Bureau of Energy Efficiency

सत्यमेव जयते
Government of India
Ministry of Power

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DEUTSCHE ZUSAMMENARBEIT

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ANGAN
Augmenting Nature by Green Affordable New-habitat

A Courtyard for Revolutionary Change in Building Energy Efficiency

An International Conference on Building Energy Efficiency

9th-11th September, 2019 | Hotel The LaLiT, New Delhi

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THIS PRESENTATION WAS SHARED BY

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FOR THE SESSION:

"Smart Cities and Smart Readiness Indicators (SRI) for Buildings

DURING ANGAN 2019

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Creating Innovative Solutions for a Sustainable Future

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Augmenting Nature by Green Affordable New-habitat (ANGAN)
A courtyard for revolutionary change in Building Energy Efficiency

The International Building Energy Efficiency Conference 9th ~ 11th September 2019
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K. K. JOADDER

Thematic Track 4– Smart Cities and Smart Readiness Indicators (SRI) for Buildings

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POINTS FOR DELIBERATIONS:

- Do SMART cities mean ensuring efficiency through technological advancement or is a city which provides safety, sustainability and security to all?
- How do we measure the SMART-ness of a city?
- Can India make all its cities SMART?
- How do we do so?

What is SMART?

- **SMART**= Efficient and Resilient = **Sustainable**
- **Efficient** = High level performance & functionality
- **Resilience** = Breakdown and disruption proof
- **SMART CITY** = Efficient & resilient system of Governance, Infrastructure & Service network = **Sustainable & Livable City**

SMART CITIES – PROPOSAL PREPARATION

NO particular model suggested /adopted by the Smart Cities.

- Approach is **not 'one-size-fits-all'**
- Each city has to formulate its own concept, vision, mission and plan (proposal) for a Smart City that is **appropriate to its local context**, resources and
- Each City have to choose own Model of Smart City and will prepare own **Smart City Proposal (SCP).**

Smart City Plan should have :

- the vision, plan for mobilization of resources
- Intended outcomes
- infrastructure up-gradation &
- smart applications.

SMART CITIES – AREA BASED STRATEGY

Each Smart City Proposal to have a Pan City component along with one or more of the other components as below:

❖**Retrofitting** - *Development of an existing built area* ***greater than 500 acres*** *so as to achieve the objective of smart cities mission to make it more efficient and livable e.g.* ***Local Area Development (Ahmedabad)***

❖**Redevelopment** - *Replace existing built environment in an area of* ***more than 50 acres*** *and enable co-creation of a* ***new layout, especially enhanced infrastructure, mixed land use and increased density*** *e.g. Bhendi Bazar, Mumbai*

❖**Greenfield** - *Develop a previously vacant area of* ***more than 250 acres*** *using innovative planning, plan financing and plan implementation tools with provision for affordable housing, especially for the poor e.g. Net Town, Kolkata.*
80% buildings would be energy efficient green building
15% of the building will be in the affordable housing category

❖**Pan-city Development Approach – an initiative** in which **at least one Smart Solution** is applied city-wide e.g. ITS, NRW reduction, online services etc.

Relaxation for **North Eastern and Himalayan States -** *The area can be one-half of what is prescribed for any of the alternative models - retrofitting, redevelopment or Greenfield development.*

SMART CITIES – CORE INFRASTRUCTURE ELEMENTS

- **Assured electricity** - least 10% of the energy requirement solar power,
- Sustainable environment, use of green technology, Energy efficiency, rain water harvesting
- **Adequate water supply** including waste water recycling and reuse,
- **Efficient urban mobility and public transport**,
- **Sanitation**, including solid waste management,
- **Affordable Housing**, especially for poor,
- **Robust IT connectivity** and digitalization,
- **Good Governance**, especially e-Governance and citizen participation,
- **Ensuring safety of citizens,** especially women and elderly, and Health and education.

MODEL BUILDING BYE-LAWS 2015

SUSTAINABLE DEVELOPMENT AND GREEN BUILDINGS

PROVISIONS FOR SANCTION

- Energy Efficiency
- Solar Energy Utilisation
- Roof Top Solar Energy Installations
- Installation of Solar Water Heating Systems in Buildings
- Water Conservation and Management
- Waste Management

Integration of Green roof and Solar Potentials

(Energy Efficiency & Renewable Energy combination)

Concepts of Rooftop Gardens

Rooftop gardens concept is not the new concept, since the **Mesopotamia region** Green roofs are in practice.

Civilizations built landings of
Ziggurats
Stepped Pyramids.
Hanging Gardens

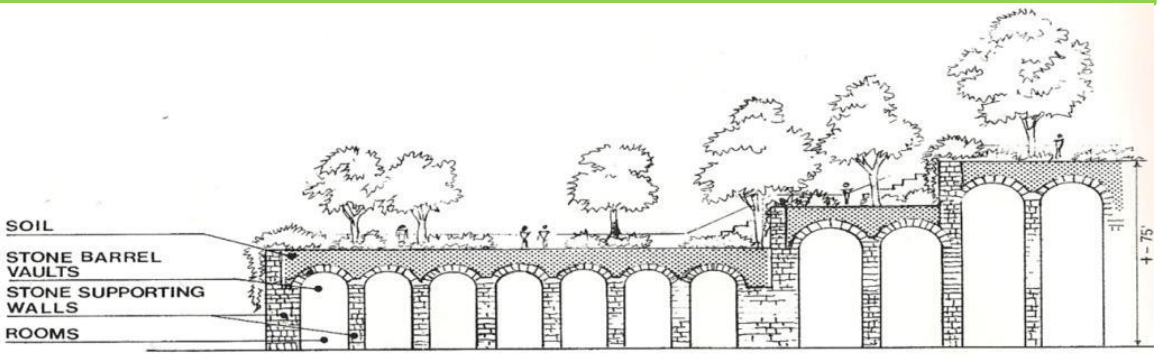


Figure 1 The section drawing of the Hanging Garden of Babylon

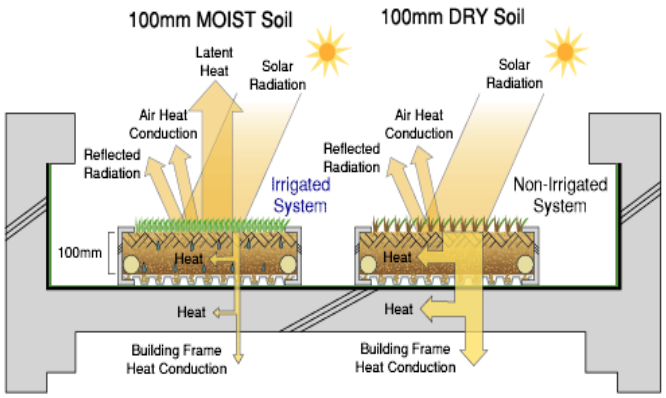
Typology of Green Roofs

CHARACTERISTICS	EXTENSIVE	INTENSIVE	SEMI-INTENSIVE
Depth of material	6” (15.2 cm or less)	More than 6”	4”-6”
Accessibility	Often accessible	Usually accessible	Partially accessible
saturated weight	Low (48.4-170 kg/sq m)	High (244.1-1,464 kg/sq m)	Varies (170.9-244.1 kg/sq m)
Plant diversity	Low	Greatest	Greater
Cost	Low	High	Varies
Maintenance	Minimal	High	Varies

ADVANTAGES OF GREEN ROOFS

1. Evapo-transpiration

Evapo-transpiration & shading from the plant cover reduce up to **90%** in solar gain and Indoor temperature decrease of 3-4°C (6-8 °F) may be attained.



2. Reduce energy budgets (reducing heating & cooling costs) of individual buildings

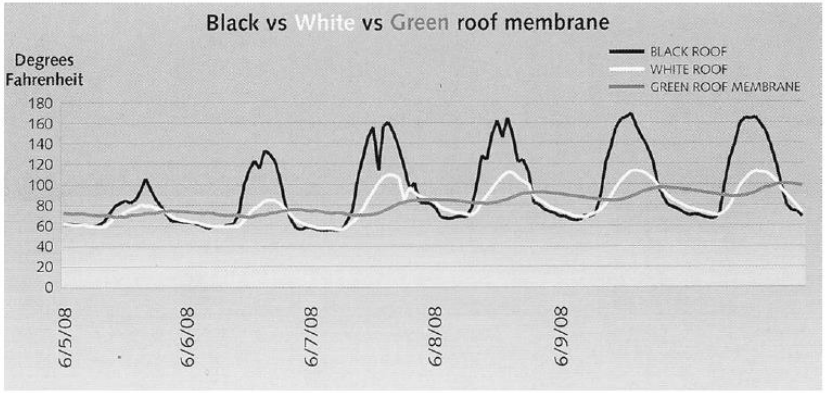
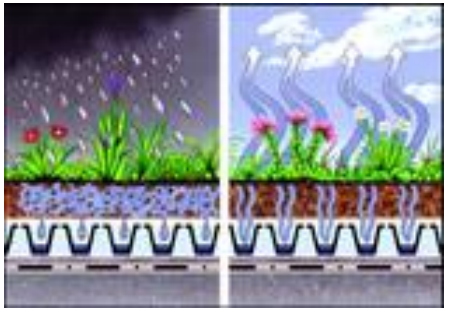
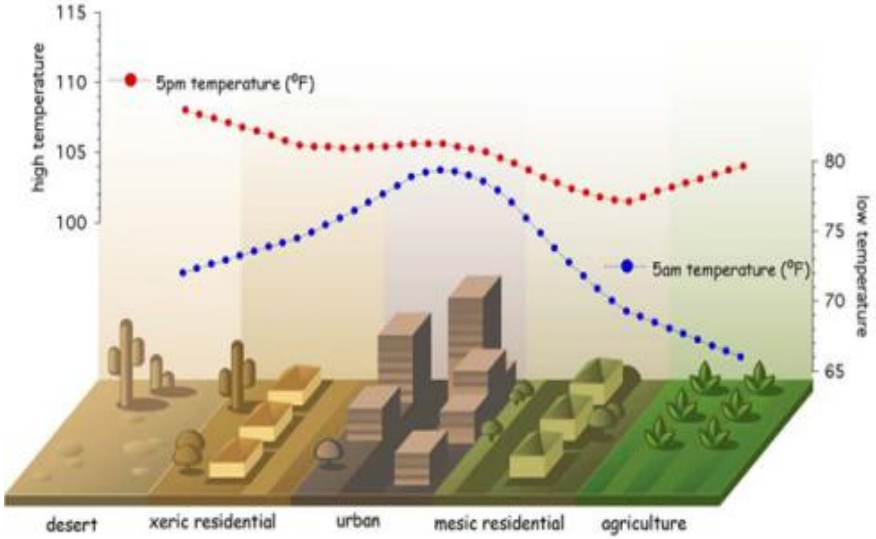


Figure 2.18: Graph illustrating the surface temperature fluctuations on a green roof, a reflective white roof, and an unprotected black roof between 5 and 9 June 2008. On hot days, temperature on green roof remains cooler than white roof and a black roof(Werthmann, 2007)

In internal building temp by 4°C may reduce electricity consumption



3. Urban Heat Island Effects



Source: 1 Green roofs in sustainable Landscape Design
Steven L. Cantor

OTHER ADVANTAGES OF GREEN ROOFS

SUBJECT	GREEN ROOF	CONVENTIONAL ROOF
Air quality	Reduced volumes of pollutant	None
Air quality	Increases evapotranspiration	None
Habitat	For insects and birds	None
Livability	Buffer noise, offers passive recreation	None
Costs	Highly variable from Rs 3200-7740 /Sqm new construction and Rs 4500-12,900 /sqm	Highly variable from Rs 1300-6420/sqm
Durability	Waterproof membrane protected from solar and temperature exposure lasts more than 20 years.	lasts less than 20 yrs

Source: 1 Green roofs in sustainable Landscape Design
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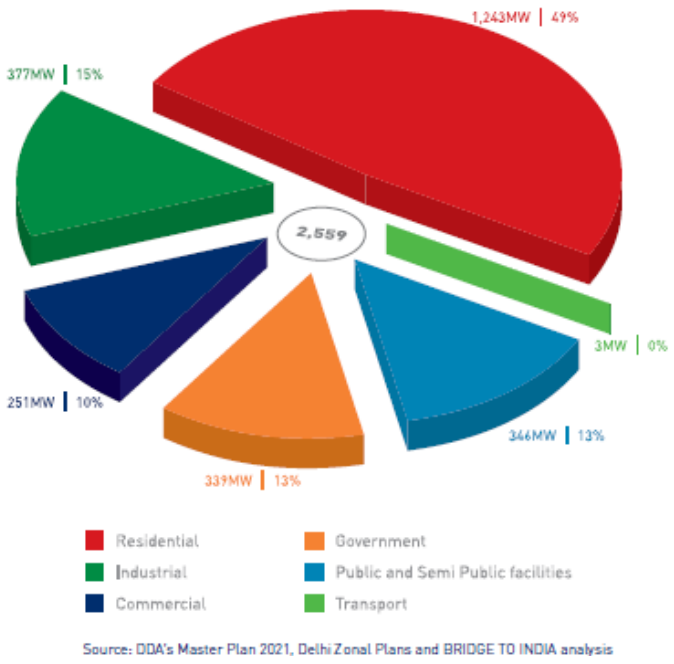
DELHI'S POTENTIAL FOR ROOFTOP SOLAR ENERGY



Source: DDA's Master Plan 2021, Delhi Zonal Plans and BRIDGE TO INDIA analysis

Land area type	Total qualified rooftop area (km²)	% of solar suitable rooftop space
Residential	74.5	49%
Commercial	10.9	10%
Industrial	11.3	15%
Government	10.2	13%
Public and Semi Public Facilities	11.9	13%
Transport	0.2	0.10%
TOTAL	118.9	

Suitable Area for Roof Top Garden

Out of this, 26% potential exists in the government/ public sector, 25% in commercial/ industrial sector and 49% in domestic sector.

Residential areas as per municipalities governing them	Total built area/ raw rooftop area (km2)	Total qualified area after 20% discount for old rooftops (km2)	Solar suitable roof top area (km2)
Area under the MCD	79.2	63.32	12.6
Area under the NDMC	8.6	6.9	1.4
Area under the Delhi Cant.	5.3	4.3	0.85
TOTAL	93.1	74.5	14.90

Theoretically, the total land area on which Delhi is built could support Approx. 1.23 GW of solar PV.

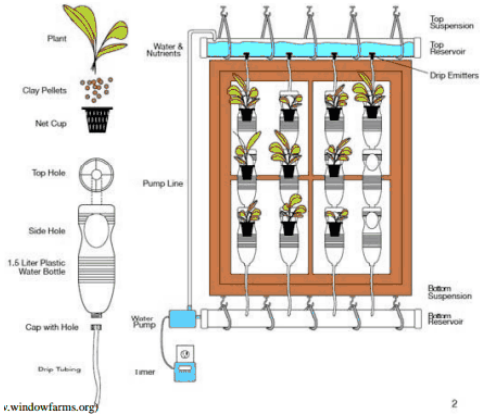
Source: 4 DDA's Master plan 2021, Delhi Zonal Plans, Google Earth and Bridge To India analysis

PROPOSALS

1. STRUCTURAL LOADING

Proposal: As Delhi has both old and new construction

For new building whose additional loading capacity is good enough can be converted to **extensive rooftop.**



2. Protection from harsh sun and wind

Proposal: Movable living wall

Predominant wind direction (Delhi)
Summer – W in morning, NW in evening
Monsoon – SE
July and August – E
September – NW
Post Monsoon – W(morning), N(evening)
Winter – W,SW(morning), N,NW(evening)

Source: Bridge To India analysis

PRIVATE AND PUBLIC BENEFITS

Scale of Development	values associated with the construction			
	Economic	**Social**	**Environmental**	**Aesthetic**
Private Development (apt/single family dwelling)	Reduction energy costs	Outdoor gathering space	Clean air, free of pollution	Aesthetic pleasure for the owner
Public Development (Institutional, Municipal infrastructure, Industrial & Ecology	Reduction in energy Costs Moderation of internal temperature	Healthy Work environment Lower air pollution thus health benefits for users Bio-remediation: Native grasses & plants rid the soil of contaminants	Microclimate formation Water management system storm water runoff reduction Protection from UV radiation Urban heat Island Mitigation Ecosystem restoration Providing habitats for native plants, birds & insects.	Community & neighbourhood appreciation

Source: 4 Basic book of natural gardening by W.E.Shewell Cooper council of agro economic research

RECOMMENDATIONS

1. All new and renovated flat roofs to be greened.

2. Green roofs should be installed over air conditioned spaces that are heated and cooled
3. Financial incentives for green roof development on private roofs.

4. Green Roof policies- Energy Conservation code that stipulates min. solar reflection standards for all new and retrofit roofs

5. Solar panels can be incorporated with green roof which lowers down the consumption of energy.

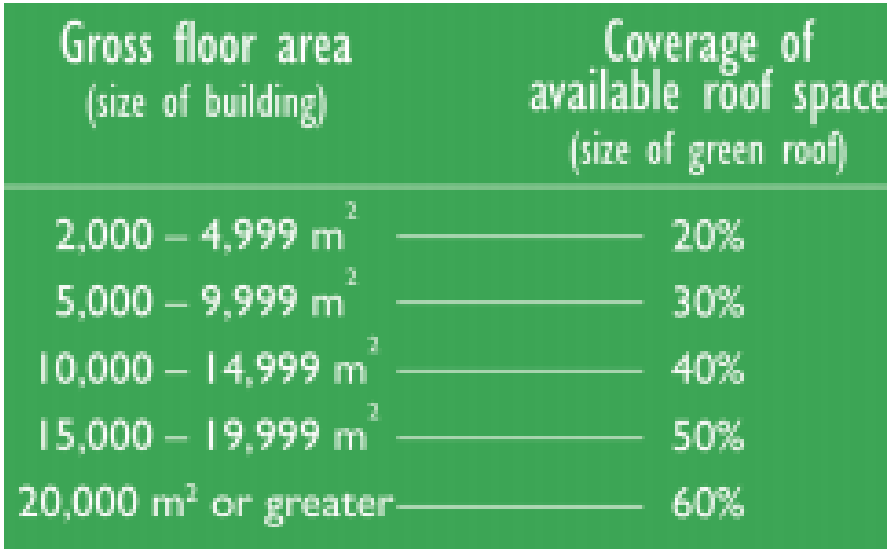


Figure 12. Green roof coverage requirements for Toronto's green roof bylaw (Source: City of Toronto, 2010)

Source: Bridge To India analysis

MY ROOF GARDEN

USING RECYCLED KITCHEN WASTE WATER

THANK YOU FOR YOUR ATTENTION