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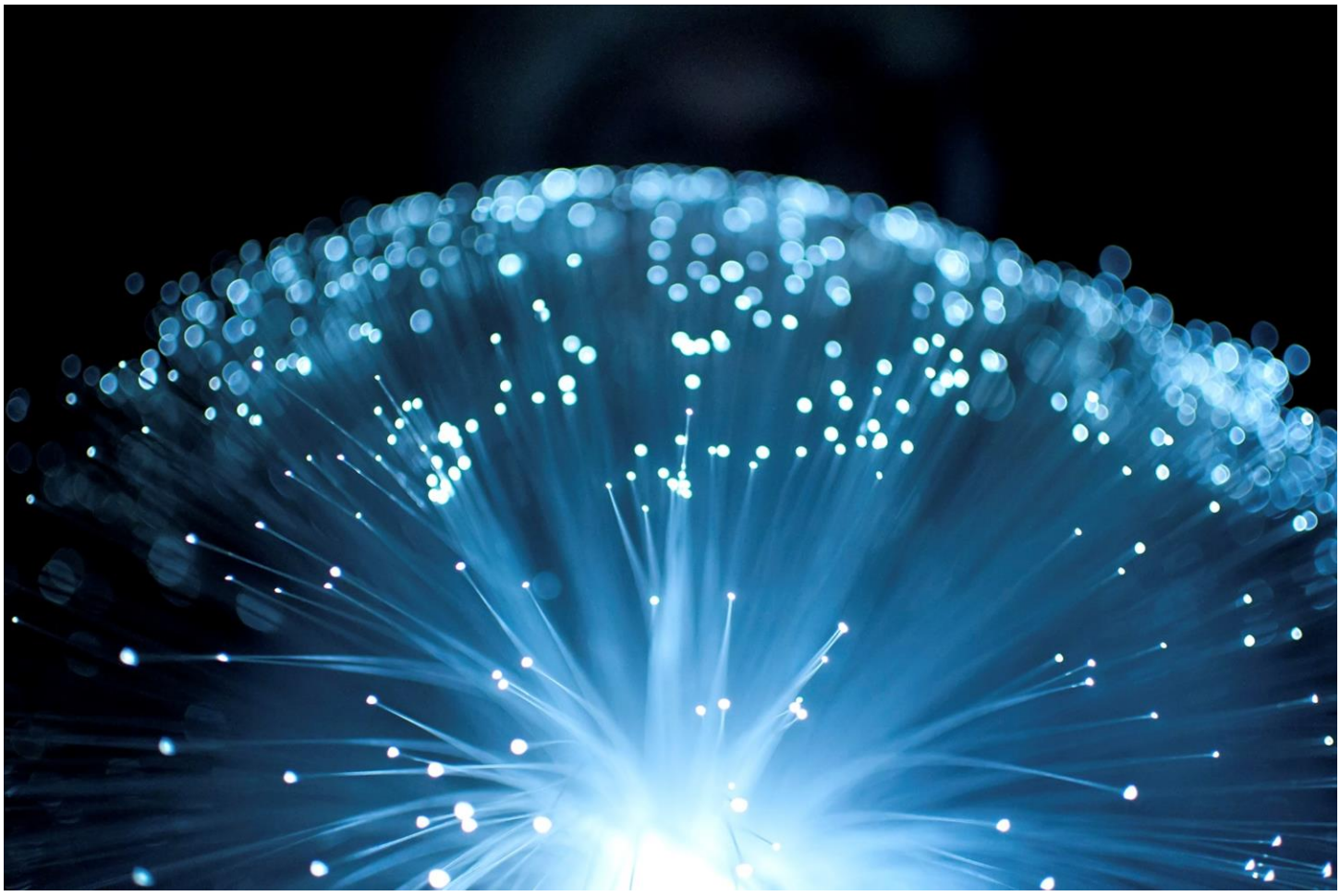
Sustainability Outlook

Shaping New Age Urban Systems

Energy, Connectivity & Climate Resilience

BRIEFING PAPER

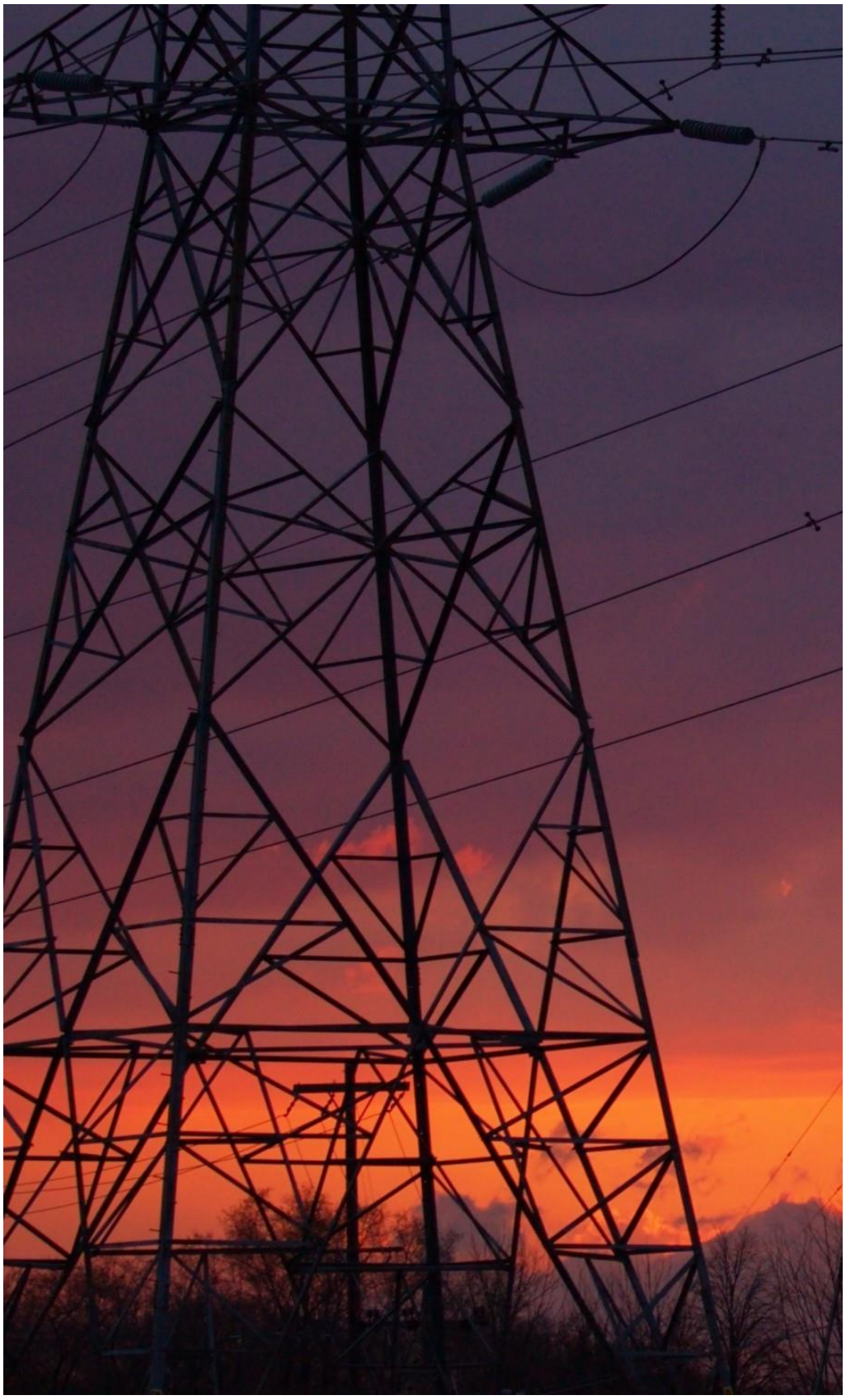


SUPPORTING SUSTAINABILITY CONVERSATIONS
AT THE 4TH ANNUAL SUMMIT OF THE SUSTAINABLE BUSINESS LEADERSHIP FORUM
NEW DELHI | OCTOBER 2014

Shaping New Age Urban Systems

Energy, Digital Connectivity & Climate Resilience

[OCTOBER 2014]



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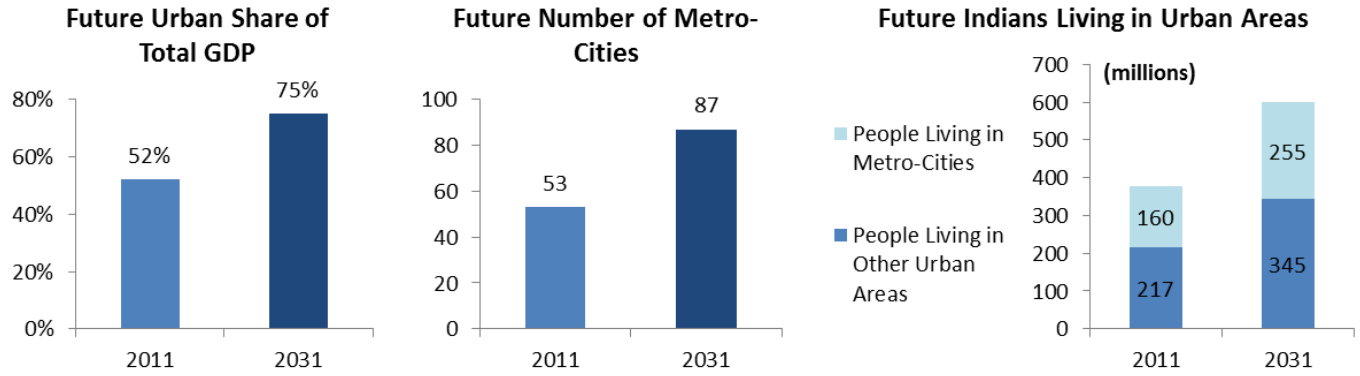
Indian cities are struggling to accommodate the accelerated pace of urbanization – resulting in crumbling urban infrastructure and unaffordable options for urban accommodation

Urbanization is only bound to rise – with a manufacturing-led, knowledge driven economy forming the core focus of India's efforts at creating a 'step change' in economic growth. Our industrial growth ecosystem must be planned and created – liveable cities will need to enable people to live and work near production zones.

By 2031, the urban share of GDP is expected to rise from 52% to 75%. The national level of urbanisation in India will rise from 31% in 2011 to 50% by 2031, and more than 600 million Indians will choose to live in urban areas. Urban areas of the future will be clustered – almost 50% of all future urban Indians will be concentrated in 87 metropolitan cities.

FIG 1: India GDP & Urban Growth Forecast



Source: Government of India, Census 2011

New Age Urban Systems: The Funding Challenge

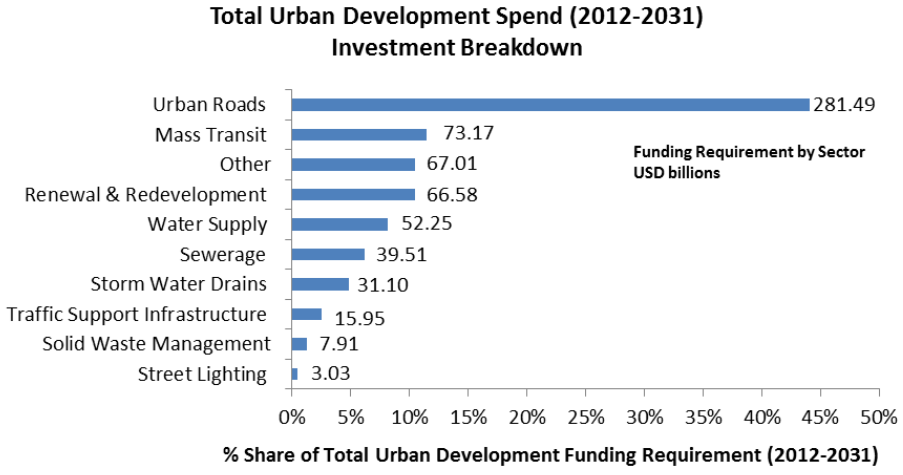
In 2012, the High Powered Expert Committee estimated urban investment requirement for the 20-year period from 2012-13 to 2031-32 to be Rs. 39.2 lakh crore (US $638 billion) – to cover both existing urban infrastructure shortages and future development for projected population growth.

As HPEC report pointed out, these figures do not take into account the cost of land and hence figures are underestimated.

Further, HPEC assessments do not build a 'smart city concept' into their estimations.

Nevertheless, the HPEC report has informed the total funding projections for urban development & smart cities in India.

FIG 2: India Urban Development Investment Breakdown to 2031



Source: Working Group Report on Financing Urban Infrastructure for 5th Five Year Plan

The 100 Smart Cities is a clear call for private sector to partner with India to build resilient cities

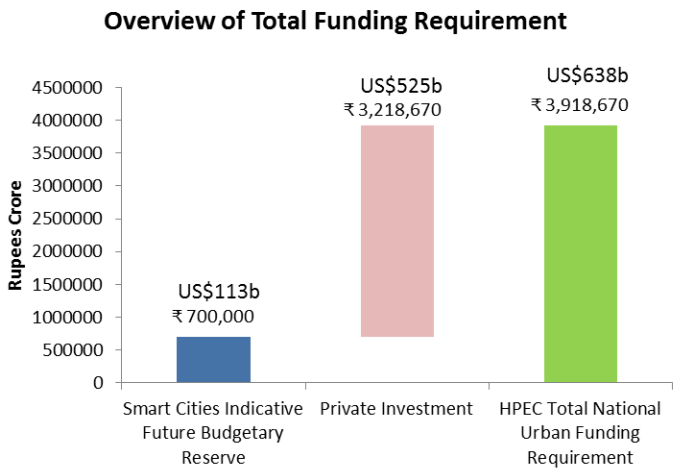
The total estimate of investment requirements for 100 Smart Cities comes to Rs 7 lakh crore (US$113 billion) over 20 years (with an annual escalation of 10 per cent from 2009-20 to 2014-15). This translates into an annual requirement of Rs 35,000 crore (USD $5.7 billion). It is expected that most of the infrastructure will be taken up either as complete private investment or through PPPs.

The government has also indicated that it will provide incentives in the form of a CAPEX subsidy for projects via Viability Gap Funding mechanism – up to 90% reduction in project cost for cities in hilly areas and 40% reduction in project cost for cities on the plains.

The VGF instrument has also been used in recent phases of the National Solar Mission - however, a key issue with VGF in the past has been that funding is often received at commissioning whereas project developers typically need funding in pre-commissioning & construction phases.

100 Smart Cities At a Glance

Funding



Highlights:

- 100 Smart Cities Union Budget FY15: Rs 7,600 Cr (US$ 1.2b)
- Indian Government's Indicative Future Budgetary Reserve: Rs. 700,000 Cr (US$ 113b)
- HPEC Urban Funding Requirement: Rs. 3,918,670 Crore (US$ 638b)
- Desired Funding Model for Smart Cities: Private Investment/ PPPs
- Government Incentives: 40% VGF for cities in plains; 90% VGF for cities in hills

Purpose

Enhance infrastructure & use ICT to solve urban problems

Candidates for 100 Smart Cities

- All state & UT capitals
- 44 cities in the population range of 1-4 million people
- 9 satellite cities with a population of 4 million or more
- 10 cities that are of religious and tourist importance (six identified to-date include: Varanasi, Mathura, Gaya, Ajmer, Amritsar and Kanchipuram)
- 20 cities in the 0.5 to 1 million population range

To enable a 'Smart Cities' vision, the Modi government (a) is fast tracking the easing of all FDI related to urban infrastructure development; (b) desires to infuse flexibility in PPP models to give investors security against policy variation and (c) is inviting other countries & development agencies to invest in India.

While a slew of major investment commitment announcements have been made in recent months (see Table below for numbers as of October 2014), between 62% - 82% of the Total HPEC Funding Requirement for Infrastructure could remain unmet. It is difficult to foresee this gap being met by private capital alone.

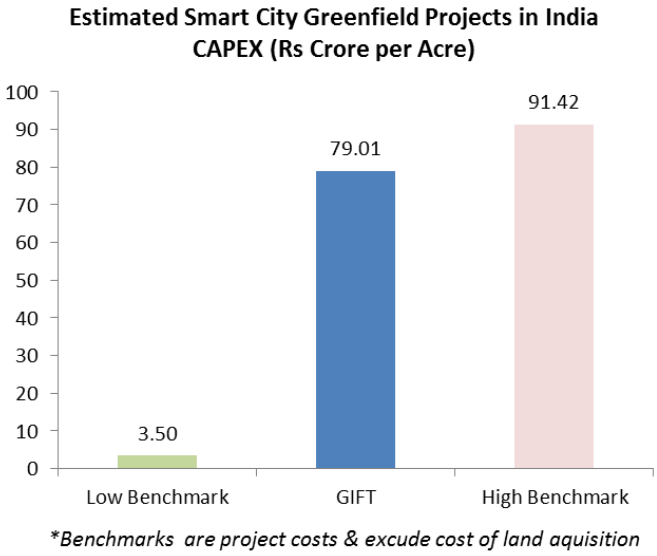
Entity	Selected Major Investment Plans in India
USA	Anticipated $41 Billion Private investment pathways into India; partnership on clean water & solid waste management for 500 cities
Japan	$35 Billion – mix of Private & Public investment
China	$20 Billion – mix of Private & Public investment
Germany (KfW)	EU 1 Billion on solar capacity for next ten years
ADB	$2.5 Billion to establish 5 Industrial Zones for Andhra Pradesh; $63.3 m for North Karnataka Urban Sector Investment Program

Further, there is no clarity on the 'scope' or the definition of what constitutes a 'Smart City'. As an illustration, the associated CAPEX per acre of built 'Smart City' environment has a large variation due to the specific urban locations as well as the Smart City elements which are infused in these greenfield sites.

Of the three pilot projects underway (Pavala by Lodha Group & IBM; GIFT City and Dholera Investment Region as part of DMIC), the greenfield project costs per acreage vary significantly.

Based on these initial experiences, the Indicated Future Budgetary Reserve desired by the Indian Government of Rs. 700,000 Crore for Smart Cities could fund anywhere from 7,700 to 200,000 acres of built environments.

FIG 3: Estimated Cost of Smart City Greenfield Projects



Source: Sustainability Outlook analysis

To put this in perspective, the new Andhra Pradesh capital is associated with 30,000 acres of land acquisition alone! A municipal budget request of Rs. 100,000 Crore was submitted to initiate this project.

Prior to infrastructure development, the Central Government has indicated that States may need to spend Rs. 5000 Crore (Rs. 100 Crore per City) for capacity building & doing detail assessments for Smart Cities, of which 5% will be supported by the Center (Rs. 250 Crore).

Hence, funding remains a key challenge to implement the vision of 'Smart Cities' as it has been broadly architected. Furthermore, this domain will require policy & regulatory synchronization between many different governing bodies thus only increasing the execution complexities.

The following table outlines key investment areas under 100 Smart Cities, and the sources of external funding as expected to support each of these.

Target City	Reported Initiatives	Funding & External Partners
Active Projects (As of October 2014)		
Allahabad, Ajmer, & Visakhapatnam	Clean water & municipal solid waste	US Government
GIFT City	Global 'smart city' & commercial hub for financial and IT services	Gujarat Government, IFLS
Gwalior, Ujjain, Sagar, Jabalpur & Dewas	Nurture integrated smarter communities by investing in power, gas, water, solid waste & sewage treatment, city drainage; city WiFi & broadband, intelligent traffic management	Madhya Pradesh Government, Essel Group
Jabalpur	State-of-the-art waste to energy plant for municipal solid waste	Essel Group, Hitachi Zosen
Dholera & Shendra Bidkin (Phase I); Vikram Udyogpuri, Greater Noida Industrial Township & Guragaon Global City	Master ICT plan created for unbuilt cities to ensure cost effective investment in sensing technology, telecom & ICT infrastructure. A total of 7 cities originally announced along DMIC.	DMIC, Cisco, Government of Japan and others
Surat	'Safe City' program - intelligent surveillance systems, with 650 surveillance cameras installed along with 100 monitoring junctions	Verint, working with State Civil Authorities & Police
Vijayawada-Guntur	Smart City budget to build out Andhra Pradesh's new capital over five years	Temasek Holdings (Singapore)
Varanasi (Sarnath, Banaras Hindu University and Airport City)	MOU between India and Japan to develop Varanasi as a smart heritage city based on the Kyoto model; Google may provide data services to aid execution	Kyoto Partner City Program, Google
Pending Decisions		
Vijayawada, Visakhapatnam, Tirupati and Nellore	Metro, BRTS, ring road, Wi-Fi connection, 24 hour water supply and power supply; CCTV monitored traffic systems	Centre in conversation with Andhra Pradesh
Patna	Proposal submitted for all 11 municipal corporation cities and nine other towns in Bihar, including Madhubani and Motihari for 100 Smart Cities	TBC - Centre in conversation with Bihar
New Delhi	Privatise the management of basic utilities such as power, water, and sewage treatment	Centre in conversation with IBM, CISCO, Microsoft, Parsvnath, DLF, cement & steel companies
Pending Decisions on Smart Cities	7 smart cities each in Gujarat, Kerala, Rajasthan and Karnataka; Bangalore- Chennai (Punderi, Krishnapatnam and Tumkur); Vizag to Chennai; Vizag to Kolkata; Amritsar-Kolkata Corridor; Chennai-Visakhapatnam Corridor	TBC – with interest expressed from ADB
Smart Villages	All the 800 Parliamentarians to select one village each to develop it as an Adarsh Gram (Model Village) by 2016 followed by two more by 2019	TBC – Awaiting details on Scope / Target Villages & Roadmap
Pilots Underway prior to 100 Smart Cities / Other Private Pilot Projects		
Pondicherry	Smart City simulation pilot conducted of physical cities using 3D models to aid planning	Dassault Systemes, POWERGRID
Bangalore	'Internet of Things' Innovation Hub to design and develop products, services and solutions for a Smart Connected City by 2015	CISCO Systems, Electronics City Industries Association
Palava, near Navi Mumbai & Dombivali	Build smart city infrastructure; centralise key city functions through real time monitoring and advanced analytics over 4000 acres	Lodha Group, IBM Intelligent Operations
Unnamed 15 cities in India	Hybrid-electric buses for 'within state' transport (currently in 15 cities, target of 20 cities in India)	Volvo
Neermana (Private Pilot project initiated post 100 Smart Cities)	Pilot city for 100% renewable energy generation; 100% efficiency in water & waste management	ETI Dynamics

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What does a successful resilient city look like?

Given the formidable challenges in rolling out Smart City infrastructure, there is no scope in proceeding towards creating a 'non-optimal' city.

Indeed, the maturity of a city is not due to the infrastructure or technology alone but it is a complex interplay of behaviour, processes, regulatory parameters and the physical environment. It is thus critical that smart cities rollout is forged after accounting for these dimensions.

Current State View of 'Successful Resilient City' in India & the World

In September 2014, **the Indian government suggested a set of benchmarks for Key Parameters for the Smart Cities construct** — these span across transport, spatial planning, water supply, sewerage, sanitation, solid waste management, storm water drainage, electricity, telephone connections, WiFi connectivity, healthcare facilities, education, firefighting and others. (*Some of these Key Parameters & Benchmarks are listed in at the end of this Briefing Paper for reference.*)

Earlier in 2014, **the ISO 37120 (*Sustainable development of communities – indicators for city services and quality of life*)** was launched as part of an integrated suite of standards currently being formulated for sustainable community development. **ISO 37120 is important as it is the first ISO standard for smart city indicators.** Relevant indicators from ISO 37120 have been mapped to the Key Parameters & Benchmarks proposed by Indian Government Smart City Framework, to enable a comparison (*as detailed at the end of this Briefing Paper.*)

Our analysis (below) shows that the current paradigm for 'successful cities' focuses mostly on access to services and infrastructure. In some cases, the metrics could drive efficiency over the lifetime of physical assets while these assets are being used.

However, there is a very limited focus and scope to drive resource optimization over the 'whole system' of a city, particularly through the integrated use of physical infrastructure and ICT in:

- **Changing behavior of citizens** when interacting with the physical environment
- **Closing the loop on resource & energy flows** within different parts of a city, as also its exchanges with other cities, peri-urban areas & rural supply bases
- **Creating negligible response times** to variability events (bio hazards, climate change, security, disasters, crime)
- Measuring, tracking and **embedding efficiencies** in resource and energy consumption

To shape a common lens on success of these initiatives, we have developed a Smart Cities Maturity Model (SCMM) to establish the metrics to be applied to a Future City for gauging preparedness against these aspects.

Maturity Model	1	2	3	4
	BASIC URBAN SERVICES	→		**HIGH URBAN RESILIENCE**
KPIs relate to….	**Access**	**Efficiency**	**Behaviour**	**Systems Focus**
What success looks like…	*Urban infrastructure and technologies are available and urban services are being delivered*	*Efficient resource & energy use is actively measured and embedded in a future city*	*People interact with physical assets in ways which unlocks new pathways for sustainability*	*Closed-loop & sustainable resource & energy exchanges are being strengthened within a city*

Conceptualising a Maturity Model for Smart Cities

Below table synthesizes the Maturity Model as applied onto the Key Resource-Related Areas proposed by the Union Government (Transport, spatial planning, water supply, sewerage & sanitation, solid waste management, storm water drainage, electricity, telephone connections, Wi-FI connectivity. We have excluded healthcare facilities, education, firefighting and so on.)

SCMM	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
	BASIC URBAN SERVICES			HIGH URBAN RESILIENCE
	Access	Efficiency	Behaviour	Systems Focus
Transport	Convenient and affordable access to light rail, high capacity transport & non- motorized pathways	Infrastructure metrics, load factors & route optimisation Efficient last mile transport options	Online, seamless, real time mobility services which enable mode-switching based on criteria (cost, time, footprint)	Shifting mobility from asset ownership to public transport or shared services models, as per type of trip
Spatial Planning	Availability of green space, Socially cohesive communities; Green building & sustainable physical infrastructure creation	Reduced mobility & congestion; Climate-resilient urban planning	Toolkits and behavioural practices to empower communities to become resource secure & efficient; Maintenance & upgrades of existing infrastructure	Opportunities for collaborative industrial & residential ecologies (e.g. common ETP, decentralized energy)
Water Supply	Sustained access to potable supplies of water; Visibility of domestic & other water consumption	Water consumption, metering and collections; Smart grids for water; Standards for water efficient devices, storage & transport; Lost / unaccounted water; Water markets	Water re-charge metrics for groundwater; Preventative action on unintended pollution sources from goods consumed or practices	Location specific risk metrics & tracking, dependent on water sources; Real-time disaster response & monitoring for water security; Embodied value of water to GDP
Sewerage & Sanitation	Access to toilets; waste water collection and treatment services	Process efficiency KPIs on collections, treatment & recovery infrastructure	N/A	Closed loops for organic matter recovery and biogas
Solid Waste	Solid waste collection; treatment & disposal services (incl basic recycling)	Efficient, aggregated and sustainable solid waste streams for processing	Reduction in waste through regulatory measures & behavioural support tools	Solid waste tracking, auditing, and recovery channels
Storm Water Drainage	N/A	Absence of water clogging	N/A	N/A
Energy & Electricity	Reliable, sustained access to electricity; Access and share of non-electrical forms of energy	Energy efficient infrastructure, devices & standards; Grid control and grid infrastructure performance	Demand side management; Reduction of peak load, power consumption; Incentives for fuel switching; Infrastructure to enable uptake of RE energy	Electrification of all energy needs; Share of renewable energy for electricity; Share of renewable energy for non-electrified energy needs
ICT & Systems Intelligence	Access to Telecom and WiFi / digital services which is convenient, affordable and non-exclusionary; Geospatially, real time access to services	Resource efficiency analysis; resource monitoring; scenario testing through reliable & secure data streams and integrated data platforms	Predictive resource load management; predictive risk management; enable negligible response time to failure-events. Open data to enable service innovation	Technology-enabled optimization of urban service delivery, resource efficiency; immediate response; urban governance; & city performance management
Economy & Finance	Access to opportunities for affordable healthcare, education and financial services (e.g. insurance)	Labour force productivity, skills & talent distribution and growth; human health & savings growth	Performance metrics on the provision of services delivered	NA
Environment	Institutional, technical, financial and R&D facilities to grow natural capital; track & manage pollution	Pricing of eco-system services and investment in natural capital; Efficient linkages & connectivity with other cities, rural & peri-urban areas	Regulation and legal enforcement to protect common environmental goods	System-based view of material, climate and energy flows between urban areas and peri-urban and rural linkages

Evaluating Urban Resilience efficacy in emerging concepts

Applying the SCMM to the new *ISO Sustainable Cities Standard* and the Union Government's *Smart City Concept Note Benchmarks* to evaluate efficacy for urban resilience reveals the following:

Maturity Model	1		2		3		4	
	LOW URBAN RESILENCE						HIGH URBAN RESILIENCE	
	Access		Efficiency		Behaviour		Systems Focus	
	ISO	India	ISO	India	ISO	India	ISO	India
Transport	✓✓	✓✓	●	●	✓	●	●	●
Spatial Planning	✓✓	✓✓	●	●	●	●	●	●
Water Supply	✓✓	✓✓	✓	✓	●	●	●	●
Sewerage & Sanitation	✓✓	✓✓	●	●	NA	NA	●	●
Solid Waste	✓✓	✓✓	●	●	●	●	●	●
Storm Water Drainage	NA	NA	●	✓	NA	NA	NA	NA
Energy & Electricity	✓✓	✓✓	✓✓	✓	●	●	●	●
Telecom & WiFi	✓✓	✓✓	●	●	●	●	●	●
Economy, Finance, Education & Health (Grouped)	✓✓	✓	●	●	✓	✓	NA	NA
Environment	✓	●	●	●	●	●	●	●

Key Findings

1. Indian and International norms are on-par and in agreement on: (a) baseline performance expected for urban services in Smart Cities; and (b) the need to build & embed a focus on resource efficiency as we start to use Smart City infrastructure
2. There is absence of KPIs to promote resource sustainability and urban resilience by creating a change in resource flows within the city or through the way citizens interact with the physical environments.
3. The conversation on Efficiency is limited to energy and water only – there is a huge missed opportunity to recover materials & energy from sewerage, solid waste, and wastewater from urban ecosystems
4. There is a lack of a 'systems' approach both within the National and the International standards framework to fostering urban resilience.

Reference Table: Key Parameters, Performance Indicators & Benchmarks as Detailed by International & Indian Norms

The table below groups and lists the Parameters, Indicators and Benchmarks by theme stated under *ISO Standard for Sustainable Development for Communities: Indicators for City Services & Quality of Life* and Government of India's *Smart Cities Concept Note*. It focuses on resource-relevant themes and excludes healthcare, education and social metrics.

	ISO: 31120:2014 Sustainable Development for Communities: Indicators for City Services & Quality of Life	Government of India Smart Cities Concept Note List of Benchmarks (p.24)
Transport	• Km of high capacity transport system per 100,000 persons • Km of light passenger transport system per 100,000 persons • Km of footpaths & biking lanes per 100,000 persons Annual # public transport trips per capita • No. of personal automobiles, 2-wheelers per capita • Commercial air connectivity; fatalities • % people not using person vehicle for work commute	• Travel time: 45min for metros; 30 min for cities • Continuous unobstructed footpaths • Dedicated and physically segregated bicycle tracks • High quality and high frequency mass transport within 800m(10-15 minute walking distance) in residences for 175persons / ha built area • Access to para-transit within 300m walking distance
Spatial Planning	• % of people living in slums • Green areas per 100,000 population • Annual number of trees planted per 100,000 population • Aerial size of informal settlements % of city area • Jobs/housing ratio	• 175 persons per Ha along transit corridors. • 95% of residences should have daily needs retail, parks, primary schools and recreational areas within 400m; access to employment and public and institutional services by public transport or bicycle or walk • Min 20% of residential units occupied by economically weaker sections in each Transit Oriented Development Zone 800m from Transit Stations • Min 30% residential and 30% commercial/institutional in every TOD Zone within 800m of Transit Stations
Water Supply	• % potable water service; • % of population with sustainable access to improved water source • Total water consumption per capita; total domestic water consumption per capita	• 24 x 7 supply of water • 100% household with direct supply • 135 litres of per capita supply of water • 100% metering of water connections • 100% efficiency in collection of water charges
Sewerage & Sanitation	• % city population served by wastewater collection • % wastewater receiving treatment (none, primary, secondary, tertiary) • % pop with sustainable access to improved sanitation • % of lost / unaccounted water • Avg. water service interruptions per household (hrs)	• 100% households should have access to toilets • 100% schools should have separate toilets for girls • 100% households connected to waste water network • 100% efficiency in the collection and treatment of waste water • 100% efficiency in the collection of sewerage network
Solid Waste	• % population with solid waste collection • Total collected solid waste per capita • % solid waste recycled' • % solid waste disposed (landfill, incinerator, burned openly, other) • Hazardous Waste generation and % waste recycled	• 100% households with daily door-step collection • 100% collection of municipal solid waste • 100% segregation of waste at source, i.e. bio-degradable and non-degradable waste • 100% recycling of solid waste
Storm Water Drainage	No metrics	• 100% coverage of road network with storm water drainage network • Aggregate number of incidents of water logging reported in a Year = 0 • 100% rainwater harvesting
Energy & Electricity	• Residential electrical use per capita (kWH/ year) • % population with access to electrical service • Electrical consumption of public buildings (kWh/m^2) • % Renewable energy as a share of Total Energy • Total electrical use per capita (kWH/ year) • Average number of electric interruptions per year • Avg length of electrical interruptions (hours)	• 100% households have electricity connection • 24 x 7 supply of electricity • 100% metering of electricity supply • 100% recovery of cost tariff slabs
Telecom & WiFi	• No of internet, mobile, and landline connections per 100,000 population	• 100% households have a telephone connection including mobile • 100% of the city has wi-fi connectivity with 100 Mbps internet speed
Economy & Finance	• Unemployment rate; full time employment rates; % living below poverty line • Number of new businesses; number of new patents per 100,000 population • Debt service ratio; CAPEX as % of Total Revenue; Own Source as % of Total Revenue; Tax Collections	No metrics
Environment	• Fine particulate & particulate matter concentration; GHG emissions per capita; nitrogen & sulphur dioxide concentration; and biodiversity measures	No metrics

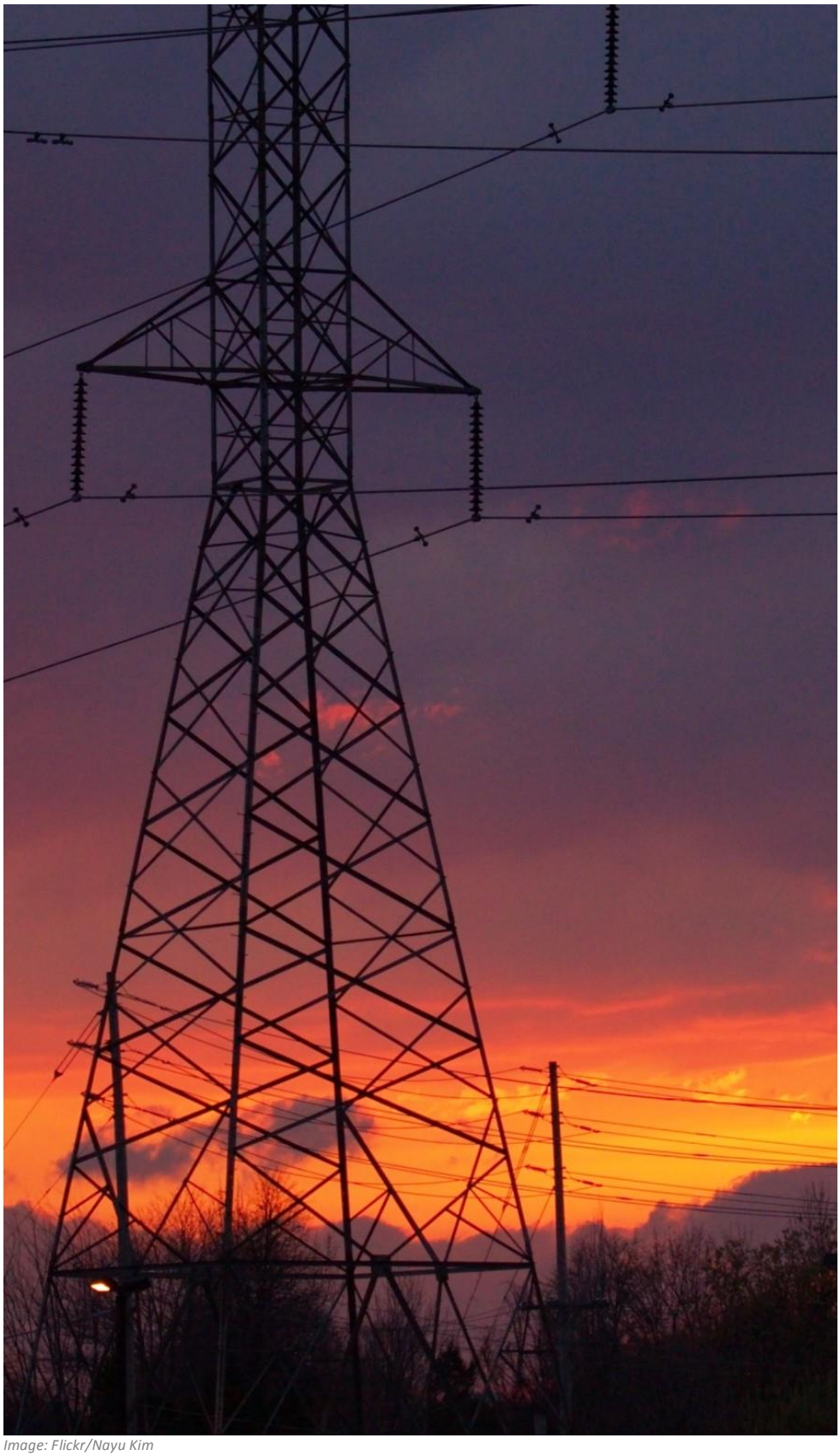

Image: Flickr/Nayu Kim

Path Forward

There is an urgent need to redefine how we conceptualise and evaluate the success of Future Cities.

This will ensure that as we bridge the infrastructure gap, we are tuned to making the right investment decisions and we are open to alternative models for resource consumption and thus long term urban resilience.

Without a clear view of what is required for a future city to be resilient, we risk wastefully utilizing precious capital today. This could diminish quality of life for citizens, strain a city's productivity, and create resource shocks for generations of future urban citizens in India.

About Sustainability Outlook

Sustainability Outlook is a market access, insight and collaboration platform tracking actions related towards enhanced resource management in the Indian economy. Sustainability Outlook provides market analysis and data tracking services, news and intelligence updates, and creates momentum towards specialised sustainability interventions by facilitating a structured process for multi-party collaboration.

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