of life, make them compliant with socio-economic-cultural infrastructure norms of NBC 2005.

(d) ENERGY SMARTNESS

Post urban morphology studies, identification and spatial distribution of potential neighborhood, there will be a need to prepare Energy Master Plan.

Energy master plan would have strategy to design and establish a smart micro grid, its design & execution mode.

The master plan would have brief about sources of energy, demand side management i.e. stake holders, their values & lifestyle segmentation and energy consumption pattern; how the interface would work and needs for its optimal performance & use.

Demand side energy management system will also include protocol, tools and IOT applications.

(e) SMART URBAN SYSTEM

It's all about integration of services, utility, infrastructure and amenities through ICT applications SERVICES, UTILITY, INFRASTRUCTURE & AMENITIES through ICT applications.

The ICT applications would monitor service quality (output) and performance of system components. Predict the immediate operating or operations parameter. It will execute instantaneous actions, prepare the system to ensure its availability either immediate or in the near future.

(f) CONSUMER SMARTNESS

Objective is to achieve affordability through development or customization of consumer interface and IOT products. It can be also achieved through promotion of global scale domestic manufacturing of IOT products.

3.7 Benefits of SMART URBAN retrofits

SMART RETROFIT projects proposed is in synergy with EU SMART CITY characteristics that are significant, have definite measurable factors and indicators of quality urban life.

The SMART REPROFIT address public issues, has scope for employing Information and Communication Technology (ICT) based solutions, implemented by a municipality driven multi stakeholder partnership.

SMART RETROFITS have an additional dimensions promoting (i) economic development; (ii) employment generation (iii) adequate Water & efficient distribution (iv) Waste collection, treatment & disposal.

SMART RETROFITS needs implementation through development of SMART NEIGHBOURHOOD ERP, APPS, analytic's that is acceptable to the stakeholders (administrators) and in synergy with existing citizen's interface with administrators.

SMART RETROFITS initiative would benefit from investments in SMARTCITIES and introduction of alternate approaches to investment and growth management by PUBLIC PRIVATE PARTNERSHIP.

In the following paragraphs, objective analysis of SMART RETROFITS initiative is done.

PART B
SMART RETROFIT PROJECTS AND INITIATIVES

4 Green Transfer of Development Right (G- TDR[8])

G-TDR is a policy initiative that the Government of Karnataka can take without any capital expenditure. The objective is to promote use of Solar power, generated for captive consumption from dedicated solar PV Power plants with BESCOM distribution areas.

The Solar PV Power plants can also be part of Solar Parks within the 220 KV above grid network of KPTCL (State Grid) and PGCIL (national grid) passing through the state from convenience of monitoring and co-ordination by State Load Dispatch Centre at Bangalore.

The State Load dispatch centre at Bangalore is also physical sub-set of Southern Regional Load Dispatch centre at Bangalore. Therefore PV Power plants, part of solar parks, operational under SRLDC can also go for long term open access trading with customers in BESCOM, paying the required charges.

4.1 G-TDR - Target Group & Area

HT Consumers of Bangalore Development Authority or Local Planning authorities within Bangalore, distributed power by BESCOM[9]. BDA & BMRDA area also has large demand for TDR. Ideal stake holder mix includes but not limited to HT consumers of BESCOM in BDA & BMRDA.

4.2 Target consumer or user of G-TDR

Developer or owner of commercial & residential property in proposed clusters and growth nodes of BMRDA[10] or in designated growth corridors of BDA like

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8 Transfer of Development Rights (TDR) is a market-based mechanism that promotes responsible growth, while conserving areas such as working forest, prime agricultural areas and environmentally sensitive lands.

A Transfer of Development Rights (TDR) is a certificate from the Municipal Corporation that the owner of a property gets where his/her property (either part or whole) is reserved for the purpose of public utilities such as road, garden, school etc.

Transfer of Development Rights (TDR) means making available certain amount of additional built up area in lieu of the area relinquished or surrendered by the owner of the land. The owner of land either use extra built up area for himself or transfer it to another in need of the extra built up area for an agreed sum of money.

TDR is generated on plots reserved for public amenities like roads, playgrounds, gardens, schools, markets etc. TDR is an effective tool to simultaneously limit development in valuable open space areas while stimulating additional development in areas well suited to higher densities.

TDR for prospective development is granted, though it can be generated from preservation of privately owned past developments of heritage value.

Use of TDR as an urban planning instrument started more than a decade back in MUMBAI, followed by Cyberabad Development authority and Bangalore through CDP-2005.

Bangalore has a good demand for TDR.

TDR in Bangalore, Karnataka was introduced in the year 2005. If a property obstructs the "Right of Way" of an infrastructure project, the executing agency / the government can acquire your property by compensating the land / property owner with TDR.

TDR issued is permission for built-up area one and a half times the property originally surrendered.

In Karnataka, planning takes place as per the guidelines laid down in the Town and Country Planning Act. This is a State Government Act. Any amendment to this act has to come from the State Government.

9 BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED - BESCOM distributes more than 50% of total power distributed in the state. Bangalore contributes more than 40% to State Domestic Product of Karnataka, highest density of habitation & energy consumption in the state.

10 BMRDA Structure Plan 2031. Clusters and growth nodes like C1 (Ramnagara – Channapatana); C2 (Bidadi-Harohalli); C3 (Nelamangala-Peenya); C4 (Dobaspete-Neelamangala); C5 (Dodballapur); C6(Devanahalli-Yelahanka); C7 (Hoskote – K R Puram); C 8 (Jigani-Electronic city – Bommasandra – Attibele) and Growth Nodes at Anekel, Kanakpura, Vijayapura & Magadi.

Urban Redevelopment Zones[11]; Ca-Mixed Residential Area[12] and other uses where additional FAR[13] is allowed, gets an opportunity to use GREEN TDR.

The proposed GREEN TDR is similar to DRC[14] referred in CDP 2015.

The value of GREEN TDR consumed per project would be between 0.125 (12.50 %) to 0.25 (25.00 % - minimum DRC allowable for ZONE B[15] of BDA i.e. the FAR shall not exceed 3.5 (350.00 %) in any case.

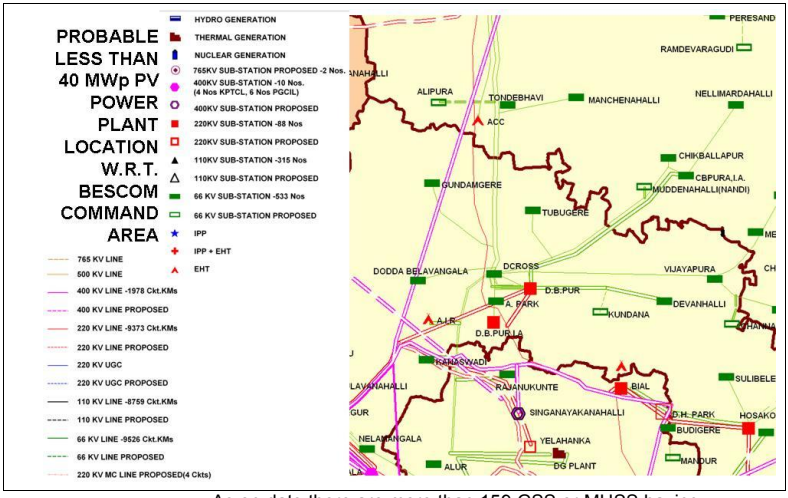
4.3 G-TDR - Beneficiaries and Benefit

Existing & Upcoming real-estate project on plot area greater > 4000 SqM within all the three DRC generating zone of BDA (ref RMP 2015) .

Upcoming real estate projects coming up in proposed Growth Clusters (C1, C2, C3, C4, C5,C6 & C7) and Growth nodes of BMRDA (Anekel, Kanakpura, Vijayapura & Magadi.)

Tangible benefit from use of day time power from dedicated solar PV power plant 33% to 50% (12 hrs annual average day light in Bangalore) of the Total Power Consumption are security in availability and stability in price of bundled power.

4.4 Location of Dedicated PV Power Plant



As on date there are more than 159 GSS or MUSS having spare 4 MVA capacity, located within 2 Hrs drive within the command area of BESCOM, suitable to accommodate PV Power plant up to 5 MWp.

PV Power plants greater than 5MWp but less than equal to 40 MWp, requiring cheaper land can be located within 50 Km

11 Urban Redevelopment zones: B - Ba (MG ROAD AREA Zone); Bb (CBD Area Zone); Bc (CBD Precinct Zone); Bd (Transformation & Development Area Zone); Be (Mutation Corridor Zone);

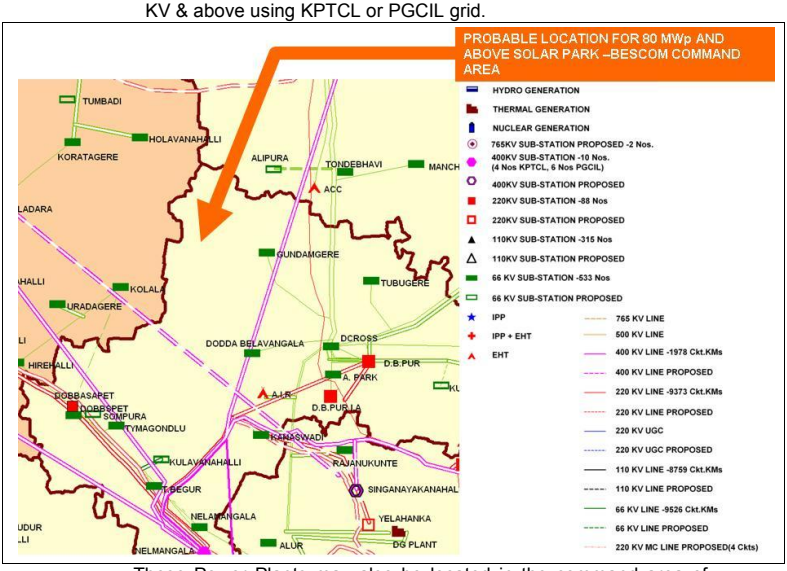
12 Residential Area Zones: C – Ca (Mixed Residential Areas); Cb (Mainly Residential Area)

13 Premium FAR is additional FAR that is availed on payment of fees as prescribed by the authority.

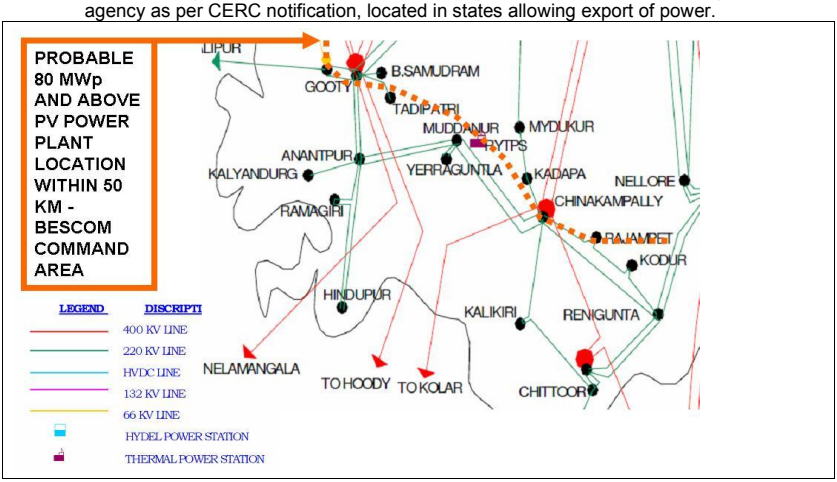
14 Development Rights Certificate

15 ZONE-A (1st Ring: The core area Planning Districts 1.01 to 1.07); ZONE B (2nd Ring: The developed urban areas surrounding the core area – Planning Districts 2.01 to 2.18) and ZONE C (3rd Ring: The urban extension areas in the City's outskirts – Planning Districts 3.01 to 3.22)

from perimeter of BESCOM command area but within KPTCL command area. Solar Parks > 80 MWp located within 50 Km from perimeter of BESCOM command are can evacuate power at 220 KV & above using KPTCL or PGCIL grid.



These Power Plants may also be located in the command area of Southern Region Load Dispatch Centre at Bangalore, the Solar Coordinating agency as per CERC notification, located in states allowing export of power.



4.5 G-TDR - How it's going to work

The concept is explained using a generic case.

The gross rentable/ saleable area is 0.47 Man SFT. The Connected Load for the building is 4.91 MW and the Demand Load of the building is 6.138 MW (6.819 MVA).

Total Power consumption will be 43.012 MU/Year.

Annual daytime power consumption will be 17.20 MU/Hrs (40 % of annual total)for 9.6 Hrs avg annual day lighting in Bangalore, to be met through generation of a PV Power Plant.

LEED gold rated commercial (business) building coming up on a 12000 SqM land abutting a road of right of way more than 30 M in Bangalore Dev Authority (BDA). Allowable FAR is 3.25 and ground coverage is 40%.

Total Energy	3.58	Million Units /Month
Consumption	3584300	kWh/Month
No of SPV / Bill	1	Nos
	6138	KW
Avg Demand Load	6819	KVA
PF (KWh / KVAh)	0.9	
LF	0.8	
Energy Consumption		
Total	3584300	kWh/ Month
Deficit in availability	-12.90	%
BESCOM -after deficit.	3121925	kWh/ Month
Captive DG	462375	kWh/ Month

Assuming PV power generation at 16.57 % Capacity Utilization Factor, the PV power plant will generate 1.45 MU/Year/MWp, the net size of the proposed PV power Plant will be 11.85 MWp.

The PV power plant has a debt of 10 years tenure and allowable power degradation in the first 10 years is around 10 %. Therefore the Gross Size of the PV Power Plant is 13.17 MWp.

The Project cost (EPCC + Land + Evacuation infrastructure) @ Rs 7.5 Cr/MWp comes to around Rs 98.75 Cr.

O & M Cost @ 14 Lakh/Year escalating at 6.7 % PA over 10 year period (tenure of plant debt) will be 25.11 Cr.

Therefore the lease rental from additional FAR has to provide for 123.86 Cr over 10 year period.

The lease rental is assumed to be Rs 36/ SFT , net escalation of 2% PA or selling price of Rs 4825/SFT. The additional FAR required is 0.25 or 25%.

The real estate project developer develops 13.17 MWp Grid linked PV Power Plant and gets additional FAR of 0.25 or 25.00 %. The power plant injects power to the grid and real estate project uses the power by just paying the required wheeling charges.

The real-estate project or the power plant developer gets 90 % of the Carbon Credits in the 1st year and BDA gets the balance carbon credit.

The carbon credit share of BDA becomes 20% in the 2nd year; 30 % in the 3rd year; 40 % in the 4th year and 50 % for the 5th year to the life of the project 25 to 30 years.

In existing buildings and areas where new buildings cannot consume all the additional FAR, the balance will be treated as Transferable Development Rights (TDR).

4.6 Benefits to Stake Holders

(a) New Real estate project developer-

The lease rental from additional built-up area after utilization of G-TDR pays for the PV Power plant project cost and O & M cost, completely recovered within 10 years.

The solar energy bundled unit power cost is lower than that paid by users of non-green building. ; The real estate project fetches premium lease rental for its green quotient [tangible due to Carbon Credit] and the tenant benefits from **energy security (availability) and price stability.**

(b) Existing Real Estate Project Owner-

G-TDR computed assuming (i) benchmarked cost of renewable energy project (ii) operation & maintenance over 10 years (iii) Loan repayment from benchmarked rentals equal to preceding three years average lease rental. To avoid computation complications in G-TDR value, the regulator SMIT might opt for a fixed value of G-TDR subject to maximum allowable limit.

The project capital and O & M cost is recovered either from sale of TDR or from levelised cost of power paid by tenants. The levelised tariff is computed for nominal life of the PV Power Plant.

Existing real-estate project using green power benefits from green quotient without costly retrofit. Secondly the bundled energy cost of green retrofit building would be less, it will also fetch premium lease rental for its green quotient [tangible due to Carbon Credit]. The tenant also benefits from **energy security (availability) and price stability.**

(c) BESCOM The Power Distribution company-

The cost of additional transmission infrastructure required for grid linking of PV power plant project is bourne by the power plant developer.

BESCOM is able to increase its catchments and command area with nominal investment. Majority of HT consumers will opt for dedicated PV Power plants, reducing the need to procure daytime power from other sources at high tariff.

(d) Ministry of New and Renewable Energy and Karnataka Renewable Energy Development Ltd (KREDL)

MNRE and KREDL meets the mission targets of Jawaharlal Nehru national Solar Mission with nominal funding due to extended participation of realty sector.

SMIT and other debt funds gets the confidence to offer non recourse funding of project as the PV power plant capital cost is clubbed with real estate project.

Currently most of the projects are concentrated in North-West India, far away from concentration of consumers in metropolitan cities. This policy initiative will also promote establishment of PV Power Plants at locations with above average radiation and higher concentration of consumers and vibrant realty sector.

Well distribution of projects throughout the country is good for safety, stability and diversifies risks of national power grids.

4.7 G-TDR The Road Ahead

SMARTCITY Investment Trust (SMIT) will also play the role of a regulator, established in Public Private Partnership.

> SMIT will arrive at Benchmark capital and its operation & maintenance cost. Thereafter SMIT will undertake computation of G-TDR and size of PV Power Plant. Technical due diligence of probable locations along with load flow analysis of KPTCL GSS / MUSS within BESCOM command are will be done by SMIT.
>
> The real-estate project development SPV is expected to be same as PV power plant development SPV.

In real-estate protects requiring solar fields smaller than installed solar field of 40 MWp, SMIT's role will be limited to

(a) Technical due diligence of the real-estate project and separate the PV power plant capital cost from total project cost.

(b) Investment in the Solar PV field development excluding cost of energy storage systems.

(c) Secure & enforce tariff payment through enforceable and assignable power purchase agreement with either real-estate project consumers or building facility Management Company (depending on customers' requirements & tenancy tenures).

SMIT will thereafter monitor the completion of the Solar PV power plant & grid synchronization for release of G-TDR. To prevent misuse of the system, SMIT will release G-TDR post Commercial Operation Date.

> Real estate projects that will have a separate SPV to generate solar power from solar fields larger than 80 MWp might also have energy storage systems. The realtor might not be interested in fully consuming the G-TDR. The realtor has the option of selling G-TDR and using the proceeds to fund the project. In such types of project, developed either within or outside KPTCL command area (within 50 KM of BESCOM perimeter), SMIT may also play the role of Energy Project Development Manager along with realtor.

5 Solar GREENHOUSE

Functional evolution of Solar Greenhouse from GREEN RETROFITS for existing solar PV Power Plant, identification of appropriate PV Power Plant Module mounting structures with lowest carbon footprint and finally SOLAR GREENHOUSE, is detailed in following paragraphs.

5.1 GREEN RETROFITS for existing solar PV Power Plants

Grid linked PV Power plants Operation & Maintenance is done as per standard operating procedures of EPC Contractors & component manufacturers.

The O & M teams have a long term contract, usually 10 years after Commercial Operation date or till the life of critical component module, life of 25 years.

The biggest O & M challenge is housekeeping of the plant for minimizing soiling of plants.

Existing PV power plants only generate revenue only from the sale of power.

Non-power tariff revenue options complementing O & M activity, deploying additional unskilled work force are

A green hedge along project perimeter, planted with arid agro climate species like Simmondsia chinensis (JOJOBA), requires negligible irrigation. These types of hedges can be a major component of dust abatement landscape.

Modules cleaned by using use of enzyme based - phosphate free liquid detergent along with softened water is considered safest washing option. It is also observed that wash from commercially available enzyme based detergents promote growth of plants in kitchen gardens - herbs, shrubs and vegetables. Therefore Module mounting structures that has accessible the space below it can utilize the wash to grow shade tolerant herb, shrub and vegetables, making it part of project landscape.

Reverse osmosis spent, currently waste from PV Power plant water softening plant, can also be utilized in water raceways to grow suitable species of micro algae.

These GREEN RETROFITS proposed for existing solar PV Power plants, currently consuming around 6000 L of dematerialized water for cleaning/ housekeeping of an MWp of solar field.

Tangible benefits of the GREEN RETROFITS are (i) reduction in PV power plant carbon foot print; (ii) reduction in O & M cost due to reduced soiling. Currently module cleaning & cost of water is around 44 % of total O & M cost in the first year of operation; (iii) Generate additional revenue from sale of JOJOBA seeds, dried algae & vegetables along with unskilled employment generation.

The layout plan of most of the PV Power plants executed till date in India have arrays of conventional ground based module mounting structures for all types of terrains and soil conditions.

Most of the Solar Field Arrays have maximum two strings of modules, maximum ground clearance of array toe is around 500 mm to minimize soiling and wild grass growing below & between arrays. However, the arrays built have same structural form for all agro climatic zones of our country, except spacing and tilt. The built form is function of solar geometrics of a site in particular agro climatic zone but looks the same throughout the country.

GREEN RETROFITS, customized for an agro climate zone would add character to the image of PV Power plants, for example Vineyard-PV Power Plant.

Today developers consider land development activity related to a PV Power Plant only to either cut or fill to make it flat. They believe that a flattened land can accommodate more solar arrays. On the other hand minimizing cutting & filling and retaining the natural site grade though contour bund aids site drainage and reduces risks from nearby flood plains.

Contour bunds and sustainable landscaping is a standard practice in any real estate project. Landscaping should therefore be included in the project capital and O & M Costs.

A functional landscape in real estate and infrastructure projects has positive effects on site microclimate, especially the resultant site temperature & dust reduction and regulated wind patterns.

A PV power plant with dust-abatement landscape would directly reduce heat & heat island formation, i.e. through reduction in site ambient temperature and generation of localized wind eddies. This effect of change in site micro climate reduces power loss due to module temp coefficient, as the site radiation levels remains the same.

GREEN RETROFIT PV power plant i.e. layout maintaining existing grading, enhancing site drainage, promoting dust abatement landscape reduces the O & M Cost; generate additional revenue & employment.

5.2 PV Power plant Module Mounting Structure

PV module mounting structure (MMS) keeps the modules oriented in the correct direction while providing them structural support and protection. Mounting structures may be fixed or tracking.

Fixed mounting systems keep the rows of modules at a fixed tilt angle while facing a fixed angle of orientation. The tilt angle and orientation needs optimization for each PV power plant according to locations solar geometry, to maximize the total annual incident irradiation and total annual energy yield.

MMS are made up of galvanized structural steel, comply with National Building Code-2005 and designed for the wind and seismic zone. In the future manpower for operation and maintenance of Solar PV power plants would be skilled, scarce and expensive. There would be also additional design features that are also going to make it future proof.

A large structure housing at least 4 strings per array, reduction in the number of columns, the reduction in foundation, increases flexibility of its use in all types of terrain.

The Array TOE (lower portion) must have a finished ground clearance of minimum 800 mm, where minimum 500 mm is the space required to reduce soiling and additional 300 mm to accommodate accessible cable tray.

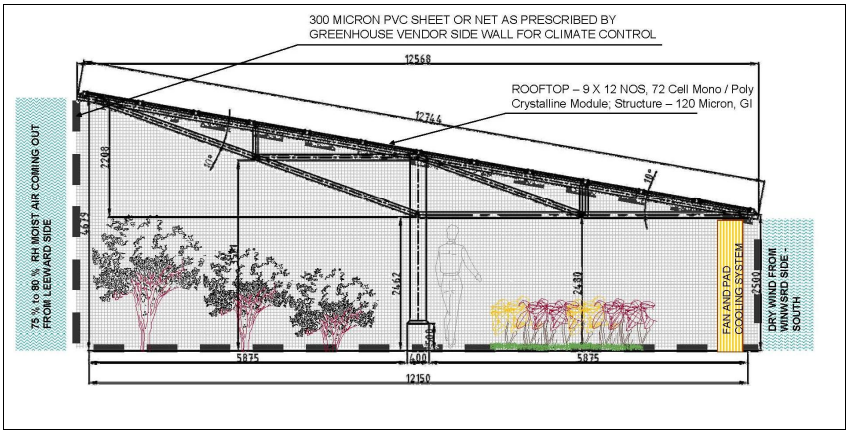
Ground clearance of minimum 800 mm at the array toe leaves adequate space for work by maintenance & horticulture crew. Large MMS would also reduce the number of de-mineralized water laterals / MWp. Secondly MMS would have minimum 3000 mm inter array space (space between heel of preceding MMS and toe of following MMS), sufficient for maneuverability of automated guided vehicles (AGV) with cleaning probe and pressurized water tank. Even though large arrays reduces the number of water laterals & pipe losses, expect reduced availability of de-mineralized water for housekeeping in the future would require either optimized use of water through probe with pressurized water tank on AGV, or MMS retrofit that uses micro-fiber brushes with pressurized dust blower.

The inter-array spacing would be water bound macadam path, secured with curb-stone cum saucer drain at heel & toe. This will also keep the space below the module mounting structure well drained, suitable for growing shade tolerant vegetation.

Module mounting structure	Type - A	Type - B	Type - C
Clearance and access of space below	Low	Medium	High
Array Toe – Min in mm	500 mm	800 mm	2400 mm
Strings / Array	1 - 3	Up to 4	6 and above
Foundation/ Module ratio	More than normal	Normal – 0.2	Lowest
Inter array spacing between Toe & heel	Less than 3 M	Around 3 M	More than 10 M
Steel – kg/ SqM MMS Area	9 Kg / SqM	12.5 to 14 Kg /SqM	> 16 Kg/SqM

5.3 Solar GREENHOUSE

The Solar GREENHOUSE prototype proposed for Bangalore and its neighborhood is a “Type-C”, optimally designed Module Mounting Structure with GREEN RETROFIT.



It can be a Grid independent, 25 KWp to 30 KWp PV Modules, adequate for residences and utility like water pumps or grid linked power plant of MW range contributing towards neighborhood food security.

6 Solar Energy Industry's Human Resource capacity building

6.1 Fact s as on date

Capacity building needs of Solar PV Park's business segment / sector has remained unaddressed until date. Ministry of new and renewable Energy (MNRE), Government of India has given accreditation to around six institutions for entry-level programs affiliated to foreign institutes.

MNRE has developed curricula for M. Tech and other graduate program to be taught in engineering colleges in the country. These initiatives of MNRE are in the takeoff stage and needs to be integrated with additional programs, extended participation of industry, linking the entry level programs, on job experiences hierarchically to graduate programs.

Today graduate under the M-tech program neither has the hands on experience nor does he develop the leadership quality to lead a design development / project team.

Majority of the existing manpower (manufacturing, installation, design, integration and O & M) in the Indian market are alumni of companies like TATA Power Solar, Moserbaer and PSU's like BEL, BHEL, ECIL, CEL (Shahibabad) & Semiconductor Complex Limited (Mohali). Rest of the employees have either trained or worked abroad.

Many employees of Solar PV Engineering Procurement and Construction Companies (EPCC) were either in thermal and other energy sectors or diversified into Solar PV Business. Some of these EPCC companies were in the real estate electrical contracting business, diversified to service telecom sector and now got into Solar EPCC.

Most of the Business Development Professionals migrated from allied electronics manufacturing sector like Telecom Infrastructure.

Existing Plant O & M personnel are employed with contractors, not in plant owner's payroll.

These personnel got training on SOP prior to handing over of plant to owner/ O & M Contractors by EPCC. They were previously employed in HT/LT system O & M in GSS/ Small Power Plants/Real-estate facilities and Industrial units.

In Indian conditions, O & M contractor also has informal responsibility of energy billing and its realization. Owners generally employ consultant as owners engineer for project development and over see Operation & Maintenance (O&M). Owner's commercial staff is responsible for liaison at the time of execution and realization of energy bills.

For projects grid linked to medium voltage state Distribution Company (DISCOM) / Transmission Company (TRANSCOM) grid, liaison for facilitating grid availability is a critical activity as metering is at the GSS end.

6.2 Existing system of "Personnel Certification & Competency"-

Personnel employed in designing of plant (Engineering) are mostly electrical engineers having experience in AC side- LT, HT,Transmission, GSS and in plant BOS.

They either gained experience while being employed with State PSU, Private Sector Independent Power Producers (IPP) or private sector consultancies, with limited exposure to solar resource simulation, optimizing DC part of solar field.

Most of the design, development and O & M personnel are into job on the basis of relevant experience claims neither validated by employer nor there is a **"Certificate of Service"** issued and validated by employer/ project head.

Undertaking of systematic competency mapping of available skill, job description (needed skill); roles & responsibility definition vis-a-vis project size or complexity, needs to be done immediately.

The industry has just taken off though it's the 4th year after launch of JNNSM and there is little opportunity for job & skill based training, competency certification system and training programs other than entry level programs for installers; LT/HT lines man & electricians and Graduate Programs.

There is also a need for integration of entry level programs, making them mandatory for entry level jobs and subsequent professional growth. Immediate interventions like on job trainings/ skill up-gradations along with intermediate job creation would be required.

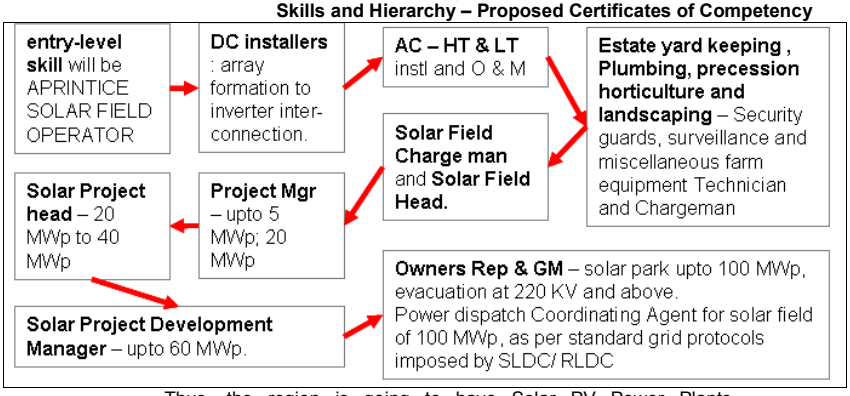
6.3 Capacity Building - SMARTCITY Investment Trust's (SMIT's) stake.

Objective of establishing SMIT is to achieve energy security and price stability, i.e. ENERGY SMARTNESS. SMIT will administer G-TDR; provide non-recourse funding, project development & management of allied solar PV power plants and parks over 5 to 7 years time.

SMIT based out of Bangalore would be located in the geographical centre of peninsular India where in the Q4-2014, around 2 GW of Solar PV Capacity has been put on bid by state governments of Karnataka, Telangana, Andhra Pradesh & Tamil nadu. Having stringent targets for grid linking, synchronization – i.e. Commercial operation date (COD), maximum 18 Months including extensions for meeting conditions precedent for financial closure.

Solar Energy Corporation of India, a public sector unit of government of India also got mandate to develop 3 solar parks aggregating 3 GW in Andhra Pradesh and Telangana. Average energy deficit of around 20 % in the southern peninsula states of India would also expected to create market for 3rd party solar parks of 80-100 MW, aggregating 1 GW.

Skills and Hierarchy – Proposed Certificates of Competency



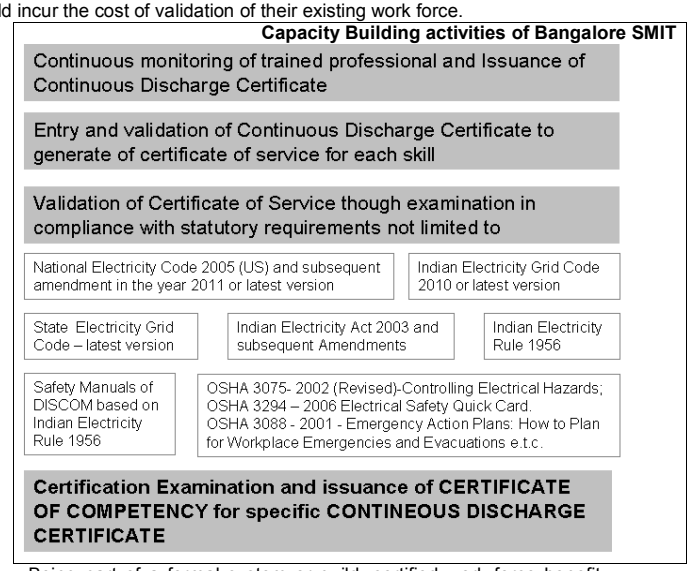
Thus, the region is going to have Solar PV Power Plants, aggregating 6 GW in the near future.

There would be an immediate need for formal "competency mapping" of existing work force, its validation and issuance of "certificate of service".

Pool of mapped, certified workforce and its database will assist project developers and EPCC to plan their in-house HR initiatives and open up the training market.

It would also improve the employment potential of personnel in India & abroad; reduce the project risk quotient [for example ships registered with Flag of Convenience, manned by under certified personnel or those on dispensation, has the highest insurance rates and risk quotients. In the last 70 years, most of the shipping disasters happened with Flag of Convenience (FOC) registered vessels or by personnel having only certificate of service].

Solar field owners & EPCC desirous of competent professionals would have to pay fees for accessing the pool of certified work force and would incur the cost of validation of their existing work force.



Being part of a formal system or guild, certified work force benefit from standard minimum wage. Certification body would maintain a record of existing employees on job performance for a place of work (International JV of SMIT) called Continuous Discharge certificate (CDC). CDC will be a Pass Book of Experience - starting with entry-level deployment to a particular site until as on date employer, project, & roles responsibility in job, incidents and leadership initiatives of the concerned personnel.

Site project manager or owners engineer, site in-charge and surveyors / inspectors of Certification body (International JV of SMIT) will annually validate CDC. This will reduce the level of employee attrition and dissatisfaction.

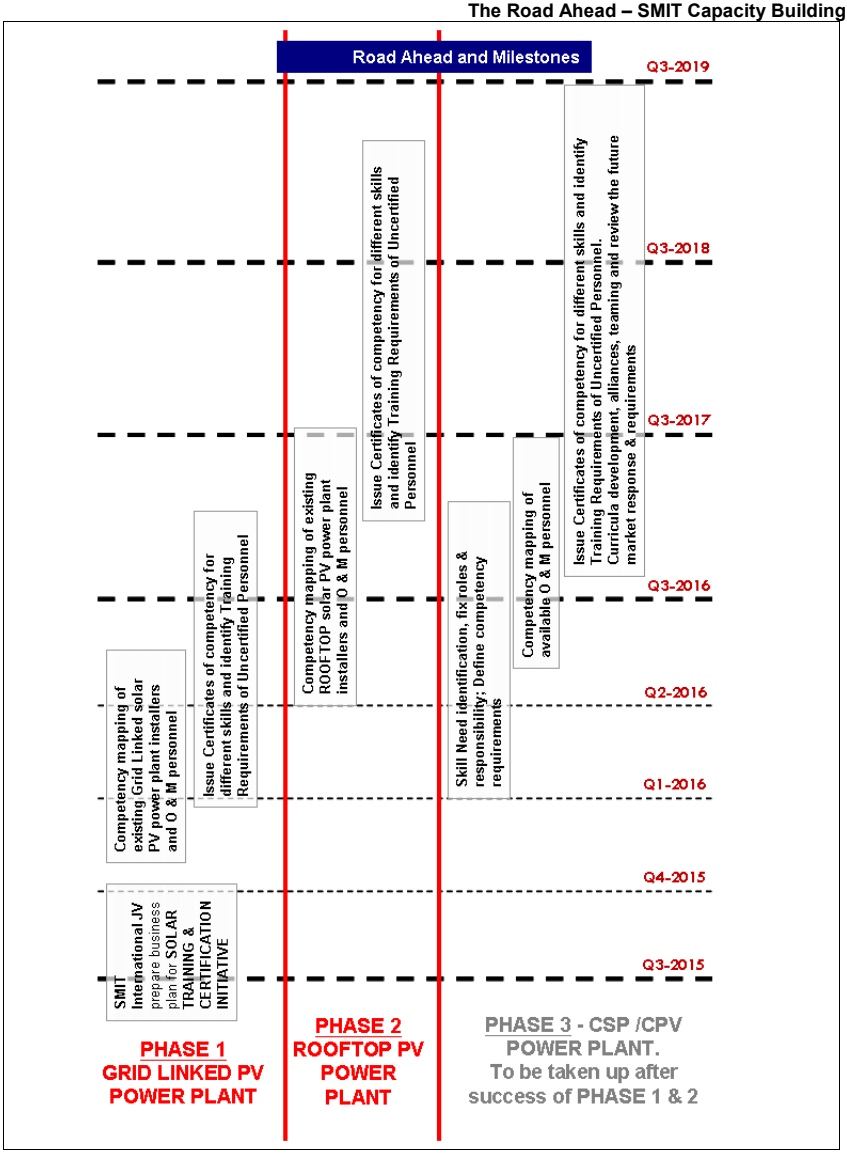
SMIT being the initiator of this program will gain from availability of quality pool of work force for its own projects even when there is going to be shortage of work force in the IMMEDIATE FUTURE (Q2- 2015 onwards).

CERTIFICATE OF COMPETENCY developed and administered by international JV of SMIT, will be open for limited period for existing employees desirous of conversion from CERTIFICATE OF SERVICE and career progression of entry-level professionals.

The work force capacity building initiative will be a sustainable business operation with revenue from issuance of CERTIFICATE OF SERVICE, Pre Certification Trainings and examinations before issuance of CERTIFICATE OF COMPETENCY.

The above actions by International JV of SMIT will lead to formation of a SOLAR PV PROFESSIONALS GUILD in peninsular India within the next 5 years.

The Road Ahead – SMIT Capacity Building



7 Neighborhood Solid waste to combined cycle power plant –

Bangalore city generates 4500 Tons of solid waste per day. Around 40 % of this waste is non-bio degradable and classified locally as dry waste. At bulk generation points like gated community of residences, the dry waste is further segregated as e-waste and hazardous waste (includes used medicine tubes and packages).

7.1 Existing situation

In the introductory chapter, the process of solid waste collection system is detailed. Today aware & educated households follow the segregation requirements and the enlightened neighborhoods maintain the waste segregated at their TRANSFER STATIONS.

Doorstep collectors and contractors handling Garbage/ Solid Waste beyond TRANSFER STATIONS don't have incentive to keep it segregated other than the need to selling the recyclables illegally and optimize the logistics Ton-Mile. Contractors neither procure factory built customized solid waste collection vehicles nor do they retrofit new vehicles as per standard specifications. Most of these vehicles are inadequately covered, causing spillage during transportation.

There are very few factories made customized vehicles owned by BBMP, funded by grant from Ministry of Urban Development, Government of India.

Today at the transfer station, at the time of loading solid waste into trucks, garbage/solid waste gets mixed. This also makes it difficult to handle at the landfills. During transportation of the mixed solid waste, rag pickers sitting within these trucks sort recyclables for illegal sale and store it in ragbags, hanging along the truck chassis.

The city's 171 odd dry waste collection centers (DWCC), created by Bruhat Bangalore Mahanagara Palike (BBMP) to collect 40 per cent of the total solid waste generated in Bangalore, and remains underutilized.

> Hasiru Dala, an NGO, which presently manages 34 of these 171 DWCC's observed that though the amount of dry waste being collected at these DWCC's has increased in the recent past, it still averages less than a few tones a month. A very low quantity compared to expected average collection of around 10.5 ton / day/ DWCC.

Today garbage collection contractors are paid for the quantity of solid waste collected and transported. They bid for Ton-mile and the lowest bidder wins the bid. This is a disincentive to use factory made custom built trucks and transporting the same segregated to DWCC located in the city neighborhoods.

Transporting the non-segregated solid waste to landfills located outside the city generates more annual revenue for transport contractors.

Contractor's employee sell illegally sorted recyclables during transportation to supplement their low wages.

7.2 "Dry Waste Collection" SMARTNESS

In the take-off stage, where the old contracts are still valid, additional incentive per truck, proportional to multiple of calorific value and stowage factor, needs to be introduced.

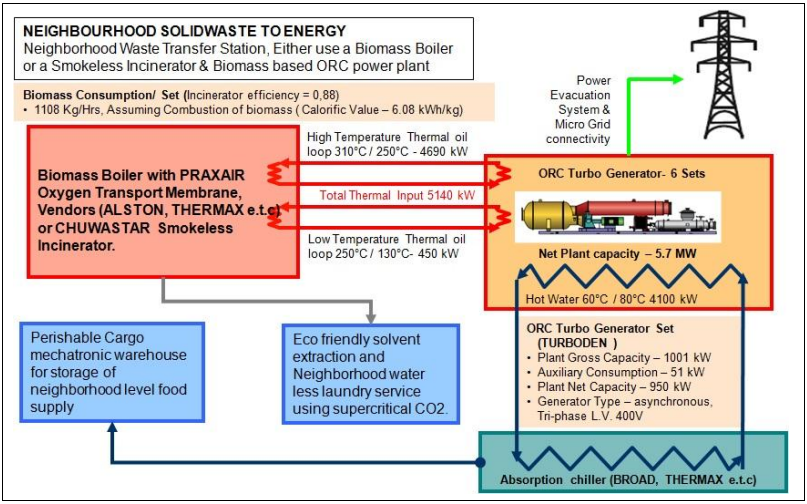
There has to be a weigh bridge with calorific value sensors and x-ray to record the calorific value and stowage factor for each pre calibrated truck. There will be also need for RIFD Tag for storage of calibrated data. Trucks without RIFD tags should also be barred from entering landfills. Thereafter contractors would be compelled to use new–well maintained vehicles.

Mixed solid waste will have lowest multiple of calorific value and stowage factor. It will be highest for segregated "Dry waste". This will be an incentive for transporting waste segregated, sealed in container with lowest stowage factor.

When the stowage factor is high, there won't be any space to accommodate rag picker. Making shorter haul to the DWCC within city also will not affect the annual revenue per truck.

7.3 Typical Waste to Energy project

Once the solid waste collection process streamlines, all the designated 171 numbers of "Dry Waste Collection Centre's" would handle more than 10.5 Tons of dry waste per day. Following prototype, attached to each DWCC can generate at least 5.7 x 171 MWp of dispatch able power to BESCOM.



8 Solar PV Modules – Globally Competitive made @ India

Success of G-TDR, programs under state solar policy and national solar missions requires bankable solar PV modules at competitive prices, possible either through extended participation of foreign module manufacturer or promotion of manufacturing at India.

To promote local manufacturing, i.e. made@India, Government of India proposed imposing anti-dumping duty on solar energy cells, after giving adequate opportunity to manufacture products and components in India at globally competitive cost through introduction of incentives.

8.1 Incentives - Indian Solar PV industry

More than a year back Department of Electronics and Information Technology (DeitY); Government of India, introduced industrial promotion initiatives like Modified Special Incentive Schemes (M-SIPS) for promotion of Electronics Systems Design and Manufacturing (ESDM) Industries.

Under M-SIPS scheme, units coming up in upcoming EMC (Electronics Manufacturing Cluster will get back benefit from Govt of India in-terms of up to 25 % of CAPEX + Reimbursement of excise/ CVD on capital equipments for facility and allowable capital cost – (i) Poly silicon manufacturing unit. Capital Investment up to Rs 850 Cr; (ii) Poly silicon Technology Ingots & or Wafers. Capital Investment up to Rs 400 Cr.; (iii) Poly silicon Technology Cells or Cell & Modules. Capital Investment up to Rs 100 Cr.

8.2 Weakness of Domestic Solar PV industry

Today Indian PV module manufacturers are either sick or weak even though there exists manufacturing facilities for immediate requirements of the nation.

Most of the existing Indian module manufacturers do not have semi-automatic lines of 100 MWp capacities and above. Batch processing and small-scale operations is responsible for overhead cost (OVH) of existing domestic module manufacturers is more than18 USD for 60 Cell modules.. OVH is 13 USD / 60 Cell Module in Vietnam and around 12 USD / 60 Cell Module in China.

Majority of domestic module manufacturers procure cells and consumables either at spot prices or from local traders, main reason for higher input costs.

Secondly, most of the domestic players have high cost of investment and debt servicing liability; they seek advance from buyer along with consigned cells.

8.3 Foreign Direct Investment (FDI) opportunity

Establishment of wholly owned manufacturing facilities in India is cost competitive.

Chinese Companies (most cost competitive manufacturer) wholly owned subsidiary in India would have an overhead of 11.85 USD/ 60 cell module, comparable to costs in China.

An Indian facilitator like SMIT can reduce the gestation time to start manufacturing operations in India by providing Built to Suite factory with plug & play utility (excluding turnkey manufacturing line) and access to a pool of trained work force. Companies would also benefit from savings in logistics cost and be in a position to export countries with entry barrier for operations out of China.

8.4 SMIT's role

SMIT may provide the BUILD TO SUITE factory. Support in identification of suitable work force and their placement. If needed SMIT may also identify global technology partner; Indian factory operating agency or partner and QC Team for best manufacturing practices.

Foreign module manufacturer consigns the best available mono / poly crystalline cells and other consumables from overseas market to its module manufacturing subsidiary in India.

8.5 Conditional Antidumping duty to promote made @ India

Government of India has imposed anti-dumping duty on PV cells imported from the US, China, Taiwan and Malaysia. Dumping is not limited to price reduction; we have seen flooding of market with non-bankable poor quality products, labeled as bankable products.

> Anti-dumping duty would do more harm than good because there are very few completely vertically integrated manufacturing units in India. Most of the domestically manufactured modules are not bankable, as they don't follow good manufacturing process / documentation needed to ease re-insurance by global players. Domestic module manufacturers are too debt ridden to do contract manufacturing at globally competitive cost even when all materials are consigned to them.

On the other hand, Government of India has given adequate opportunity to manufacture products and components in India at globally competitive cost through introduction of industrial promotion initiatives like Modified Special Incentive Schemes (M-SIPS).

> Government of India must make removal of anti dumping duty conditional. Foreign companies desirous of doing business in India without imposition of anti dumping duty must commit to start manufacturing within a period of 18 to 24 months after commencement of trade.
>
> The volume of import is linked to the proposed manufacturing capacity of Indian plants production over 18 to 24 months. Over this period (18 to 24 months) the importer deposits the computed anti dumping duty with a government designated Renewable Energy Investment Trust like Smart City Investment Trust (SMIT). Once the production of modules starts, SMIT returns the principal amount deposited by the importer equal to value of anti dumping duty.
>
> If the importers miss the target due to regulatory bottlenecks or force majeure condition, the importer would be offered time dispensation. To avail time dispensation, importer has to make additional deposit with SMIT, equal to value of anti-dumping duty for time dispensation period.
>
> In the case a non-serious importer doesn't start production after time dispensation, deposit of anti-dumping duly value gets forfeited.
>
> Deposits available with SMIT and interests from short-term deposits would fund low cost non-recourse debt / mezzanine capital for solar PV power plants. SMIT can also promote products manufactured at India by entities supported by it.

Conditional anti dumping duty will also act as deterrent for non serious importers (who don't even have a local company or corporate entity to do trading, just a liaison office). It is not going to hinder the national objective of Grid parity and promote localization of strategic industry.

9 SMARTCITY Investment Trust (SMIT) –

SMART URBAN RETROFIT PROJECTS are high impact, high revenue and revenue positive projects.

These projects cannot be executed by conventional PPP BOOT CONTRACT as they need to be bundled by the SMIT as all components are not expected to have lucrative revenue stream even though it may have positive revenue stream. Bundling is also required to execute priority sector with low revenue before the lucrative one with less priority.

SEBI (Infrastructure Investment Trusts) Regulations, 2014, dated 10th August, 2014 is the guiding principle of establishment of SMIT. SMIT will be a **Category 1 Infrastructure Investment Trusts (InvIT),** where the InvIT may invest in multiple infrastructure projects, whether pre or post-Commercial Operation Date.

Smart City budget of Rs 70 Cr per city, earmarked by Government of India can be the initial subscription amount to form SMIT. It will act as a NODAL AGENCY (NA), co-ordinating with different departments.

SMIT will be functionally a drawing and disbursement body for grants and subsidy channeled through the Central Govt to execute the projects. Bangalore based public sector units and private sector CSR Funds would subscribe Balance amount.

The proposed holding of SMIT in the underlying assets shall be MORE THAN Rs 500 Cr and the offer size shall not be less then Rs 250 Cr. at the time of initial offer of units.

The aggregate consolidated borrowing of the SMIT and the underlying SPVs shall never exceed 49% of the value of SMIT assets.

SMIT would raise funds only through public issue of units; have a minimum 25% public float and at least 20 investors. SMIT would distribute not less than 90% of the net distributable cash flows, subject to applicable laws, to the investors, at least on a half yearly basis.

SMIT would use the services of competent valuation expert, undertake a full valuation on a yearly basis and updating of the same on a half-yearly basis and declare NAV within 15 days from the date of such valuation/updating.

SMIT will invest at least 80% of the value of the assets in the completed and revenue generating assets and balance 10% on PPP & Non PPP under construction projects. For balance 10% of under construction project, SEBI guidelines would be complied.

The focus area of **SMARTCITY Investment Trust** in the **Take-off stage** would be

Solar PV field of minimum 100 MWp, capital expenditure of Rs 915 Cr. Rs 900 Cr for preparation of neighborhood Energy Smart Master Plan, 90 MWp solar PV power plants established using G-TDR & waste to energy projects**.**

Capacity building including competency mapping of existing solar field work force, entry level programs for installers and O & M personnel. Equity exposure in the project takeoff stage limited to Rs 15 Cr.

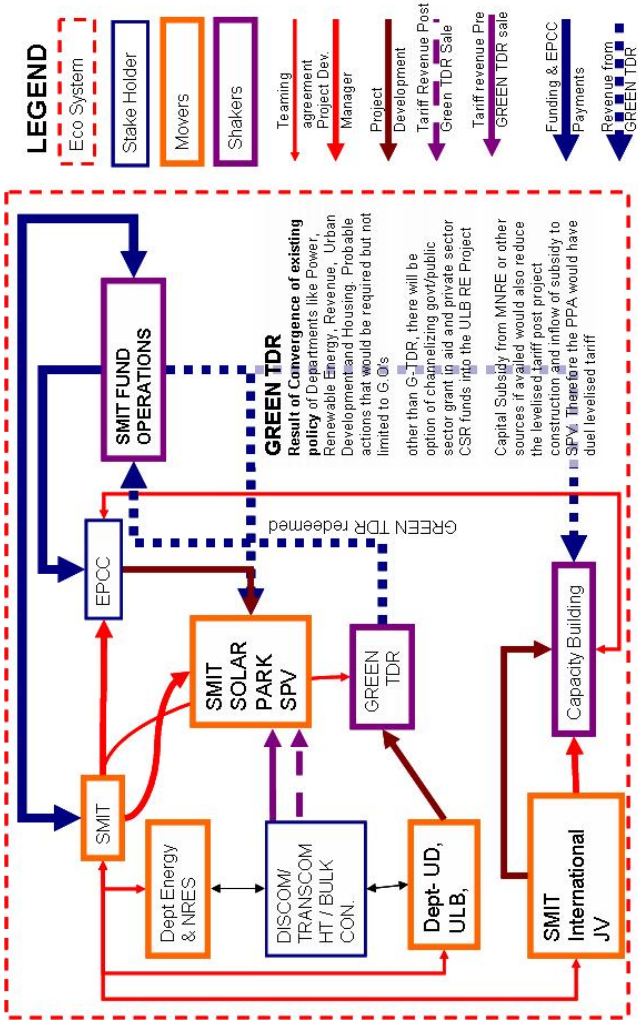
Promote domestic manufacturing of **Solar PV Module & Cell Manufacturing,** its **demand & supply side infrastructure, leveraging on DEITY** support for eligible electronics cluster under **MSIP's** policy of **Government of India**.

Exposure of fund would be limited to **procurement** of **BUILT TO SUITE** factory or its **leasing** and sales support with funding exposure limited to Rs 50 Cr.

Post trial production in the manufacturing unit, support would be limited to designation of manufacturing unit as **PREFERRED MODULE SUPPLIER** for solar field capacity under development.

SMIT may provide **working capital support** for supply to **solar fields / projects** it has **invested.**

9.1 SMARTCITY Investment Trust (SMIT) at a glance -



10 Urban Morphology Studies for a planned future

The city of Bangalore is slowly losing its scale, character and ability to maintain a sense of continuity of fundamental values and security to exist in a good living environment.

> The city has failed to maintain settlement character due to reduced harmony between the built environment and the people, necessary for a balanced community of the various socio-economic groups.
>
> Co-operation within, lack of fraternity & tolerance has reduced self-help process within community.
>
> The city is in need of a framework within which there will be an opportunity for incremental physical development, within existing legal, economical and organizational framework.

After take-off Green TDR funded Solar PV Plants and solar PV capacity building initiatives matures and integrates with the URBAN SYSTEM of Bangalore, SMIT needs to undertake Urban Morphology[16] Studies through extended participation of citizens, using IoT apps, analytics including game theory.

> The objective is to study the urban pattern (fractals), density and factors that help in the formation and sustenance of neighborhood of 30000 populations. The outcome of the study will be identification of homogeneous neighborhoods within the urbanized areas of the city.
>
> For each neighborhood, there will be Value and Lifestyle based segmentation[17] (VALS) of the population. Based on the VALS, inadequacy

16 Source http://en.wikipedia.org/wiki/Urban%2520morphology?oldid=625963801

Urban morphology is the study of the form of human settlements and the process of their formation and transformation. The study seeks to understand the spatial structure and character of a metropolitan area, city, town or village by examining the patterns of its component parts and the process of its development.

This can involve the analysis of physical structures at different scales as well as patterns of movement, land use, ownership or control and occupation. Typically, analysis of physical form focuses on street pattern, lot (or, in the UK, plot) pattern and building pattern, sometimes referred to collectively as urban grain. Analysis of specific settlements is undertaken using cartographic sources and the process of development evolves from comparison of historic maps.

Special attention is given to how the physical form of a city changes over time and to how different cities compare to each other. Another significant part of this subfield deals with the study of the social forms which are expressed in the physical layout of a city, and, conversely, how physical form produces or reproduces various social forms.

Urban morphology is the study of urban tissue, or fabric, as a means of discerning the environmental level normally associated with urban design. Tissue comprises coherent neighborhood morphology (open spaces, building) and functions (human activity). Neighborhood exhibit recognizable patterns in the ordering of buildings, spaces and functions (themes), within which variation reinforced an organizing set of principles. This approach
challenges the common perception of unplanned environments as chaotic or vaguely organic through understanding the structures and processes embedded in urbanization. Complexity science has provided further explanations showing how urban structures emerge from
the uncoordinated action of multiple individuals in highly regular ways. Amongst other things this is associated with permanent energy and material flows to maintain these structures

17 Segmentation models based on Demographics, Geo-demographics, SEC data & Benefits and usage are inadequate in their description & analysis of a person since they generate only isolated fragments. Values And Lifestyles segmentation based on lifestyle characteristics and values provide a rich view of the market and a more lifelike portrait of the consumer.

Value refers to a single belief that transcends any particular object, in contrast to an attitude, which refers to beliefs regarding a specific object or situation. Values are more stable and occupy a more central position in a person's cognitive system, are determinants of attitudes, behavior and provide a stable and inner oriented understanding of consumers. Values within a system refer to a wide array of individual beliefs, hopes, desires, aspirations, prejudices etc. Values provide potentially powerful explanations of human behavior as they serve as standards or criteria of conduct; they tend to be limited in number & are remarkably consistent over time. The value construct is used to segment the population into homogenous groups of individuals who share a common value system.

Lifestyle is a distinctive mode of living, deals with everyday behavior oriented facets of people as well as their feelings, attitudes, interests & opinions. It embodies the patterns that develop and emerge from the dynamics of living in a society.

of the social -economic - cultural infrastructure of the neighborhood would help to quantify quality of life.

Neighborhood strategies to improve quality of life (includes effect of population growth within a particular VALS and scenario of migration from one VALS to another due to change in aspiration) needs to be prepared to also comply with social -economic - cultural infrastructure norms of NBC 2005.

10.1 Neighborhood & pattern -

Urban Design and Planning philosophies starting from "Garden City Concept (Letchwoth)", "A Pattern language" of Christopher Alexander and "New Urbanism" of early nineties have always emphasized on making the place of work nearer to residence and transportation trip reduction.

At the same time, it wanted to resolve the issues of (i) decrease in availability of suitable agricultural land for the growing population; (ii) Need for conservation of agricultural lands for future food security and other ecological issues of urban development.

The desired urban pattern must have hierarchy of different types of land use and proper spatial distribution such that the whole thing works like a system. The "System" should on the other hand must also have attributes like

Vitality to support biological requirements and human capabilities.

Image that can be clearly perceived and differentiated, leading to synergy between built form and culture.

Balanced community with equitable access to resources generated by planning process.

Maximum coverage of utility and distribution efficiency.

Offers flexibility of incremental growth of community that is feasible within given legal, fiscal & organizational framework and in a realistic time frame.

The processes that generate an identifiable neighborhood and part of the urban web can be summarized in terms of three principles, are as follows-

(a) **Nodes**: The Urban Web anchored at nodes of Human Activities where Interconnections make up the Web.

There exist distinct types of Nodes - Home; Work Park: Store: Restaurant and Church.

Natural and Architectural elements serve to reinforce human activity nodes and their connective paths. The Web determines the spacing and plan of buildings, not vice versa. Pedestrian paths cannot connect the Nodes that are too far apart.

A Node is in a Major Street. The Sidewalk of the Major Street is wide. A Node is near interaction of two or more busy street. Many Land Use meets in this small area. It also has residential area nearby. Commercial and Institutional areas are present near the nodes.

(b) Connections: Pair wise connections formed between complementary nodes not like nodes. A pedestrian path consists of short straight pieces between nodes but does not exceed certain maximum length**.**

Value and Lifestyle segmentation unlike traditional segmentation begins with people instead of products and classifies them into different types, each characterized by a unique style of living - it then determines how marketing factors fit into their lives. This perspective provides a three-dimensional view of the target consumer.

Connections / Paths form trees / loops of a network. Depending on the path types the tree thus formed can be : exo-centric, minimum spanning, minimum circuit and combination type. Network formation by nodes and paths is best defined by "Traveling Sales Man" problem of operation research.

(c) **The Web:** The Urban Web self organizes by creating an ordered hierarchy of connections on several different levels of scale.

The Degree of Organization (**D**) of any complex system can be defined as follows-

D = K(No of Connections / No of Nodes)		Where
D(exo-centric and minimum spanning tree network)	< 1 K =>	No of connections 1 less than no of nodes
D(Conventional Calculators and Minimum Circuit Network)	= 1 K =>	No of connections equals the no of nodes
D (Human Brain)	> 104 K	
D (Parallel Processors)	= 2K to 5K	

The processes of Urban Web generations are the inputs for formation of Web Forms with D less than 1K. Depending on the path types, the web tree / loops formed can be the web is either exo-centric, minimum spanning, minimum circuit or combination type. Even when the urban pattern is complex, its degree of organization is less than 1K. i.e. exiting computational methods and tools can be used with customization.

At the micro level pattern or Web Forms should represent a residential cluster (Identifiable within a Neighborhood) of population range 500 to 1000 (100 to 200 households), similar to an OBJECT (Types 0 to N).

These OBJECTS link each other in different permutation and combination to form a NETWORK of utility, infrastructure forming part of the urban web called community.

An urban community has a diverse population of around 7000 (7 to 14 objects and each object has a anthropogenic character identifiable with the residents Value & Lifestyle Segmentation). Though the urban Community consists of diverse object, it has an identifiable sub culture.

An identifiable neighborhood consists of minimum three urban community of average population range 21000 to 30000 persons. Once the size of neighborhood increases its density, it also gains a third dimension.

City form is a function of organization of neighborhood, integration and linkages within & outside.

10.2 Density and Urban Resilience

The urban morphology study will help in objective assessment of urban resilience factors & issues as on date like (i) Compact Densification ; (ii) Scaling; (iii) Functional Flexibility (iv) Fine Grain Diversity; (v) Highly Connected Networks; (vi) Synergy (vii) Greening And Water Recycling and (viii) Urban-Rural Integration.

As the density of population increases, the resilience of the city also increases. The analytics to arrive at maximum achievable density and resilience needs to be customized for each neighborhood of the city.

It will be varying with value and lifestyle based segmentation of neighborhood population. Strategies to increase the density of a neighborhood are to be based on sustainability of existing infrastructure, utility and availability of land within the neighborhood. Strategies to increase density might conflict with lack of land available for social-cultural and

economic infrastructure that needs to be provided for increased population density. In such cases following there might not be need for adherence to norms of social, cultural and economic infrastructure to the exact numbers, as many of the facilities can be shared by adjacent dense neighborhoods.

10.3 Reverse Engineering – Synergy with structure plan density

Let us assume that Bangalore was a garden city like "Letchworth", the city fore fathers and administrators made policy to conserve agricultural lands for future food security and other ecological issues like climate change.

At the same time, it allowed increase in density of population by increasing the global FAR, without changing the structure of city. As the density increased, the utility level also increased while the spatial distribution of utility remained same.

When Bangalore was Letchworth

Land Use	**%**	**Ha**
Total Circulation (Roads/ access e.t.c)	25.00	25.00
Green, Water bodies e.t.c	41.67	41.67
Balance Land for development	33.33	33.33
Total Area	100.00	100.00

Function/ Feature	**Scale in terms of Density**			
	D1[18]	**D2**	**D3**	**D4**[19]
Global FAR	**1.00**	**2.00**	**3.00**	**4.00**
Total Built-up area (Ha)	33.33	66.66	99.99	133.32
Population (Ref capita Space Requirement norms[20])				
• MIN Space Requirement norms	15261	30522	45783	61044
• MAX Space Requirement norms	6857	13714	20572	27429
Gross Density (Person/Ha, Ref capita Space Requirement norms)				
• MIN Space Requirement norms	152.61	305.22	457.83	610.44
• MAX Space Requirement norms	68.57	137.14	205.72	274.29
Net Residential Density (Person/Ha, Ref capita Space Requirement norms)				
• MIN Space Requirement norms	458	916	1374	1831
• MAX Space Requirement norms	284[21]	568	852	1136

As the planned density increases due to city's growth from "D1"(low rise high density) to "D2"(mid rise high density) and beyond, the neighborhood foot print would Initially bulge in the take-off stage. It splits in the post take-off stage and thereafter gains a third dimension until it reaches the maturity stage. Due to complexity arising out of third dimension, there is a need for quantification of urban pattern and processes involved.

Against these above mentioned development issues, we need to undertake URBAN MORPHOLOGY studies to make the city SMART.

18 Gross density of BMP is 190 Per/Ha and BMR is 46.97 Person/Ha, global FAR less than equal to 2.

19 Paolo Soleri's Quartet in Arcology is having Global FAR 4.18.

20 Metropolitan Per Capita Floor Area Requirements for Selected Activities (page no 327); Arthur B Gallion & Simon Eisner; The Urban pattern; City Planning & Design; 5th edition; 1986; Van Nostrand Reinhold; New York.

Per Capita Space requirement	Functional Use	Retail	Office	Parking	Public	Quasi Public	Whole sale	Indus-trial	Residential	Total
(SqM)	MIN	1.86	0.19	0.37	0.09	0.09	0.46	0.19	18.6	21.8
	MAX	5.11	1.39	1.49	0.33	0.33	1.39	1.39	37.2	48.6

21 Indian metropolitan cities like Bangalore, Net Residential Density (Persons/Ha) , around 10 times of Letchworth.

10.4 Benchmark and needs of a neighborhood.

Matured Neighborhood Resident Population 39775 persons would require

Item	Population / Unit	Facility[22]	Unit land (SqM)	FAR[23]	Numbers		∑ Land Acres
					norms	Provided	
Educational System							
Pre-Primary (Nursery) School	2500	1	800	1.2	16	16	2.64
Primary (I - V)	5000	1	4000	1.2	8	8	6.59
Senior Secondary School (VI -XII)	7500	1	18000	1.2	5	5	18.53
Technical Education Centre - ITI; Tech Centre & Coaching	1000000	0	40000	1.5	0	1	6.59
Sub Total							34.34 (**18.35%**)
Health Care System							
Multi Specialty Hospital (200 Beds)	100000	0	90000	2.0	0	1	11.12
Poly Clinic with observation Beds ;	100000	0	2500	1.5	0	1	0.41
Nursing Home, Child Welfare & Maternity Centre ;	45000	0	2500	1.5	0	1	0.41
Dispensary ;	15000	1	1000	1.0	3	3	0.74
Sub Total							12.68 (6.78%)
Socio-Cultural Facilities							
Community Room ;	5000	1	750	1.2	8	8	1.24
Community Hall & Library ;	15000	1	2000	1.2	3	3	1.24
Recreational Club ;	100000	0	10000	1.0	0	1	2.47
Music, Dance & Drama Centre	100000	0	1000	1.2	0	1	0.21
Item	**Population / Unit**	**Facility[24]**	**Unit land (SqM)**	**FAR[25]**	**Numbers**		**∑ Land Acres**
					norms	**Provided**	
Meditation & Spiritual Centre	100000	0	5000	1.2	0	1	1.03
Socio-Cultural Centre	1000000	0	150000	1.2	0	1	30.88
Sub Total							37.06 (19.80%)
Distribution Services							
Petrol Pump & Servicing Centre ;	25000	1	1400	1.0	2	2	0.69
CNG Filling centre ;	25000	1	1080	1.0	2	2	0.53
LPG Godown ;	45000	0	520	1.0	0	1	0.13
Milk Booth ;	5000	1	150	1.0	8	8	0.30

22 Facility that needs to be provided for matured neighborhood as per NBC 2005 Norms, 1 means yes.

23 As per Delhi master Plan 2022

24 Facility that needs to be provided for matured neighborhood as per NBC 2005 Norms, 1 means yes.

25 As per Delhi master Plan 2022

Sub Total							1.65 (0.88%)
Security & Safety							
Police Station	90000	0	15000	1.2	1	1	3.09
Fire Station	200000	0	10000	1.2	0	1	2.06
Sub Total							5.15 (2.75%)
Miscellaneous Services							
Telephone Exchange (40000 Lines) ;	400000	0	40000	1.2	0	1	8.23
Post office counter with delivery ;	15000	1	85	1.2	3	1	0.02
Bank Extension Counter with ATM ;	15000	1	81	1.2	3	3	0.05
Bank - Fully functional ;	100000	0	2500	1.2	0	1	0.51
Sub Total							8.82 (4.75%)
Commercial Areas							
Convenience Shopping ;	5000	1	1500	1.0	8	8	2.96
Local Shopping with Service Centre ;	15000	1	4600	1.0	3	3	3.41
Community centre with Service Centre ;	100000	0	50000	1.3	0	1	9.88
District Centre ;	500000	0	75000	1.5	0	1	12.35
Local Wholesale Market ;	1000000	0	100000	1.2	0	1	20.59
Weekly Markets	100000	0	4000	1.0	0	1	0.99
Organized Informal Sector eating Places.	100000	0	2000	1.0	0	1	0.49
Sub Total							50.68 (27.08%)

Item	Population / Unit	Facility[26]	Unit land (SqM)	FAR[27]	Numbers		Σ Land Acres
					norms	Provided	
Recreational Facility- Play area & organized Green							
4 Cluster (500-600 population , I.e. 90-100 families)	2400	1	2500		17	17	10.50
Community of 7000	7000	1	5000		6	6	7.41
Neighborhood of 24000 (3-4 Community)	24000	1	15000		2	2	7.41
Urban Node of population (3-4 Neighborhoods) 80000-100000	90000	0	80000		0	0.33	6.59
Electric Sub Station							
11 KV Sub Station & RMU	15000	1	500	1.0	3	3	0.37
11/ 66 KV GSS	100000	0	6000	1.0	0	1	1.48
Sub Total							1.85 (0.99%)
Public Transport Interface							
Three Wheeler & Taxi Stand	15000	1	500	1.0	3	3	0.37
Bus Terminal	100000	0	4000	1.0	0	1	0.99
Sub Total							1.36 (0.73%)
Other Trunk Utility							
Estate Office	2024	1	2024	2.0	1	1	0.50
Sewage Treatment Plant	2699	1	2699		1	1	0.67
Water Works Station	2024	1	2024		1	1	0.50
Sub Total							1.67 (0.89%)
						Grand Total	**187.15 (100.00%)**
						Grand Total (Excluding Recreational Area Green)	**155.25 (82.95%)**

[26] Facility that needs to be provided for matured neighborhood as per NBC 2005 Norms, 1 means yes.

[27] As per Delhi master Plan 2022

11 ENERGY SMARTNESS

Energy Smartness is the road to SMARTCITY. To achieve energy smartness, a neighborhood Energy Master Plan is to be prepared. A group of neighborhoods become part of a SMART MICROGRID.

The SMART MICROGRID would be function of energy sources (potential, current and forecasts), that is either at neighborhood (decentralized) and or imported from outside the neighborhood.

There will be demand assessment, study of demand side stakeholders and or consumers behavior. If possible, there will be Value and Lifestyle Segmentation (VALS) of consumers for a particular demand attribute.

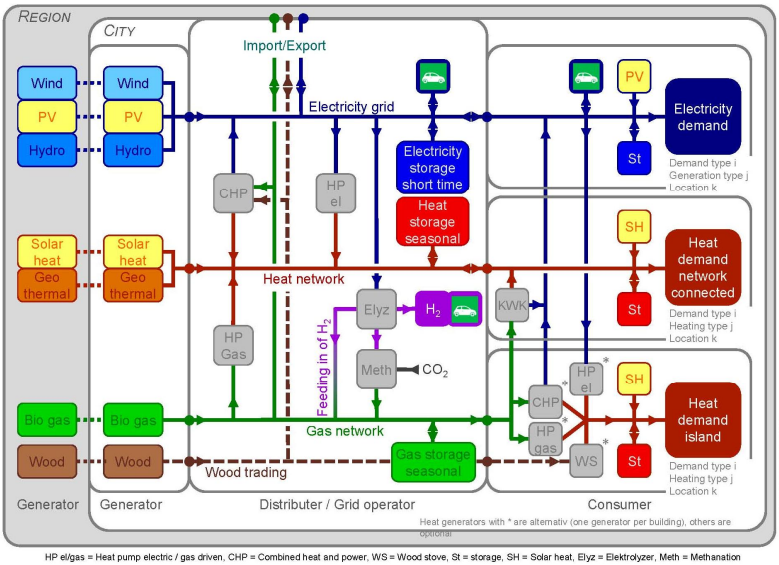
Other than VALS, the study to achieve ENERGYSMARTNESS will analyze demand site stake-holders response to the operational requirements of distribution system and vice versa.

The outcome of the study will be development of demand side energy management system; micro grid operation and interface protocol; tools and IOT applications.

11.1 Energy Master Plan – How it looks

I have come across very few good quality Energy Master Plan using complex but easy to use tools for cities. This may the area of study being new, limited exposure within a short span of time.

Energy Master Plan based on integration of renewable sources



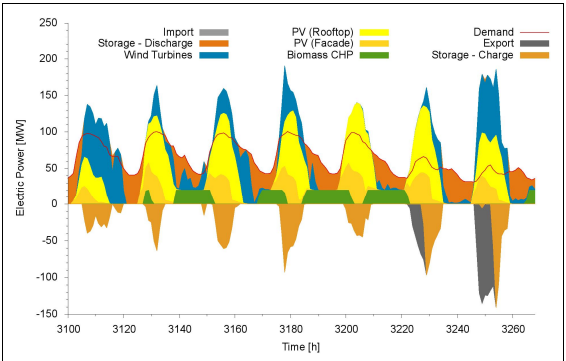
Source : KomMod , Fraunhofer ISE, Germany

The first building energy simulation tool I came across was E-Quest, based on DOE-2 platform from USA. I had Graphics user interface, ability to import from AutoCAD the building designs and site customized weather data

in EPW format from METEONORM. I enjoyed using it as part of my technical due diligence of pre acquisition real estate projects.

The first TOOL I used for prediction of output of a renewable energy plant was SAM created by NREL of USA, followed by PVSYST the most popular tools used by today's project developers and analysts.

Over the years the need for Regional Energy Simulation, part of Energy Master Plan grew, became more complex integrating past knowledge base but easy to use.



KomMod simulations spring electricity and heat

KomMod is a simulation tool of Fraunhofer ISE Germany, used to develop sustainable urban energy scenarios, needed for an Energy Master Plan of a neighborhood and region.

The results of KomMod simulations are (i) Possible energy system design and optimal mix of renewable energy resource; (ii) system capacity requirements and location of generation; (iii) storage needs within grid and import / export capability of system and Costs & greenhouse emissions.

Now there are lots of complex and easily simulate able models in the market.

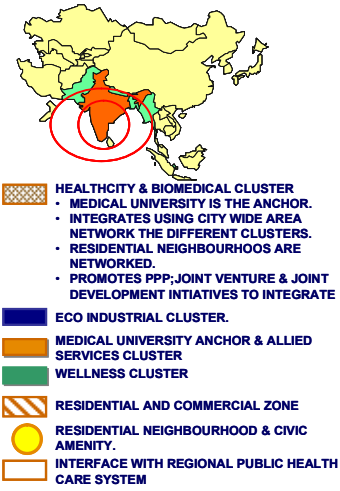
12 SMART Urban System

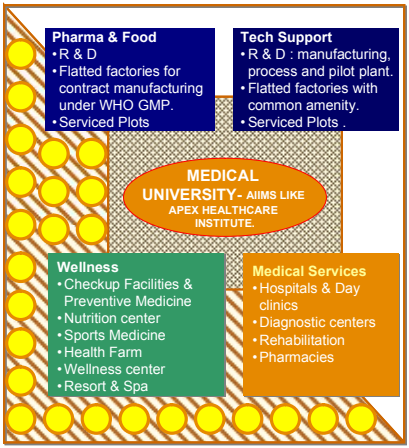
Integration of SMARTSERVICES, UTILITY, INFRASTRUCTURE & AMENITIES through ICT applications to (i) monitor service quality (output) and performance of system components; (ii)predict the immediate operating/ operations parameter; (iii) execute instantaneous actions; (iv) prepare the system for immediate and near future activities and (v) ensure system availability for normal & critical tasks; (vi) predict system failure.

12.1 Virtual HEALTHCITY

SINGAPORE "Biomedical Cluster" and its success is the inspiration behind this proposal. SINGAPORE has developed its "Biomedical Cluster" within a short span of nine years after official launch of the program in the year 2000 with the appointment of a Ministerial Committee, its Executive Committee, and the International Advisory Council for the Biomedical Sciences.

Virtual Health City at a glance





Year 2000 marked the official launch of Singapore's biomedical initiative with the appointment of a Ministerial Committee, its Executive Committee, and the International Advisory Council for the Biomedical Sciences. Today Singapore has become a regional Biomedical Hub, contributing a lot to the country's GDP and wellness. This happened within a decade of launching of the initiative. Contributing factor for success of Singapore Biomedical Cluster were (i) Physical infrastructure & utility of global standard; (ii) Telecommunications and web resources; (iii) research facilities; (iv) escort facilities for technology transfer; (v) Intellectual property rights protection; (vi) global lifestyles. Tax incentive, capital subsidy, education availability and work force initiatives accelerated the process.

Bangalore has the potential to become a virtual HEALTHCITY by interconnection of existing facilities, service, stake holders, products, sub products and unit level system into a HEALTHCITY Platform. This

HEALTHCITY Platform will be anchored by a MEDICAL UNIVERSITY or AIIMS like apex healthcare unit of the city.

Stakeholders – medical and wellness cluster

Medical
- Academic Medical Center
- Day Clinics
- Private Hospitals and small Clinics
- Transplantation Center
- Diagnostics Center
- Rehabilitation Center
- Biotechnology
- Health Education
- Diabetes Center
- Dialysis Center

Wellness
- Wellness Center
- Resort and Spa
- Health Farm
- Nutrition Center
- Beauty Enhancement
- Check-up Facilities
- Cosmetic Surgery
- Sports Medicine

Healthcare Support
- Medical Instruments and Supplies
- Pharmaceuticals
- Medical Appliances and Equipment
- Healthcare Plans
- Long-term Care Facilities
- Specialized Health Services
- Home Healthcare
- Medical Laboratories and Research
- Medical Practice Management Services
- Medical Product Distribution
- Health Insurance

Other Support
- Hospitality
- Catering
- Specialized Healthcare Computer Services
- Official Health Institutions
- Specialty Chemicals
- Healthcare Shopping Mall
- Specialized Waste Disposal Services
- Business Consultants

R & D - Pharma & Food

Human Healthcare
- Bio-Pharma : medicinal and botanical Manufacturing; Pharmaceutical Preparations.
- Diagnostics
- Stem Cell
- Oncology

Biotech Drug Discovery & Bioinformatics

Food & Agricultural Biotechnology

Animal healthcare

Tech Support

Medical devices and Instruments
- Surgical & Medical Instruments and consumables.
- Diagnostics
- Irradiation and electro medical apparatus.

ICT based HEALTHCITY platform will provide, in one convenient customized location, access to local, regional and international healthcare experts covering all areas of concern, from health maintenance and prevention to tertiary medical care.

Virtual HEALTH CITY'S interface with state health system will be will be an IT enabled service that will link Health City with Public Health System of the state. It will also involve extended participation of medical practitioner (physically outside the Health City) to deliver the benefit of quality tertiary treatments/services effectively by (i) Integration of patients data with lab results- it minimizes medical errors, lowers cost and increases productivity. (ii) help better manage patients' medical information and equip healthcare providers with better information accessibility at all points-of-care.

Virtual HEALTH CITY'S Core function are detailed in following paragraphs

12.2 Medical and Wellness Clusters – Core Function – Patient services

Patient Services focus on the integration and coordinated care of patients during the pre-illness, post-illness and illness care, i.e. Patient Care beyond Hospitals ("Hospital-Without-Walls"). It will not be limited to

Community Systems service enables the provision of home care by the patient or family members out of the hospital during pre-illness and post-illness phase. Areas of technology enablement may include (i) Patient Education; (ii) Tele-Medicine; (iii) Systematic Follow-up; (iv) Locator Service; (v) Health Screening; (vi) Health Folder and (vii) Product/ Vendor Information/ Services.

Patient Management service enables the coordination and scheduling of care services to patients in transit within the hospital during

illness care. Areas of technology enablement may include (i) Patient Tracking; (ii) Patient Dashboards; (iii) Admission & Registration; (iv) Appointment Booking; (v) Meals Order; (vi) Outside city Patient Management; (v) Financial Management; (vi) Bed Management and (vii) Operating Theatre Scheduling Systems (OTS)

12.3 Medical and Wellness Clusters – Core Function – Clinical services

Clinical Services enables the healthcare professionals (clinical and administrative staffs) to administer seamless, coordinated and safe care of patients during illness care, i.e. Operational Optimization within Hospital ("Hassle-Free Hospital"). This includes, but is not limited to:

Care Management service enables the clinical professionals to administer seamless, coordinated and safe treatments to the patients during illness care. Areas of technology enablement may include (i) Clinical Dashboards; (ii) Care Plans; (iii) Alerts and Reminders; (iv) Chronic Disease Management; (v) Protocols; (vi) Medical Reviews; (vii) Workflow Lists; (viii) Discharge Planning; (ix) Step-down Care Plans; (x) Drug and Medicine Knowledge Base

Medical Safety service enables safe and coordinated orders of care treatments within the hospital. Areas of technology enablement may include (i) Alerts and Allergy; (ii) Drug Interaction; (iii) Dose Management

Medical Order Entry service enables seamless and coordinated orders of care treatments within the hospital, resulting in cost effective treatments. Areas of technology enablement may include (i) Patient ID; (ii) Labs and Radiology Order; (iii) Medication Entry; (iv) Pharmacy

Imaging and Archival Systems service enables seamless delivery of medical records in electronic form. Areas of technology enablement may include (i) Records Digitization; (ii) Indexing; (iii) Picture, Archival and Communication Systems (PACS); (iv) Compression and Archival

Converged Services enables the treatment/ care information to be communicated to the appropriate healthcare worker's) or system's). Areas of technology enablement may include (i) Voice over IP Convergence; (ii) Embedded Convergent Devices; (iii) Messaging Gateway

Core Information Management Systems provides the base services for the complete hospital information system. These are (i) Unified Operational Database; (ii) Security and Privacy; (iii) Mobility Support; (iv) Video Conferencing Support; (v) Tele-monitoring & Tracking

Health Information Management service manages the constantly expanding set of health research data and the internal knowledge base. These includes (i) Knowledge Management; (ii) Transcription and Dictation; (iii) Disease Information; (iv) Digital Signature; (v) Document Management and (vi) Case Notes Tracking

Clinical Decision Support service enables Clinicians to make decisions based on the personalized patient information and accepted evidence of best practice, incorporating clinical heuristics to identify actions, reminders and guidance at the point of care, across the continuum of care. They are (i) Clinical Markers; (ii) Clinical Pathways; (iii) Drug Information; (iv) Patient Register ; (v) Clinical Algorithms and (vi) Evidence Based Medicine

Data Warehousing service collates clinical history, physical findings, physiological parameters and the results of investigations. It contains data collected over time for clinical decision research and decision making. The outcome of the analytics will be linked to integrated care pathways and care programmers. The services on priority are (i) Extraction, Transformation and Loading functions (ETL); (ii) Unified Warehouse and (iii) Analytics

12.4 Medical and Wellness Clusters – Core Function – Partner services

Partner Services includes integrated, coordinated, and cost effective care for patients across continuum of care, i.e. Healthcare without Boundaries.

This includes, but is not limited to-**GP and Nursing Homes** enables care to be integrated with healthcare partners outside of the hospital and care conditions/results of the patients to be coordinated back to the hospital. Areas of technology enablement may include (i) Step Down Facilities Dashboards; (ii) GP Dashboards and (iii) Referral Management

Asset and Inventory Management service enables cost effective forecasting, stocking, and distribution of assets and inventory within the hospital and across hospitals within a cluster. The outcome translates to a lower cost of distribution of drugs (visibility of stocks up to ward level), availability of critical drugs and safety of drugs consume by the patients. Areas of technology enablement may include (i) Asset Tracking; (ii) Drug Forecasting/Replenishment; (iii) Warehouse Management and (iv) Vendor Managed Inventory

12.5 SMARTCITY Broadband Network for SMART URBAN SYSTEMS

SMIT will fund development Smart City Broadband Network (SM-BBN). It will be operated under a Build Own Operate & Transfer contract and owned by the City Government (BBMP).

Projects like “Virtual Health city” will use the SM-BBN and integrate the stakeholders, system functional components, citizen and customers.

The SM-BBN will be also available to other non telecom services provided by existing telephone operators. Therefore, BOOT contractor cannot be an existing telecom operator, limiting access to telecom business competitors.

Goa Broadband Network (GBBN) is Public Private Partnership projects that also have capability to host projects like “Virtual Health City”.I have come across the GBBN while interacting with its BOOT operator UTL, a Bangalore based company. GBBN is a high speed network infrastructure that has changed the way Administrative Services are delivered to citizens, businesses, and Government employees.

GBBN connects the State Headquarters with District Head Quarter, all 11 Talukas, Village Panchayats, Households, institution across the State of Goa. GBBN provides 10 Gbps capacity in partial mesh topology with no single point failure of nodes. Thus Goa became the first state in country to have connected all its 189 Village panchayats to its respective Taluka HQ @ 1 Gbps.

It is also first state to have an IP based architecture, supporting voice, video and data. The end-to-end IP network carries data, phone calls as well as videoconferences within the same converged infrastructure.

The network is being used for communication between the G2G, G2B, G2C, and other Government departments.

The network has the potential to support a broader range of applications including social usage such as e-learning. With this, Goa becomes the first state in the country to have in place a truly converged Wide Area Network, the GBBN which carries voice, video and data encapsulated in IP packets across the state.

GBBN Project is unique compared to any traditional SWAN (State Wide Area Network) operational in India.

SWAN network has very limited Vertical & Horizontal connectivity as they use existing leased telephone lines, made with copper. Therefore district head quarters connecting the state head quarters in SWAN have band width between 16 to 32 Mbps, i.e. multi video conference session

underperforms. Further down the hierarchy, the available bandwidth in existing SWAN network reduces making e-governance ineffective.

On the other hand the tail end customer (village panchayat & taluka headquarter) of GBBN gets an assured bandwidth of 1 Gbps.

GBBN in partial mesh topology with no single point failure nodes helps in disruption free multiple video conferencing between village panchayat & taluka head quarter.

In India there has been operational state wide area networks (SWAN) more than a decade old. There is also a pool of adequate trained work force to execute both the hardware and software components of these types of projects.

Learning from GBBN, we can conclude that execution of SMARTCITY Broad band Network of Bangalore can be fast tracked.