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सत्यमेव जयते  
Government of India  
Ministry of Power



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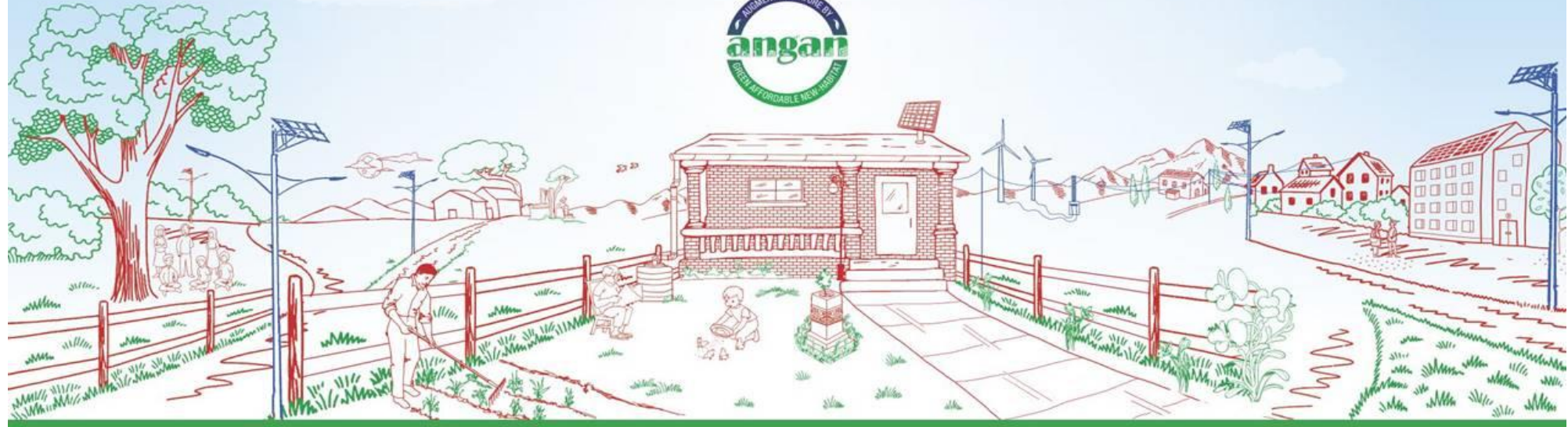
# ANGAN

## Augmenting Nature by Green Affordable New-habitat

A Courtyard for Revolutionary Change in Building Energy Efficiency

An International Conference on Building Energy Efficiency

9<sup>th</sup>-11<sup>th</sup> September, 2019 | Hotel The LaLiT, New Delhi





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THIS PRESENTATION WAS SHARED BY

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FOR THE SESSION:

*“Integration of Renewable Energy in Buildings in India”*

DURING ANGAN 2019

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Augmenting Nature by Green Affordable New-habitat (ANGAN)

# Integration of Renewable Energy in Buildings in India

**Nabeel Ahmad, EDS**

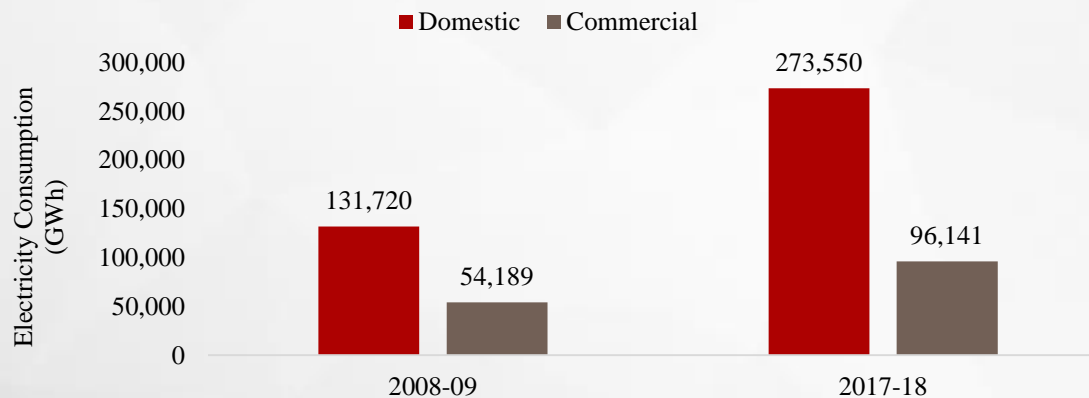
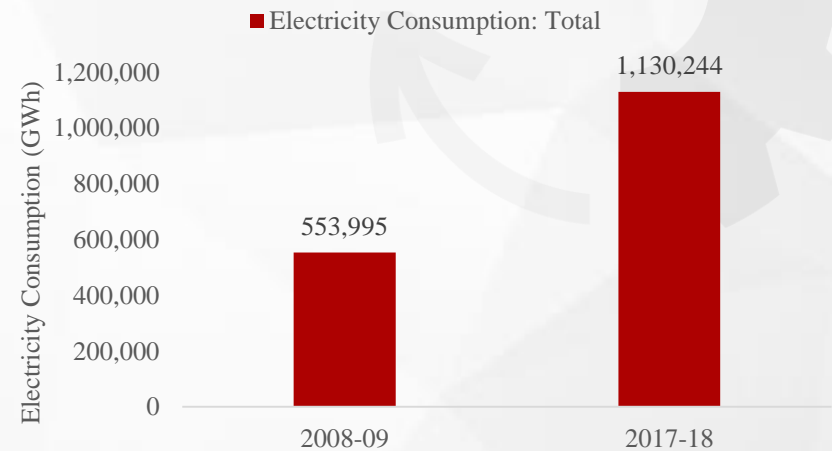
**10<sup>th</sup> September 2019**

New Delhi

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# Electricity Consumption in India

- Out of total electricity consumption, **domestic sector accounts for 24%** and **commercial sector accounts for 9%** of consumption.
- The electricity consumption in domestic sector has increased during 2008-09 to 2017-18 with **CAGR of 7.58%**

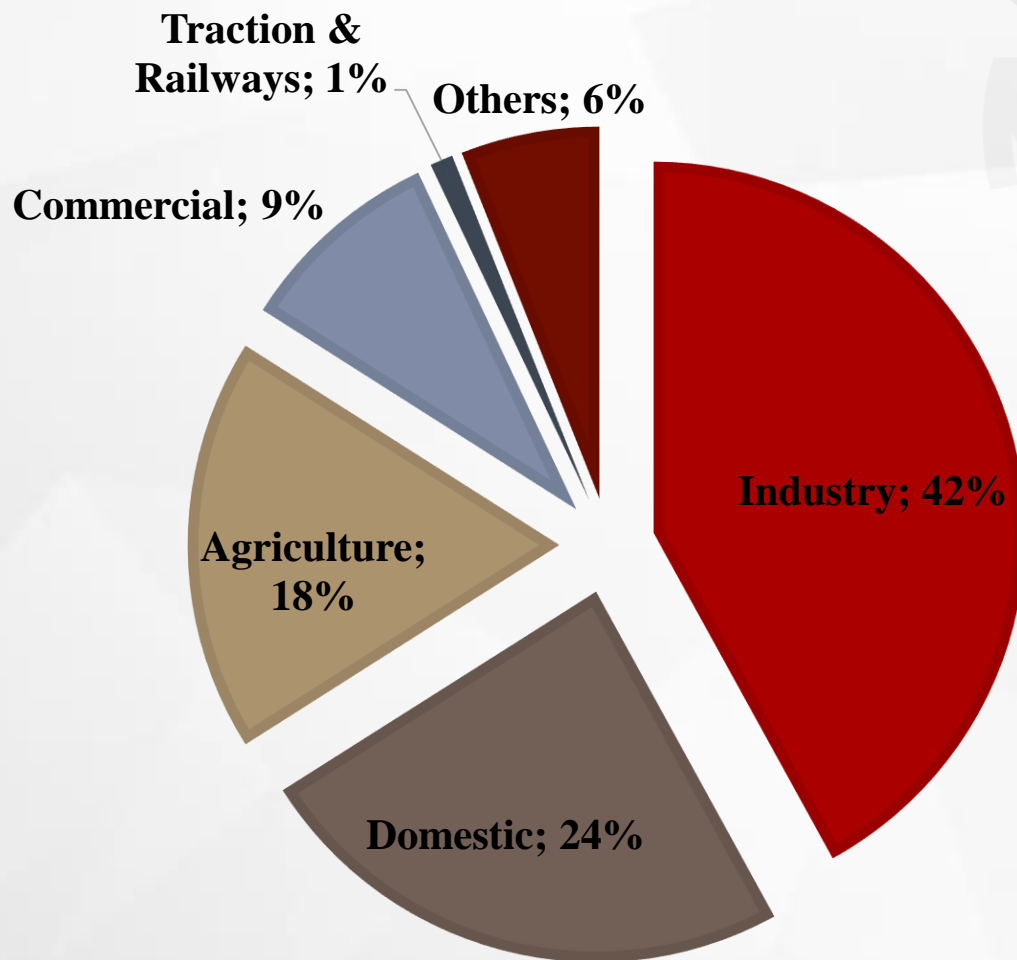


Source: Energy Statistics 2019: Ministry of statistic and programme implementation, GoI, [mospi.gov.in](http://mospi.gov.in)



# Consumption of Electricity by Sectors in India during 2017-18

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Source: Energy Statistics 2019: Ministry of statistic and programme implementation, GoI, [mospi.gov.in](http://mospi.gov.in)



# Energy efficiency in buildings

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- The buildings and buildings construction sectors combined are responsible for 36% of global final energy consumption and nearly 40% of total direct and indirect CO<sub>2</sub> emissions\*.
- **Energy efficiency is the first step in greening the buildings\*\***
- **Reducing the energy demand and Improving energy efficiency in buildings** can significantly reduce carbon dioxide (CO<sub>2</sub>) emissions from the building sector, translating to possible mitigation of CO<sub>2</sub> emissions.

Features to focus upon for achieving building energy efficiency

- ✓ Building Envelope
- ✓ Mechanical systems and equipment, including heating, ventilating, and air conditioning, service hot water heating etc
- ✓ Interior and exterior lighting
- ✓ Electrical power systems

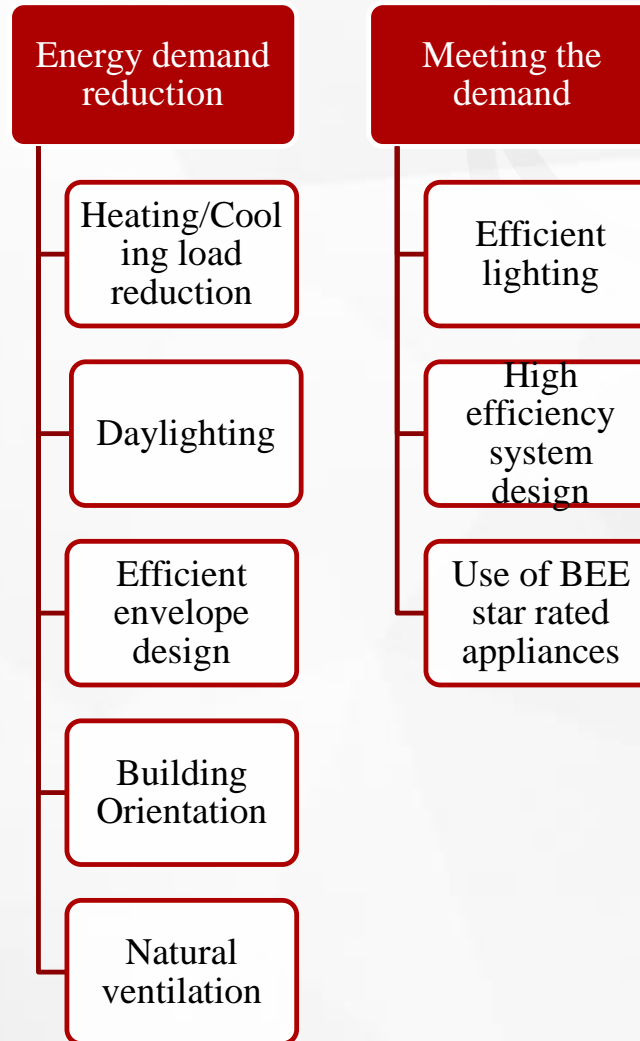
\*<https://www.iea.org/topics/energyefficiency/buildings/>

\*\*Energy star

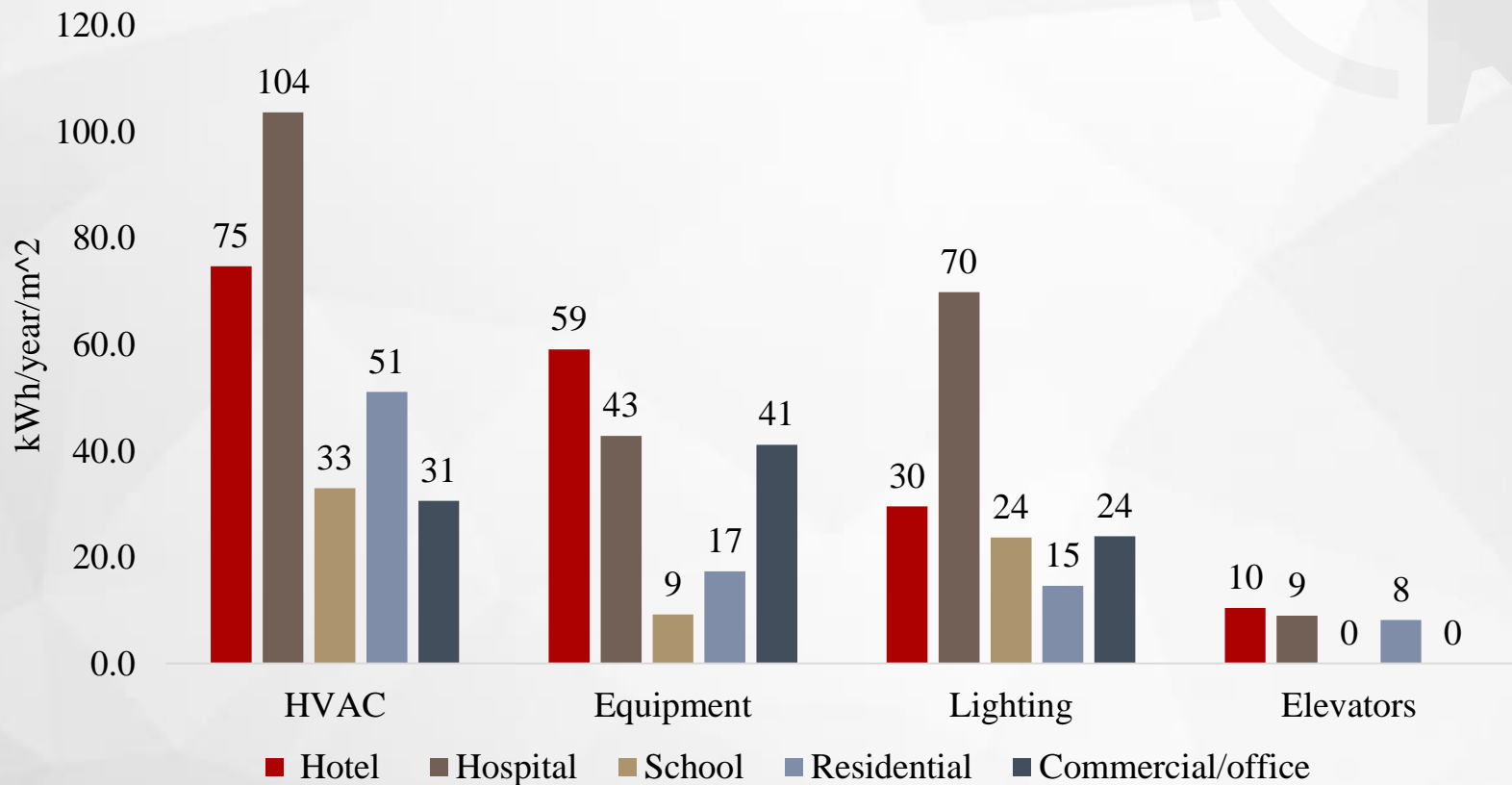


# Energy efficiency in buildings

**The building envelope** – the parts of a building that form the primary thermal barrier between interior and exterior – plays a key role in determining levels of comfort, **natural lighting** and **ventilations**, and how much **energy is required to heat and cool a building**



# Breakdown of energy end-use across different buildings



# Roof top photovoltaic : Target and achievements

Renewable Energy Technology (Grid Interactive)	FY- 2019-20		Cumulative Achievement
	Target (MW)	Achievement (MW)	
Solar PV - Roof Top	1000.00	344.68	2141.03

As per National Solar Mission it is targeted to achieve 40GW of rooftop solar PV installations by 2022



# RE achievements in India

Renewable Energy Technology (Grid Interactive)	FY- 2019-20		Cumulative Achievement
	Target (MW)	Achievement (MW)	
<b>Solar PV - Roof Top</b>	<b>1000.00</b>	<b>344.68</b>	<b>2141.03</b>
Wind Power	3000.00	1060.86	36686.82
Solar Power - Ground Mounted	7500.00	1546.02	27930.32
Small Hydro Power	50.00	11.65	4604.80
Biomass (Bagasse) Cogeneration)	150.00	28.00	9131.50
Biomass (non-bagasse) Cogeneration)/Captive Power	100.00	0.00	674.81
Waste to Power	2.00	0.00	138.30
<b>Total</b>	<b>11802.00</b>	<b>2991.21</b>	<b>81307.58</b>

Source: <https://mnre.gov.in/physical-progress-achievements>



# Why Integrate RE Systems in Building?

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## Advantages:

1. Local generation of electricity – thus, minimized transmission losses
2. Renewables are environmentally friendly
3. Policy environment is getting better and subsidies are being introduced
4. Energy consumption expenditure of building is minimized – towards Net Zero
5. Better value for the property in the market and better rental values
6. Net Metering being introduced in most states



# Renewable Energy technologies in the context of buildings

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Solar PV /  
BIPV

Solar Water  
Heater

Small Wind  
Turbines

Bio-energy

Geothermal



# Renewable energy options and their end uses in residential and commercial buildings

	Solar PV	Solar Thermal	Small Wind Turbines	Biogas plants	Geothermal Energy
<b>Electricity</b>	×		×		
<b>Cooling</b>		×			×
<b>Space heating</b>		×			×
<b>Water heating</b>		×		×	×
<b>Cooking</b>	×	×		×	
<b>Steam</b>		×			

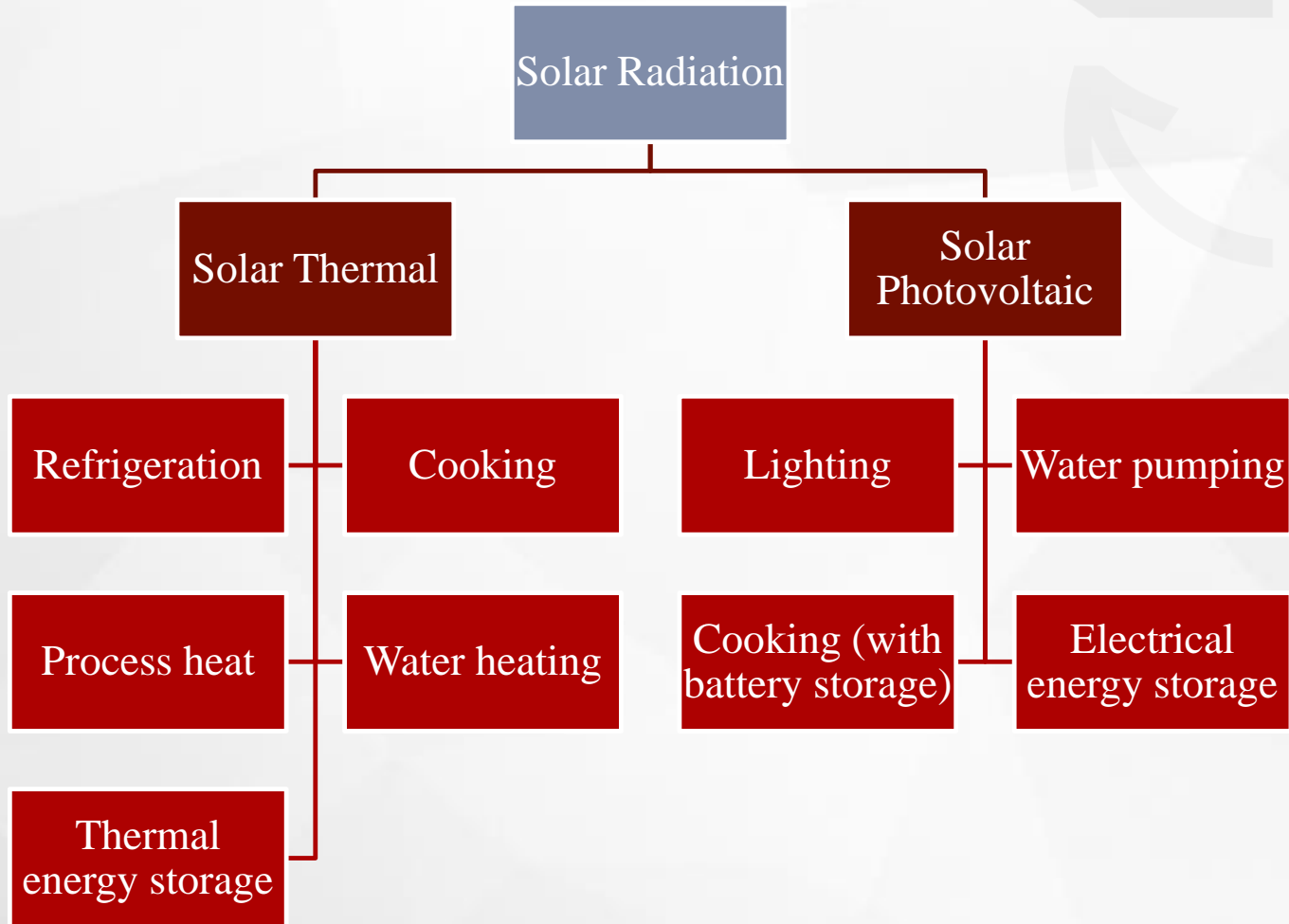
<sup>[1]</sup> Electricity is either fed to the grid or used to power the household needs like lighting, fans, television, music player etc.

<sup>[2]</sup> Utilising photovoltaics for cooking is a new kind of solar cooking and it is developed in IIT Bombay

<sup>[3]</sup> Steam is used for large scale cooking in institutions and hospitals



# Solar energy and its' application



# Solar Photovoltaic

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- ❑ Solar PV modules are made up of multiple solar cells, also called photovoltaic (PV) cells, convert sunlight directly into electricity.
- ❑ 1kWp of Solar installation can generate 1300kWh to 1500kWh of electricity per year
- ❑ 100 sqft area is required for 1 kWp installation

Source: <https://www.flickr.com/photos/mjmonty/3235660948>



# BIPV-Building Integrated PV

- Building-integrated photovoltaics (BIPV) refers to the concept of integrating photovoltaic elements into the building envelope, establishing a symbiotic relationship between the architectural design, structure and multi-functional properties of the building materials and the generation of renewable energy\*.
- Power density varies from  $57\text{W/m}^2$  (dark panels) to  $28\text{W/m}^2$  in transparent panels\*\*



\*[polysolar.co.uk](http://polysolar.co.uk)

\*\*<https://www.onyx solar.com/product-services/technical-specifications>

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# Solar thermal: Solar Water Heating

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- A 125LPD solar water heater can help to save 5 kWh of electricity per day



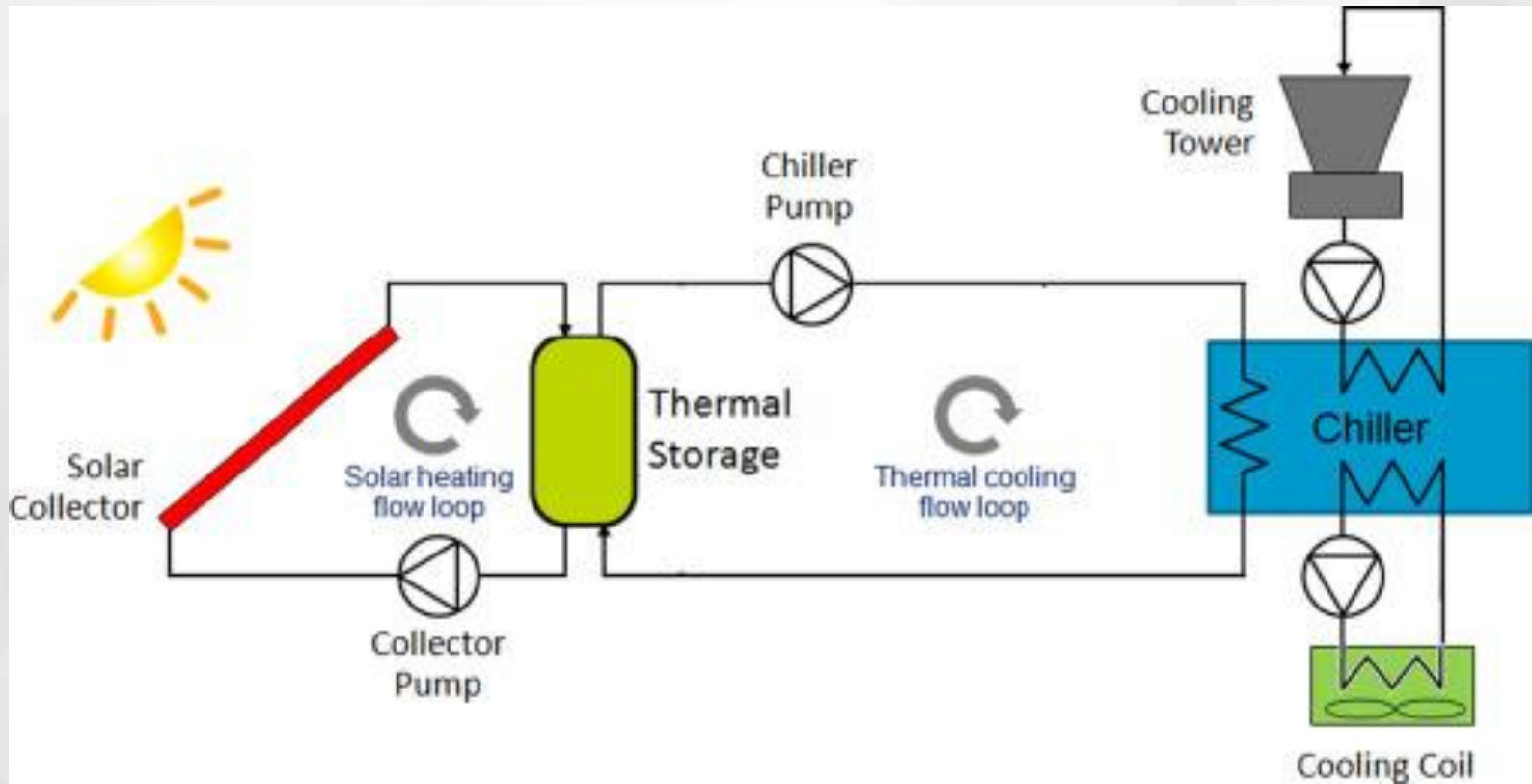
[https://commons.wikimedia.org/wiki/File:Solar\\_water\\_heating.jpg](https://commons.wikimedia.org/wiki/File:Solar_water_heating.jpg)

[https://commons.wikimedia.org/wiki/File:Solar\\_water\\_heater\\_on\\_top\\_of\\_Santos\\_Place.jpg](https://commons.wikimedia.org/wiki/File:Solar_water_heater_on_top_of_Santos_Place.jpg)



# The solar thermal cooling system

One TR or AC would require approx. 18-26 m<sup>2</sup> of collector/panel area for solar system



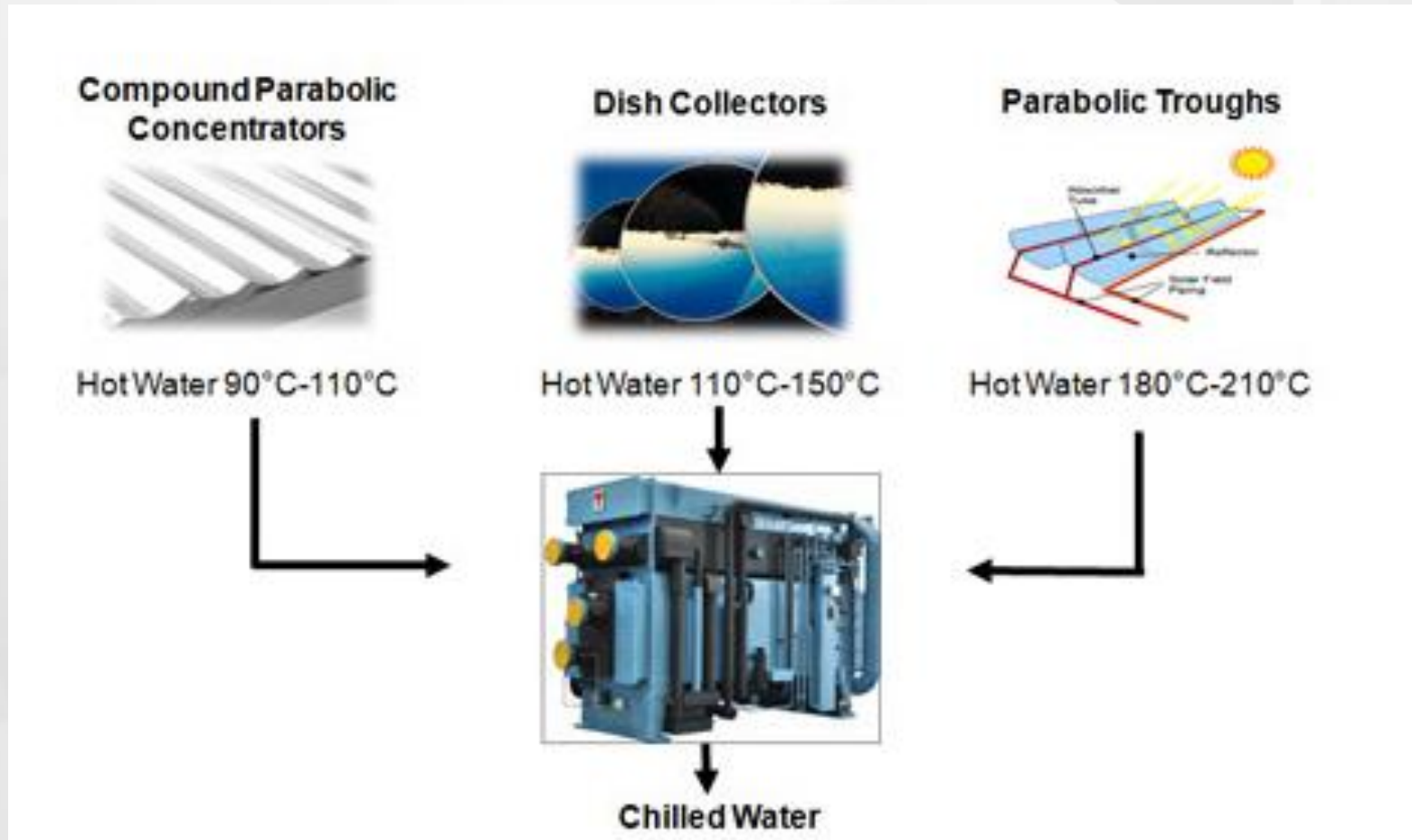
*Schematic of solar thermal air-conditioning system;*

*Source: Sciencedirect.com*

<https://www.sciencedirect.com/science/article/pii/S1364032114007485>



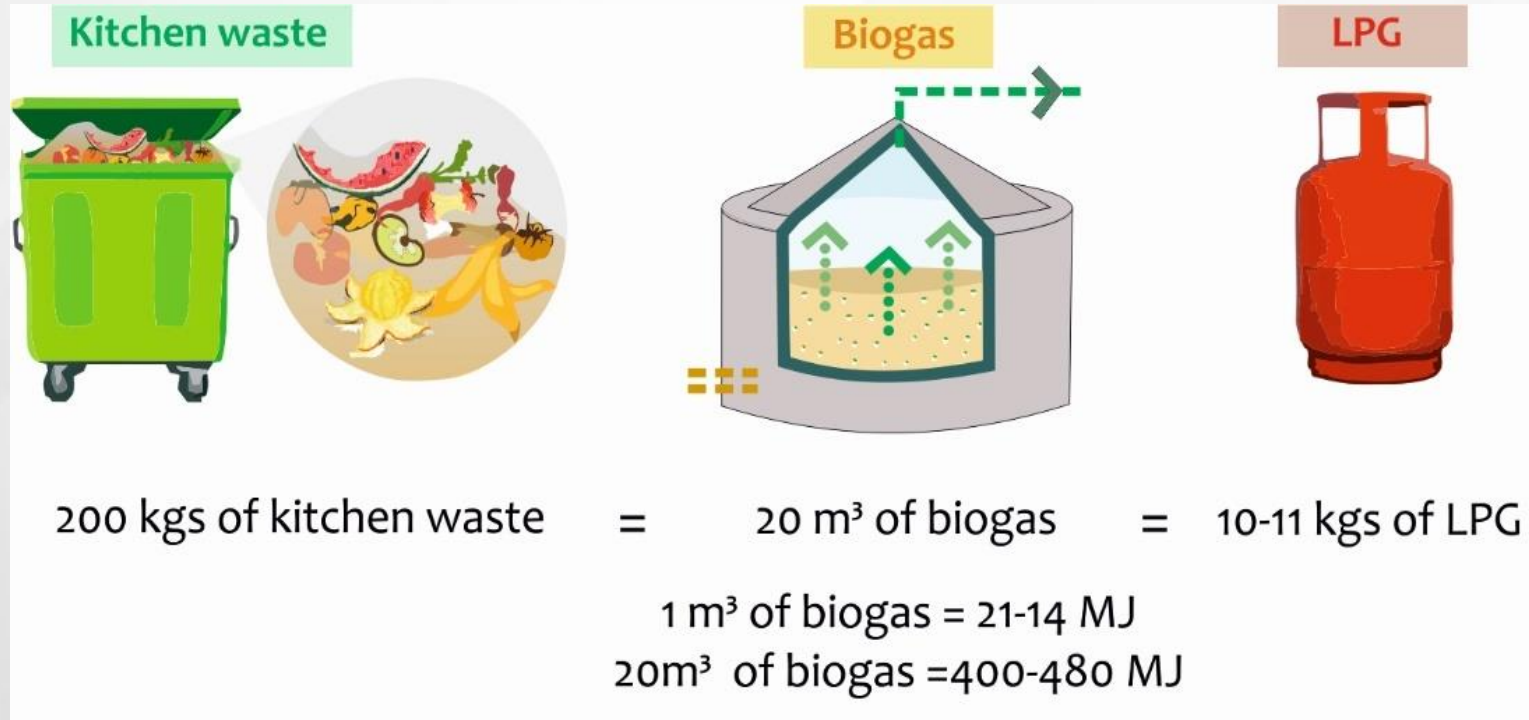
# The solar thermal cooling system



Source: <https://www.thermaxglobal.com/thermax-absorption-cooling-systems/solar-based-cooling/>



# Bio-energy : Energy from kitchen waste



Depending on the type of resources available and the end use requirement, biomass resource can be processed into types of biofuels through various routes



# Geothermal energy

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- It is the energy stored in the earth itself. Geothermal temperature increases with depth in the earth's crust.
- Ground Source Heat Pumps (GSHP's) use the earth's relatively constant temperature between 16 - 24<sup>0</sup>C at a depth of 20 feet to provide heating, cooling, and hot water for homes and commercial buildings\*.
- A borewell system for one TR of AC would require a borewell of approx. 50-80 meter depth

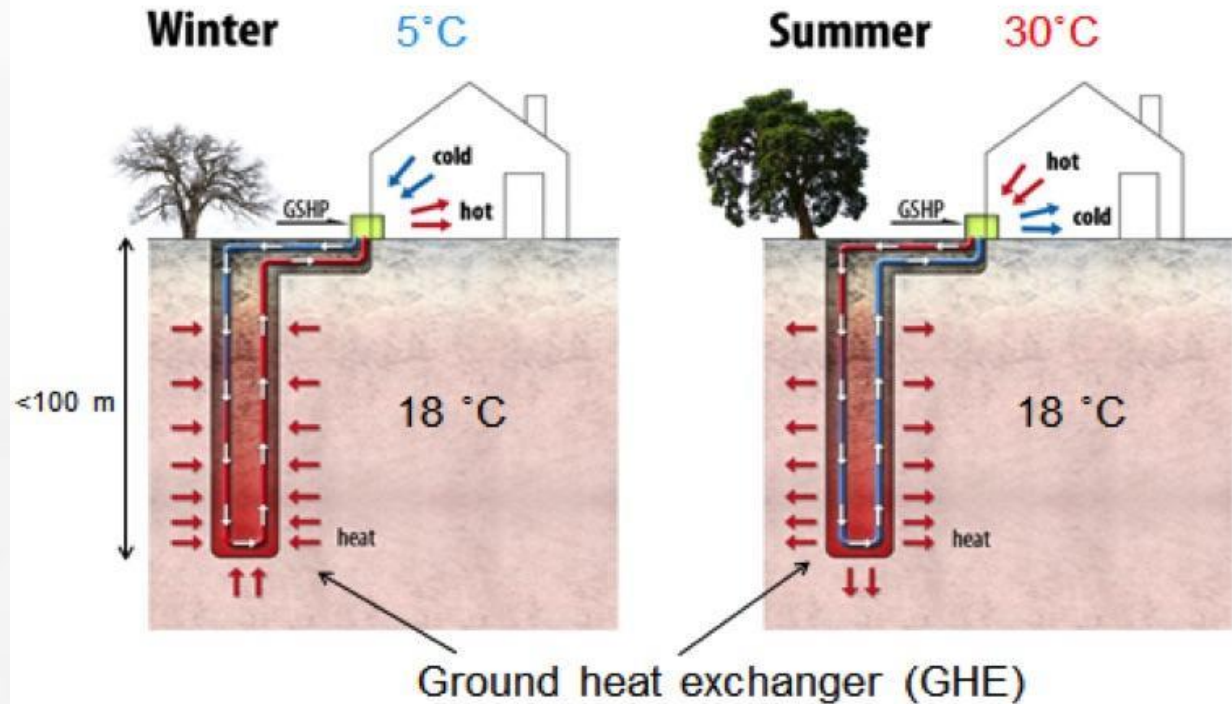
\*<https://mnre.gov.in/geo-thermal>

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# Small Wind Turbines

- In buildings and campuses, small wind turbines can be integrated to meet energy demand..
- 1kW wind turbine can generate ~1000 to 1500kWh per year\*



\*Subject to suitable site conditions and the wind turbine specifications

Source: [https://commons.wikimedia.org/wiki/File:Small\\_wind\\_turbine\\_on\\_roof.JPG](https://commons.wikimedia.org/wiki/File:Small_wind_turbine_on_roof.JPG)



# RE Systems under Codes and Rating Systems

- RE mandatory for certain types of buildings- Under ECBC and model building bye-laws Green Building Rating systems:
- RE is mandatory for buildings in GRIHA,
- Provision of credit points for RE integration.
- RE system is either based on installed capacity or on energy generation.

Technology	NBC	ECBC	GRIHA	IGBC
Solar thermal	√	√		Non-mandatory credit points
Solar PV	√		Mandatory on-site RE generation to offset a part of the annual energy consumption	
Wind	√	Mentions generation from RE at the rooftop or at the site		Non-mandatory credit points
WTE	√			Provision for both on and off-site RE generation
Geothermal	√			



# Solar integrated in building

- ❖ It has a net conditioned area of ~12,763 square meters, and the annual **energy demand** was estimated to be **13,50,000 kWh**.
- ❖ The headquarter campus is equipped with a **973kWp** grid-connected solar PV power plant.
- ❖ The plant is estimated to produce **12,80,000kWh** of electricity per year which is equivalent to 95% of energy demand.



**Jaquar headquarters**



# Wind & Solar integrated in building

- ❖ Renewable energy installation on the campus is estimated to be of 155kW,
- ❖ The RE system has 18 wind turbines of 4.75kW each, 243 number PV panels of 230W each and 128 number BIPV panels of 105W each.
- ❖ 100% hot water demand is met through the solar hot water system.
- ❖ The RE system is estimated to give an output of 2,30,000kWh per annum.



## Suzlon one earth

Source: [HTTP://SYNEFRA.COM/SUZLON-ONE-EARTH/#TAB-ID-2](http://SYNEFRA.COM/SUZLON-ONE-EARTH/#TAB-ID-2)



# Solar integrated in building

- ❖ Approx. 70 kW of solar energy system designed on terrace
- ❖ Low energy consumption with radiant cooling system.



Headquarter for satin credit care





**THANK YOU**

Nabeel Ahmed

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