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Smart Cities and Affordable Housing in India

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Abstract:
Government of India announced to build 100 smart cities and provide housing to all by 2022.This paper provides framework for establishment of smart cities and strategy for housing the urban poor in composite living through cross subsidy by unlocking of land value. Circular city predominantly based on public transport model, propelled by clean energy provides fast movement with multi-model central business districts, restricts travel from longer distances to short trips and pollution free living. Normative norms and standards of services, approval process and application of technology is prime moving factor. India from low to high level of urbanisation model can make entry to new arena by providing clean living cities by adapting new technologies. Late starter can have all benefits of application of technologies in built environment and take advantages of best of experience all over the world.

1. Introduction

India has experienced rapid growth of urban population over the last century and urban population has grown from modest share of 10.80% in 1901 to 31.16% in 2011. In absolute number, urban population in the beginning of twentieth century was 25.08 million, while it has increased to 377.10 million in 2011, which has recorded increase of 14.61 times over the period. In terms of percentage of urban population, the figures appear to be on the lower side as compared to developed countries but the number is so large that provision of housing especially for the lower segment of population and urban infrastructure services poses a big challenge. The number of towns and cities has grown by four fold over a period of 11 decades, i.e. from 1916 in1901 to 7935 in 2011[1]. Details of pattern, number, growth rate and percentage of urban population are given in the table below.

Year	Total Population	No. of Towns	Urban Population	Percentage	Decadal Growth (%)
1901	238.4	1916	25.8	10.8	-
1911	252.1	1908	25.9	10.3	0.4
1921	251.3	2048	28.1	11.2	8.5
1931	278.9	2220	33.4	12.0	18.9
1941	318.6	2427	44.1	13.9	32.0
1951	361.1	3060	62.4	17.3	41.5
1961	439.2	2700	78.9	18.0	26.4
1971	548.2	3128	109.1	19.9	38.3
1981	683.3	4029	159.5	23.3	46.2
1991	846.3	4689	217.6	25.7	36.4
2001	1028.6	5161	286.1	27.8	31.5
2011	1210.2	7935	377.1	31.16	31.8

Table 1: Urban Population (in million) and growth rate, 1901-2011
Source: Census of India

As per the Indian Urban Infrastructure and Services Report, 2011, projected that urban population would be of 600 million in 2031. The net increase of 223 million persons over two decades would require housing as well as urban infrastructure as per the laid down norms and standards. In view of growing pressure of urban population, the Government of India has declared to plan and develop 100 smart cities in near future. Assuming that initial policy decision, resources, land assembly, planning take time and execution on the field begins after one and half year, taking 2031 as time line, for the remaining period of 16 years, we need to provide houses and necessary support infrastructure, on an average to 11 million persons per annum. It is to add here that

migration to urban areas will continue to the already identified destinations, before the new cities become fully functional, existing urban settlements would have to accommodate migration and new addition of population. One can intuitively draw that of the proposed 100 smart cities, we can plan to consider for up-gradation of nearly half of the existing urban settlements (brown field cities) as smart cities. Therefore, nearly half of the proposed 100 smart cities can be developed as green field cities. As per the announcement of Industrial Corridors by the Central Government at different points of time, 51 New Cities are proposed to come up along the corridors. It is considered a opinion, however, keeping in view several other considerations, proposals can be evaluated to develop such cities at locations other than hinted above. For example, a new capital city for Seemandhra is also required, which has been proposed between Vijayawada and Guntur, land to be assembled through pooling method and farmers would be given back 35-40% developed land for generation of regular income and livelihood. On an average, the population to be accommodated in each of the cities, works out to be 2.2 million. However, variations are bound to happen due to geographical, administrative considerations and absorption capacity of local area. In view of this background, therefore, there is a requirement of population variations of each city, population could vary between 1.5 million to 3 million. The statistical details of six industrial corridors and proposed number of cities along each corridor are given in the table below:-

Sl. No.	Name of Industrial Corridor	Proposed No. Cities
1.	Delhi Mumbai Industrial Corridor	7
2.	Amritsar Delhi Kolkata Industrial Corridor	20
3.	Visakhapatnam Chennai Industrial Corridor	4
4.	Chennai Bangalore Industrial Corridor	8
5.	Paradeep Rourkela Industrial Corridor	3
6.	Mumbai Bangalore Industrial Corridor	9
	All	51

Table 2: Proposed Industrial Corridors in India

2. Why Smart Cities?

The urban scenario in the country with few exceptions, have the similar nature of problems, intensity of problems varies within and across the cities. It would be worthwhile to mention some of the major problems of urban settlements. Of the total towns and cities in the country, nearly one-fourth have master plan. Even the planned cities like Delhi, Mumbai, etc. have very significant percentage of population residing in unauthorised areas. Transport plan, which is one of the key components of the plan, is generally not adequately addressed and most of the cities have choked today. Almost all cities are planned with low density approach and such models do not support efficient use of public transport, therefore personalised modes have taken dominant role. Certain parts of city areas are out of development focus like unauthorised colonies, having low level of infrastructure. Even in fully developed areas of cities, there are regular pattern of digging, repair, etc. such features are very often observed all over time and space. Cities have high pollution, lack of infrastructure, coordination issues among departments, absence of use of required technologies, etc. To overcome all major problems, therefore, there is a requirement of planning and development of smart cities. Public transport model based city planning studies on street network density, connectivity and configuration are highly correlated with increased walking, biking and transit usage has direct health benefits. Study of 24 California cities relating to control for food environment, land use, commuting time, socio-economic street and street design has been done. Results suggest that more compact and connected street networks with fewer lanes on the major roads are correlated with reduced rates of obesity, diabetes, high blood pressure and heart disease among residents[2]. Such city planning models has inbuilt structure of induced exercise pattern especially walking, has serious policy implications.

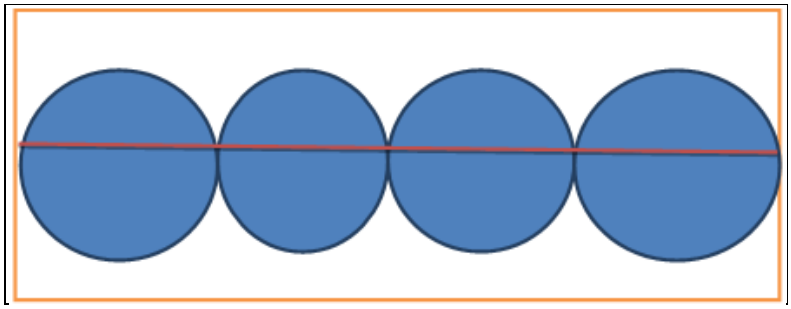
3. Concept of Smart City

Over a period of time, the urban advisory regulators have perceived that urban areas should consume least resources and produce maximum in order to preserve natural resources for next generation. The Smart Cities must use Information and Communication Technology (ICT) to generate real time data and provide best possible solutions and implement them without time loss. The standard framework of smart cities has six parameters including smart economy, smart people, smart governance, smart mobility, smart environment and smart living but also needs to recognise importance of smart transport solutions. Dr. A P J Abdul Kalam, the former President of India, propagated the concept of Provision of Urban Services for Rural Areas, (PURA) and the same could be superimposed on urban settlements. Based on literature survey and emerging trends of sustainable cities, predominantly using public transport to get rid of city pollution, it is proposed to plan a circular or hollow city. The characteristics of smart city in relation to conventional city are detailed out for quick reference and citation for consideration while planning cities are given in table below.

Sr. No.	Smart City	Conventional City
1	Fully planned	Partially planned
2	Composite living representing socio-economic population dynamics	Not representing socio-economic population dynamics
3	60-90% population travel by public transport	P T travel below 60%
4	High travel speed, above 30kmph peak time	PT slow traffic movement
5	Dominant Mode of Travel does not emit pollution in immediate environment	DMT emits pollution
6	Local travel, E-rickshaw, walking, etc.	Fossil fuel modes
7	Street light LED with dimmer, low consumption, almanac micro-processor controlled	Conventional, high consumption, manual
8	Street light repair by inverted support, sensor based fault identification	Street lights repair by putting on all lights
9	High security streets and buildings by CCTV	Does not exist or partially
10	RCC roads, supported by pipes, integrated with future expansion plans, no digging	Regular digging, black top roads, badly maintained
11	Rain water harvesting, all roads, streets and buildings	Does not exist or partially covered
12	Barrier-free pedestrian pathways	Not/partially applicable
13	100% sanitation	Low coverage
14	Natural drainage pattern, climate change, cloud burst	Drains blocked, low preparedness
15	Waste water treatment, on-site and re-use in immediate surroundings for gardening, sprinklers for dust control, etc.	No treatment/use or partially
16	Reclaiming water bodies	Filled up and used for housing
17	Bringing water use to half from standard use	Over supply and but shortages
18	Mosquito control	Vulnerable to growth of mosquito
19	Full of greenery/ plantation, bamboo and other suitable trees	Less green
20	Well-developed public facilities	Partially
21	Nearness to public services	Oddly planned
22	All green buildings	No/low percentage
23	Barrier-free buildings, metro, buses, etc.	No/partial coverage
24	Cut down electricity consumption to 50% level than normal use and 50% generation from non-conventional sources	High consumption, 100% or dominant fossil fuel source
25	Well distributed Business District Centres	Concentration of CBD
26	Low crime, immediate disposal	High crime, low disposal
27	Adequate housing for senior citizens	No provision or low
28	Waste (collection 100%) to electricity	City waste collection/disposal poor
29	Intensive use of technology/innovations	Poor
30	E-governance	No/low use e-governance
31	Smart grid	Conventional power grid, poor quality
32	Normative norms, self-declaration/approvals of buildings/town layouts	High discretions, poor clearance
33	Disaster preparedness	Partial/low preparedness

Table 3: Characteristics of Smart v/s Conventional City

For example, the city of Delhi is currently executing third phase circular ring metro having 59 km. route length and likely to be completed by 2016. If we take 2 km area on both sides as model "Smart City", the area available is 236 sqkm and effective area due to several considerations, could be of 200 sqkm. Metro fast mode of transport (average peak hour speed of 32 km) would be having very high passenger carrying capacity and that too without emitting any environmental pollution in the immediate surroundings. The broad design of circular Smart City is perceived as a single circle but if there is a requirement, the cities can be developed as twin cities or further can be extended into multi-cities. In the broader context, for local population movement, metro is an answer and for intercity movement, a linear connection could be activated. For multi-layer twin cities, the model emerged could look like a similar as of a logo of Audi Car, the same could be seen from the figure below. In Delhi context, based on certain assumptions, a single circle of ring metro could accommodate as high as 27 million persons, and the same could be assessed from the subsequent section.



The proposed area of 200 sqkm if allocated as per town planning norms, net area available for residential purposes would be of 9000 hectare, table 4. Based on composite living environment comprising of all sections of population, pre-determined size of dwelling units, number of units and percentage of area per hectare is worked out by giving due consideration to the requirements of community spaces. The details with assumptions, house size and percentage are given in the table 4.

Sl. No.	Super Built up Area of DU (Sqft)	DU%	No. of DU	Area of Sqft	Area %age
1.	400	20.0	120	48000	9
2.	550	20.0	120	66000	13
3.	800	17.5	105	84000	16
4.	1050	17.5	105	110250	21
5.	1300	15.0	90	117000	23
6.	1550	10.0	60	93000	18
7.	Total	100.0	600	518250	100
8.	Community space			11142	2.1

Table 4: Dwelling unit area, number and percentage

*Note:- *FAR=5,**Ground coverage 40%,***Height 14 floors or 42Mtr including Lift Room & Water Tank, etc.*

4. Financing of Smart City through FAR

Out of the proposed FAR of 5, about 75% of market value of land of 1 FAR for external infrastructure development, 0.5% market value of land of 1 FAR as incentive to project owner regardless public or private agency, 0.75 FAR for full neutralisation of land value for EWS and LIG housing, 0.25 FAR for neutralisation of internal development cost and the remaining 2.75 FAR could be considered as standard use. Conservative assessment of market value of land equivalent to 75% of one FAR or one-fifth of say 9000 hectares in Delhi, the figure arrived at is of Rs. 75,000 crore, which is multi-fold of the required funds to finance metro ring and built required infrastructure for entire proposed area of Smart City. Details of planning area for different land uses for ready reference are given in table 5. The government of India allocated Rs 7060 crore in 2014-15 budget for development of 100 smart cities, while our assessment indicates that notional budget could be a more than sufficient provided the land value is unlocked and utilised in right perspective. For brown field cities, approvals on automated mode (details are in housing section) and amalgamation of plots for redesigning need to be done. City while reorganising requires multi-central business districts, institutions to be planned within the radius of 3-4km to minimise travel distances within the city.

Area	Hectare		20000
	% Area		Area (hectare)
Residential Area	45%		9000
Commercial Area	3%		600
Industrial Area	5%		1000
Institutional Area	5%		1000
Recreational Area	2%		400
		60%	
Transportation	15%		3000
Utilities	2%		400
		17%	
Green	15%		3000
Forest	0%		0
Water Bodies	0%		0
		15%	1600
Miscellaneous	8%		
Total	100%		20000

Table 5: Delhi Ring Metro of 59km. area details of 200sqkm
Reference: Delhi master plan 2021[3].

On the similar lines, the funds required for city of five million population for the green field capital of Seemandhra is assessed to the tune of 5 million crore. However, except for initially required funds to kick start the project, rest of the funds would be generated through self-propelling financing model, which generally happens in most of the cases. Certainly, government requires funds for building offices, housing and other institutional infrastructure but in the long-run, development of capital city project on the pattern of circular smart city design would end up with surplus funds.

In the proposed Smart City model, up to 90% travel would be by fast and reliable public transport, the feeder service, by and large, would be by walking and cycling. For old, handicapped or those who cannot afford to walk due to paucity of time, can travel by local electrically operated vehicles, say E-rickshaw, etc. For green field cities, area within circular settlement can support day to day requirements of city population by cultivation of multi crops and also work as lung for city. Green belt as well as open areas of useable city space can have grass and plantation for absorption of pollutants and solar power project with multi-cropping options. Citizens, by and large, can depend on public transport except emergency services or inter-city requirements. Electrically operated road and rail as public transport service would not generate any pollution in immediate surroundings. City dust can largely be controlled by sprinkler by using treated city waste water. Water harvesting can also help in maintaining water table in and around city area. Solid waste from household sector and other sources can be used for generating methane or diesel whatever is most appropriate. While constructing road network, requirements of other networks can be taken care by laying additional underground pipes based on experience of other places. There would be no need for digging of road, time and again and in place of bitumen road, CC road can be constructed along with drainage and proper slope of road and drains. We need to build separate space for cyclist and pedestrians. Due to climate change, droughts and flooding are expected all over places, therefore extra caution and capacity of system needs to be built. Electrical load of road/street light, pumping machinery, etc. can be reduced to at least half of current similar demand by using state of art lighting and other equipment. Dark patches in city can be removed by installing efficient LED lights, auto-switch micro-processor based almanac, SCADA based pumping for water, etc. Repair of street lights can also be done with the help of inverter rather than putting on all lights and wasting energy. Identification of defaulting poles can be done by auto-censor or through citizen reporting mechanism. City can partially generate its own electricity by solar concentrators and other non-conventional sources.

Watch and ward services can further be strengthened by use of CCTV cameras and other detectors. This can also help in providing security comfort to females, of course, education of counter-part population is very critical in this regard. Female participation on equal footing needs to be incentivised and hostile working environment requires improvements. City needs to be built on 100 per cent sanitation, comfortable number of convenient sanitation required places and education for its use to all citizens is all the more needed seriously.

Water supply system to be designed for 24X7 for quality assurance and cost saving. Waste water to be treated by deploying small treatment systems, would save cost of long and very big size underground pipes. Yellow treated water can be used through sprinklers to control dust, watering for grass, plants and water harvesting. Solid waste of streets, cutting of plants, grass and other waste of household and other sectors can be collected and disposed of in scientific manner for generation of energy. Funds required for development of urban infrastructure are assessed to the tune of around 4 million crore[4], can be generated by unlocking of land value.

Housing including residential, commercial, industrial, institutional, etc. needs to be built on scientific principles by using better technology and construction material. For residential purpose, 15 per cent of land is to be earmarked on principle of cross-subsidy in line with National Urban Housing and Habitat Policy[5]. Adopting this approach, we can construct 40 per cent houses for urban poor on 15 per cent land and have composite culture and get rid of unauthorised development. Service population could be accommodated within one square kilometre area. Houses built by using advanced technology and better construction material can

help in saving lot of electricity for heating and cooling of buildings. Quality of city power grid could be improved by better design and material to have net metering system for two way power supply system reducing power storage cost of roof top solar system. All appliances at household and all other levels could be used by following specified norms in order to reduce electricity consumption.

Capacity building of institutions to develop and manage modern city needs to be built by specialised training institutions. City state is a dynamic framework and for forward looking approach there is need of training of each and every individual through education and skill up-gradation programmes. With this approach we can have good governance and provide comfort to each individual. Adaption of proposed city form and better development strategy we can have improved governance to support comfortably liveable city. There is further need to do detailing on several areas for micro details of design, implementation and operational plan. This conceptual model of city protects citizens from pollution and other day to day problems, efficient service delivery and provides scope for saving foreign exchange on petroleum products, develop localised dependence on energy. Investment in Smart Cities project would help in improving the built environment of city as well as immediate surroundings, growth path of country would also gain a big momentum.

5. Housing Approach

Apart from broad principles of smart city, housing requires special attention while addressing ground realities in background to existing scenario. Though there has been a lot of focus on housing yet we have significant percentage of housing shortage in the country. JNNURM having strong structure could meet only around 70% of target of 1.5 million housing that too with time lag of three years[6]. The Government of India has declared to provide housing for all by 2022. As per assessment, by 2022, around 22 million dwelling units would be required for the urban poor by factoring into other parameters including new addition of population in urban areas. As on date, requirements of finance for housing sector, for the targeted population, arrived at by our assessment is of Rs 1.5 million crore. Large volume of construction of houses and matching requirement of finances cannot be done on the pattern of past pattern and experience, HUDCO propose to provide the following framework to accomplish the task and achieve the target in a stipulated time frame.

Existing Definition of affordable housing is not as per the requirements of ground reality. Deepak Parekh Committee, 2008 defined affordable house of carpet area of dwelling unit between 300-600 sqft, while small units are too small and big one is too big, therefore needs review[7]. We need to consider house size of 400 sqft for EWS and 550 sqft for LIG housing. Significant percentage of JNNURM houses is unallocated and there is resistance among the poor to accept small houses. The Government of Madhya Pradesh in one of the meetings proposed to build no house less than 400 sqft. It is to add here that India has moved from low income to middle income category by 2010-11, likely to enter into high income category countries in coming 15 years. A developed country should have a pride of small house of reasonable size of 400 sqft and once house is built, can sustain for 50 to 100 years, and therefore, pulling structures down and re-constructing houses would be a difficult task and costs very high. Therefore, there is a need to freeze the size of EWS and LIG houses to reasonable proposed sizes.

The report of the Task Force on Promoting Affordable Housing, November 2012 unfolded that income ceilings of EWS and LIG of Rs 100000 and Rs200000 respectively, are based on 2008 prices, released in 2010, while in 2012 assessed index increase of 25% and indicated that states are free to decide/revise by giving proper justification[8]. As on date, the index of income ceiling can be revised by 40%, while all Ministry communications restrict to the 2008 based income limits and that is not realistic. The contradictions need to be removed and income ceiling for EWS and LIG should be taken as Rs 1.40 and Rs 2.80 lakh respectively in order to address ground reality and resolve problems of financial institutions for better resource mobilization for real benefits to right income group. As per consumption data of NSSO, the poor spend most of their income on food. After introduction of food subsidy, the affordability of poor has improved and income updated ceilings would help in big way to address realistic situation.

JNNURM experience of not achieving the target of 1.5 million houses even during extended time frame of three years suggest that we cannot build houses with time old technologies, needs to adapt mechanization and new technologies in construction sector. HUDCO supported building centers are not equipped to adapt to emerging urgency scenario. HUDCO alone supported JNNURM projects of Rs 4000 crore in the name of viability gap funding, largely due to time and cost overrun. Now technology is a real answer in the current scenario and housing units need to be essentially qualify features like earthquake resistant, sound and thermal insulation, low consumption of electricity after construction, waste water treatment, solar power generation at household level, use of low power appliances, etc. Adaption of mechanized technologies do save time and money, standardise housing quality and speed would help in achieving desired number of dwelling units seem to be an answer to the housing problem.

A very high target of 22 million housing units by 2022 cannot be achieved by government alone as states have limited parcels of land ownership in urban areas. Therefore, the role of private sector is very important for land assembly and construction. We need to reserve 15% land in all projects for housing the urban poor and the same can achieve 35% dwelling units in composite projects. The land contributors can be compensated by giving 1.5 times of FAR of the 15% of the pooled land to compensate land and development cost to private sector and other land pooling agencies. For construction of small houses, provision for full utilization of FAR may be made and TDR could also be allowed, where found necessary. Hong Kong, New York and Manhattan, for example, have used as high as 16 FAR and density of 1521 dwelling units per acre, while we restrict maximum FAR up to 4 that too in Mumbai and 200 DUs per acre in Delhi, is gross under-utilization of land. We can have land for housing the poor by this methodology, in a way free of cost, immediately without any cumbersome procedures and financial implications. A house of 400sqft for EWS and 550sqft for LIG can be built with cost varying between Rs 1000-1400 per sqft as per the task force report with cost ceiling of Rs 5.6 lakh and Rs 7.7 lakh at upper end of cost price range.

These days, private sector is custodian of largest land bank, do suffer from inefficiencies due to cumbersome approval procedures. If the project is situated in approved residential zone and all design development parameters are public and frozen, approvals can

be deemed as automatic on normative norms, which can be termed as single window clearance. No project proposal should require to be submitted to government office provided there is a declaration given by builder that to follow standard norms. In this case, there is a requirement of self-discipline and mechanism of standard penalties to be in place. If builder violates standard norms, should be penalized 1.5 times of the market value of extra built area, subject to third party evaluation and verification of approved team of chartered architects and engineers. Housing needs to be given the status of infrastructure for specific size proportion of houses meant for EWS and LIG segments.

It is important to add here that since land and housing are state subjects, therefore, the Central Government can provide policy; facilitating legal instruments and make provision of finances for construction of houses including monitoring for ensuring implementation and achievement of targets within stipulated time frame. The State Governments need to come up with housing policy by committing to provide houses of its share in the overall housing gap in the country. Land assembly is also required to be done to synchronize with housing requirements for the urban poor. The new technological innovation and construction material need to be incorporated in the schedule of rates for fast implementation of housing projects. The capacity of different institutions in the states including development authorities, housing boards, urban local governments, private contractors need to be enhanced and supporting technical-manpower comprising of mason, plumber, electrician, construction workers, etc. skills be upgraded. If this mechanism is in place, the possibilities of cost and time overrun can be avoided, which is very significant percentage of cost of projects at the same time, the delivery of the final product can be insured either on or before the scheduled time.

As per census data 2011, 11 million houses[9] are falling vacant, not due to deficiency of infrastructure, but due to location disadvantages and poor rental laws, also needs examination for improvement and bridging gaps for developing rental market. Credit guarantee fund also needs to be used very effectively, currently it is hardly in use and fund in a way is being wasted. Viability gap funding is also required to be created for provision of shelter for the urban poor.

Resource mobilization is one of the most important subjects need to be examined very comprehensively and added to budgetary proposals. There are couple of possibilities to mobilize resources, and it could be by way of imposing cess on different items, for example, hotel and restaurant bills, petroleum products, mobile phone instruments and call rates, electricity, etc. Resources raised through such instruments can be pooled to shelter fund. For example, if we impose Re. one cess per unit of electricity consumed by all segments, funds mobilized through this instrument alone would pool to shelter fund as much as Rs. 2,14,620 crore per year, seems to be sufficient to take care of affordable housing for all by 2022.The role of project finance could be reduced to one-fifth by speedy implementation of projects, quick transfer of property to the poor by registration and integration with retail finance, termed as quick recycling of finance. Waiving-off of stamp duty also needs to be considered for the EWS segment for further improving affordability. The possibility of exploring other financial instruments need to be evaluated and if found suitable, requires inclusion of provident funds, insurance and pension funds for housing sector. Tax-free bonds is also one of the source of cheaper funds, however, its contribution needs evaluation, as to what extent economy can support such instruments.

6. Conclusion

The concept of Smart City has emerged as one of the tools to provide efficient service delivery to residents through technological advancement and by compiling real time data and solutions. In Indian scenario, as per the proposal of Government of India, 100 Smart Cities are likely to come up in the near future. Our analysis suggests that there is a need to introduce right mix approach for selection of such cities from existing as well as green field cities, it could be on a matching basis of 50:50 also. At initial stage of each project, there is a requirement of funds but in the long-run, it could turn out to be financially sustainable model provided innovative approaches are followed. Smart Cities by design follows inclusive approach to take care of requirements of all sections of society. It would also help in reduction of crime, use of energy and other natural resources. We can have slum free cities by following composite living and cross subsidy approach. Operational efficiencies can be achieved by adapting to normative and standard procedure. This approach provides scope for building pollution free cities with all levels of efficiencies. Finally it would bring Pride to Nation being on global map that India has a list of 100 Smart Cities.

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