



CSIR-National Environmental Engineering Research Institute
Nehru Marg, Nagpur-440 020



Urban Mobility and Climate Change

On Behalf of Dr. Rakesh Kumar
Director, CSIR-NEERI

Er. Hemant Bherwani
Scientist,
CSIR-NEERI Nagpur

Email: director@neeri.res.in ; h.bherwani@neeri.res.in
www.neeri.res.in



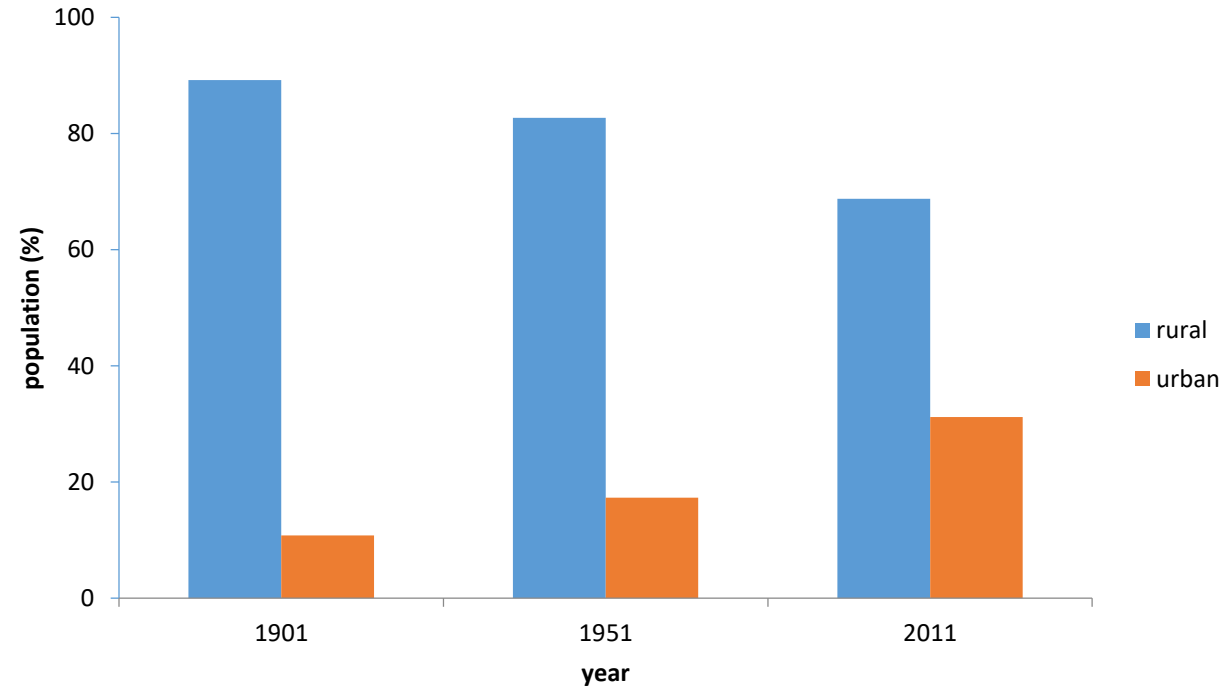
Growth in Urbanization



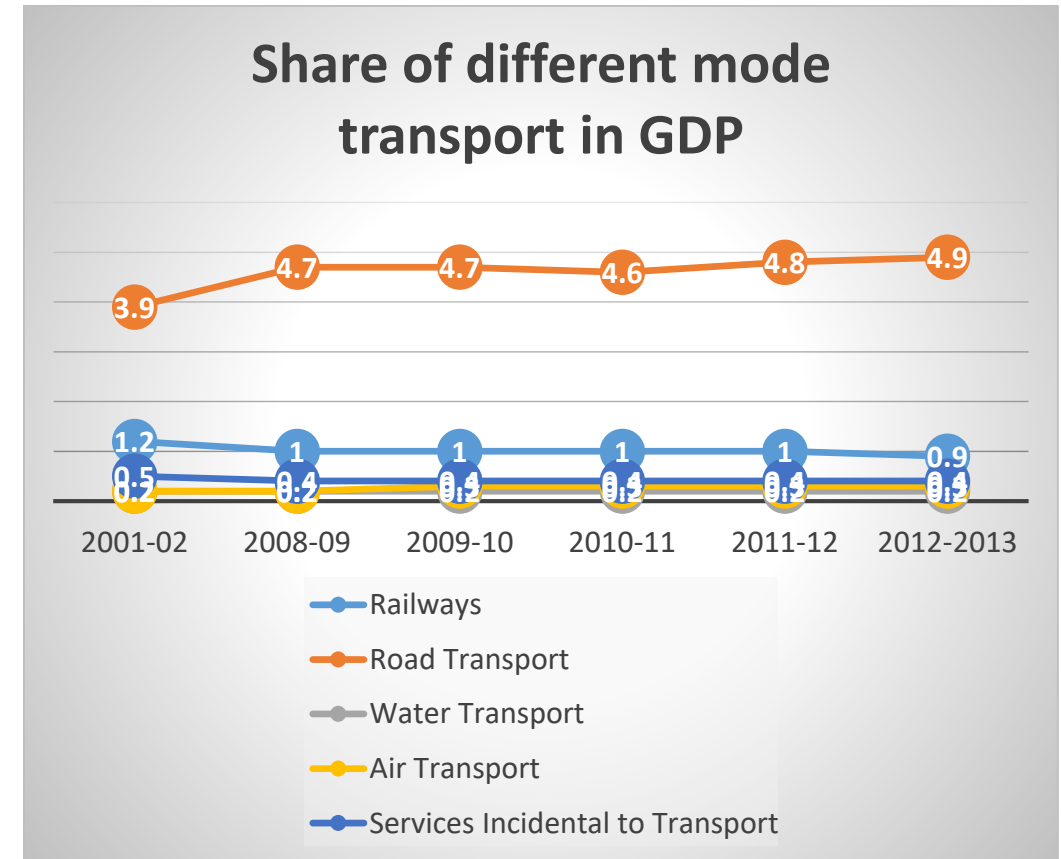
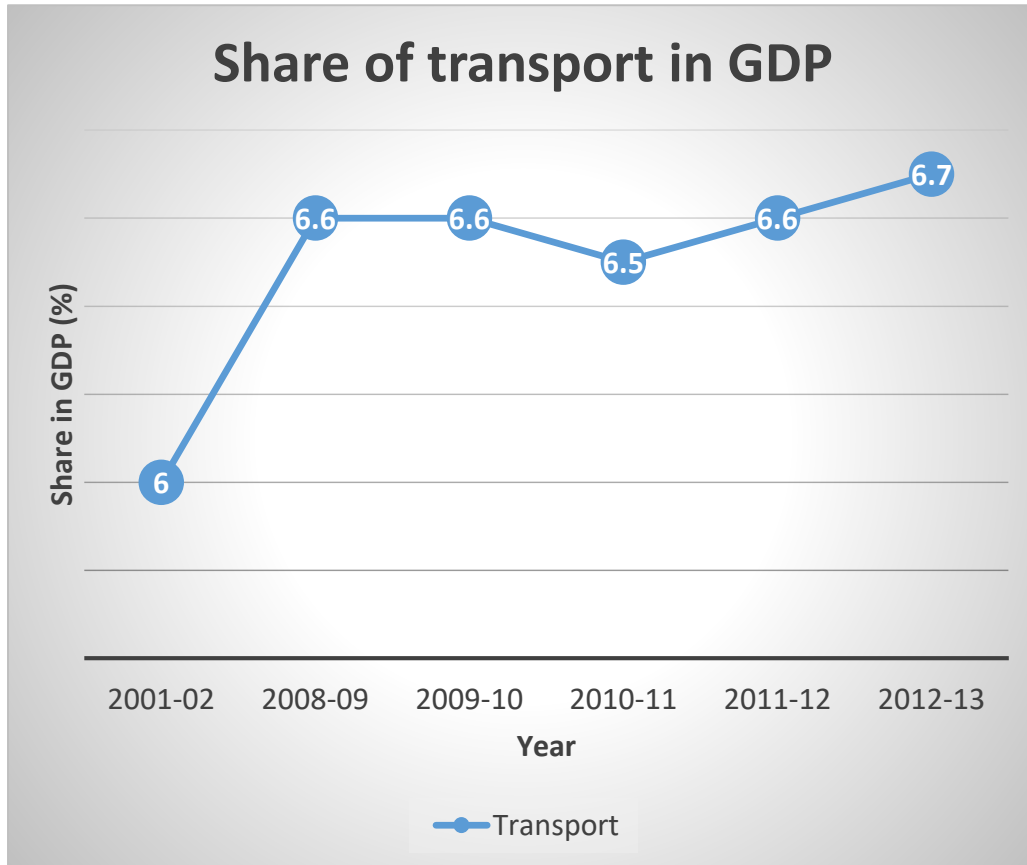
Cities 80-90 million plus cities by 2030 and 120 by 2050 in world.

Urban population will increase by 80% in 2050

As per census 2011, the Indian urban population increased from 10% to 32 % during 1901 to 2011

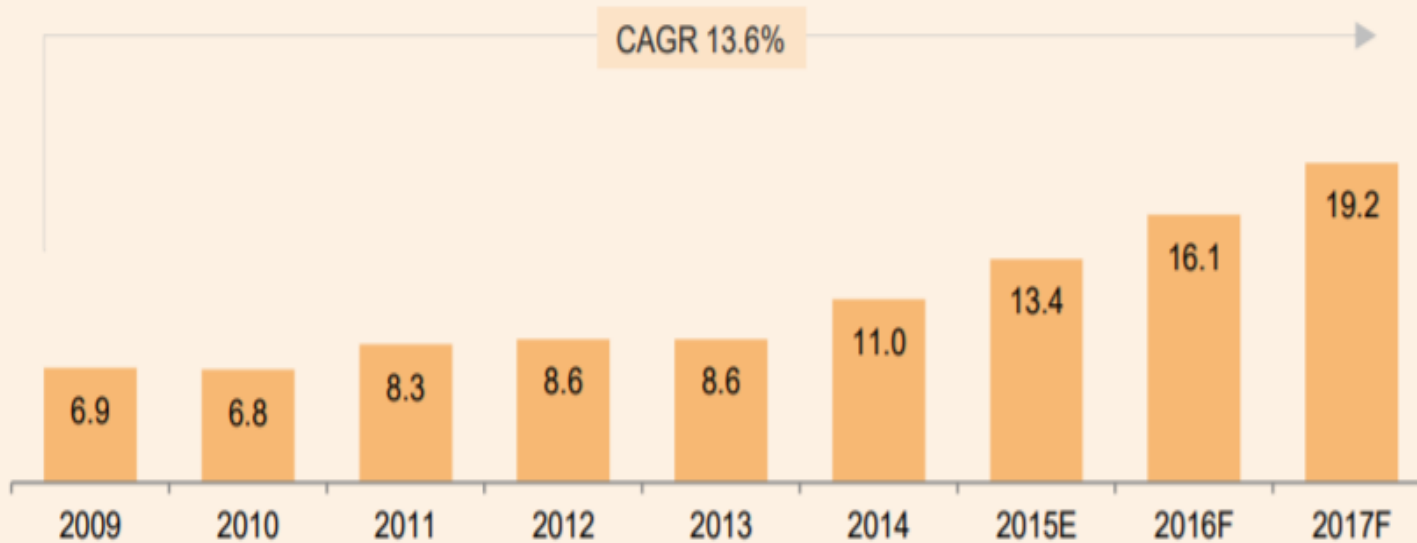


Transportation in India



Transportation in India

Roads/ Bridges Infrastructure Value (US\$ bn)



Note: E – Estimate, F - Forecast

- India has second largest road networks in the world, spanning a total of 5.5 million kilometres (kms). Production of commercial vehicles increased to 894,551 in 2017-18 from 567,000 in 2009-10 at a CAGR of 5.87 per cent.
- In May 2018, the Government of India signed US\$ 500 million loan agreement with World Bank to provide additional funding for construction of 7,000 km climate resilient roads out of which 3,500 km will be built using green technologies under Pradhan Mantri Gram Sadak Yojna (PMGDY)



Transportation in India

- Road transport is the most dominant mode of transport. Over 210 millions registered vehicles are on road in 2015
- They carry almost 85 percent of the country's passenger traffic and more than 60 percent of its freight.
- The density of India's highway network -- at 0.66 km of roads per square kilometer of land – is similar to that of the United States (0.65) and much greater than China's (0.16) or Brazil's (0.20).
- Rapid growth rate (10.5%) in automobile industry, annual production of over 4.6 million vehicles.



Transportation in India



- Third longest rail network in world transporting 19.8 million citizens daily and over 900 million tonnes of freight annually
- India has 128 airports, including 15 international airports. Indian airports handled 142 million passengers in 2010-11 and 1.6 million tonnes of cargo in year 2009-10.
- High population, rapid urbanization and availability of low cost vehicles increased use of personal and public transportation
- Poor fuel quality, poor vehicle maintenance and High use of personal vehicle due to insufficient public transportation system



Energy Consumption



- The primary energy consumption in India is the third biggest after China and USA with 5.6% global share in 2017
- The transport sector shares 7.33% consumption of total consumption for 2015-16
- Transportation is largest consumer of petroleum and shows 24.85 % growth rate of 2015- 16 over 2014-15



Transportation Policy



FAME India Scheme

- Adoption and Manufacturing of Electric /Hybrid vehicles

Automotive Mission Plan 2016-26 (AMP 2026)

- Strengthening of Automotive Industries
- Increase contribution of Automotive Industries in Indian economy by 2026

Voluntary Vehicle Modernisation/ End of Life Policy

- Control transportation emissions
- Ultimate aim is to replace old vehicles(polluting) by new (less polluting)

Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

- Improving urban transport

Smart Cities Mission

- Transportation Is key parameter in the development



Transportation Policy



Urban green mobility scheme 2017

(To promote use of hybrid/electric vehicles)

- Infrastructure development for bus system
- Safe Pathway, Cycling and Public Bike sharing
- Adopt hybrid/electric vehicles for public transport
- Development of renewable energy projects

National Urban Transport Policy 2014

(To promote a urban transport with low carbon path)

- Urban transportation - key parameter in city development
- To provide Public transport safe, user freindly, reliable public transport
- To promote walk and cycle safe mode

- Motor vehicles emission standards made in early 1990s
- UK, France has announced ban on sale of diesel and gasoline cars till 2040





Transport and Climate change



- Contributor to Greenhouse gases generation
- Contributes 21% of world energy-related CO₂ emissions
- Exceeded CO₂ natural level (180-300 ppm) and postulated that will be doubled at the end of this century
- Use of petrol and diesel, emits particulate matters affecting urban air quality
- SCLPs (black carbon, sulphate aerosols, ground level ozone, methane) are closely linked



Transport and Air quality



- Urban climate facing high air pollution (CO, SO₂, NO₂, PM and RSPM)
- Transport sector induces a high environmental concern
- CO is major pollutant from transport sector (contributing 90% total emission)
- The contribution for particulate matters emission is considerably lower than other sources (3-5%)

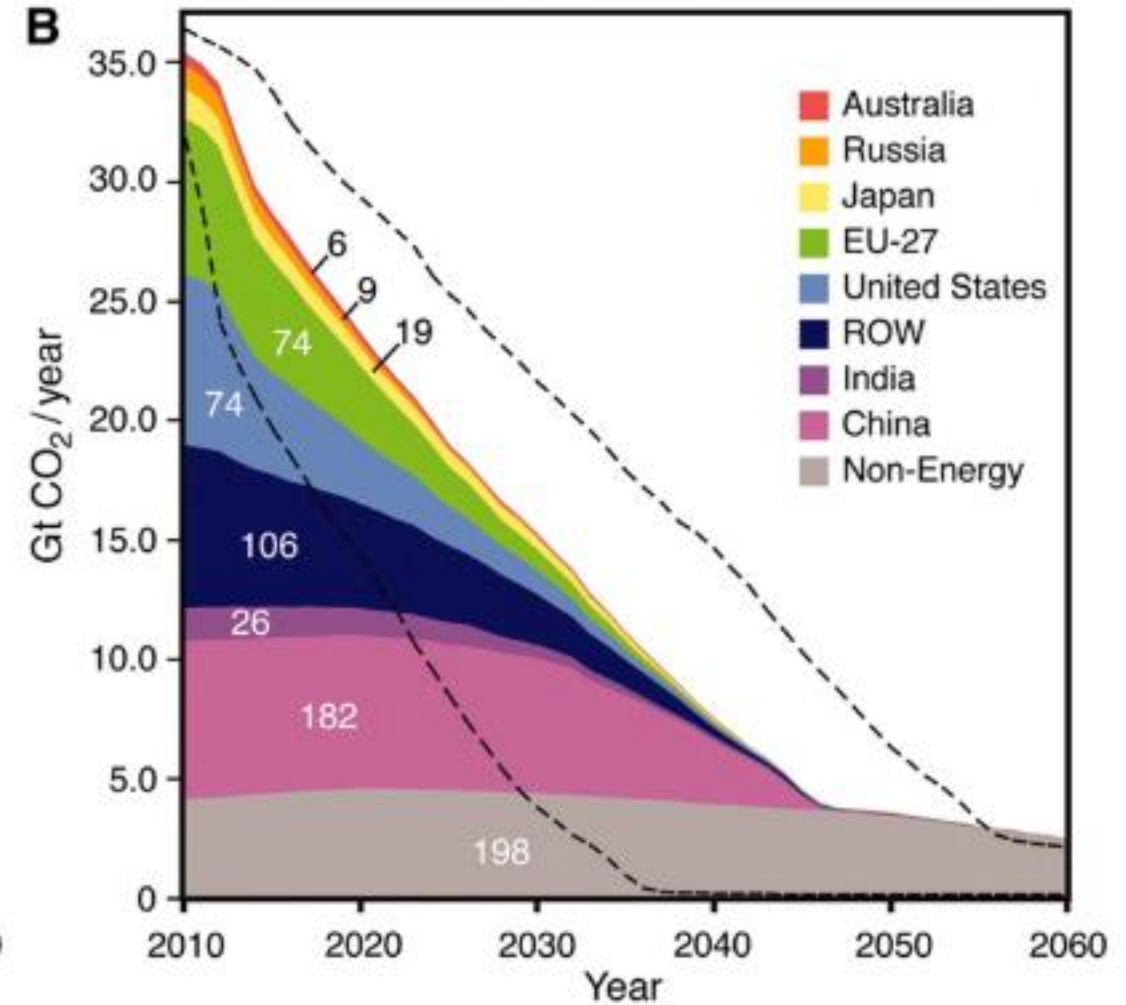
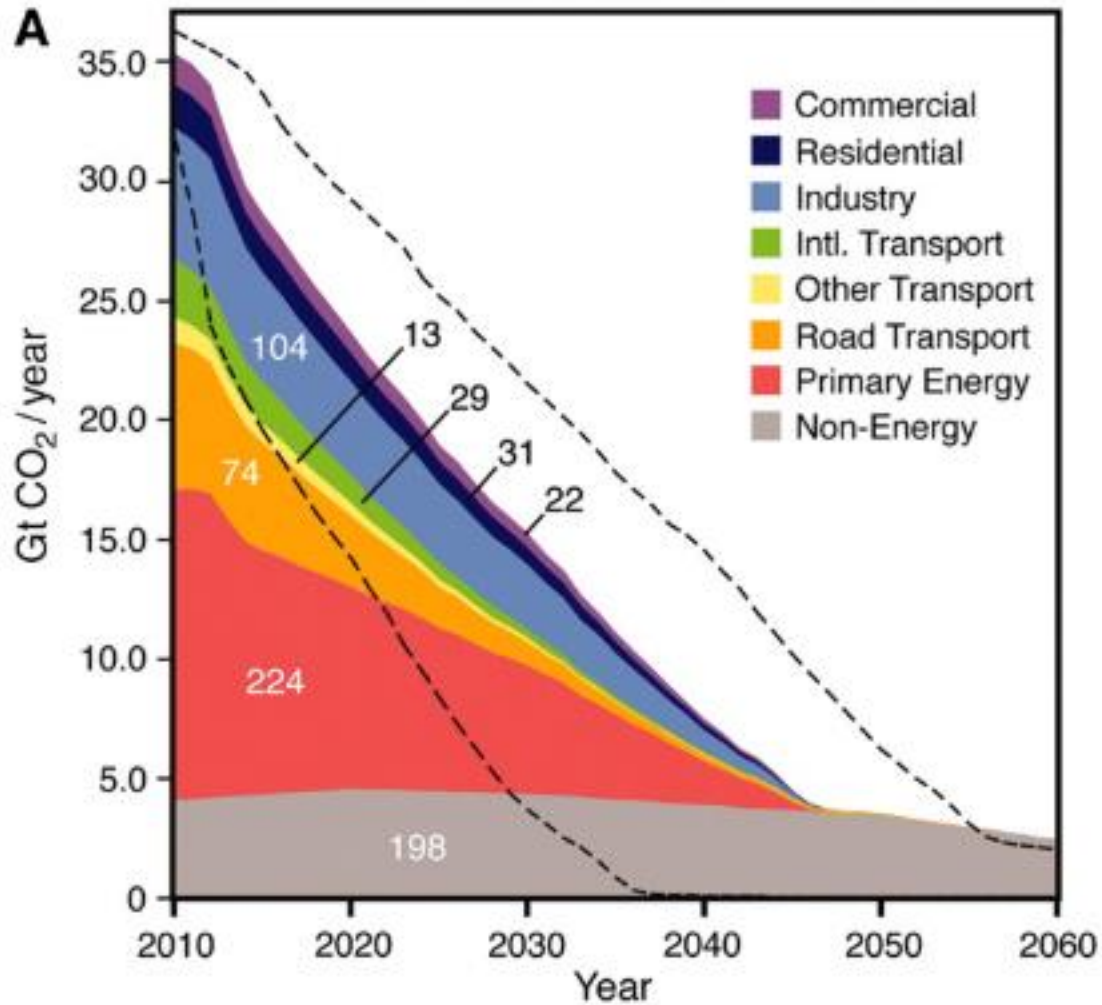


Emission of Greenhouse Gases



Purpose	GHG emission (%)
➤ Electricity production and Heat Generation	25
➤ Industry	21
➤ Transportation	14
➤ Other energy sources	10
➤ Agricultural, forest and land use	24
➤ Buildings	6

GHG Emissions and Transportation

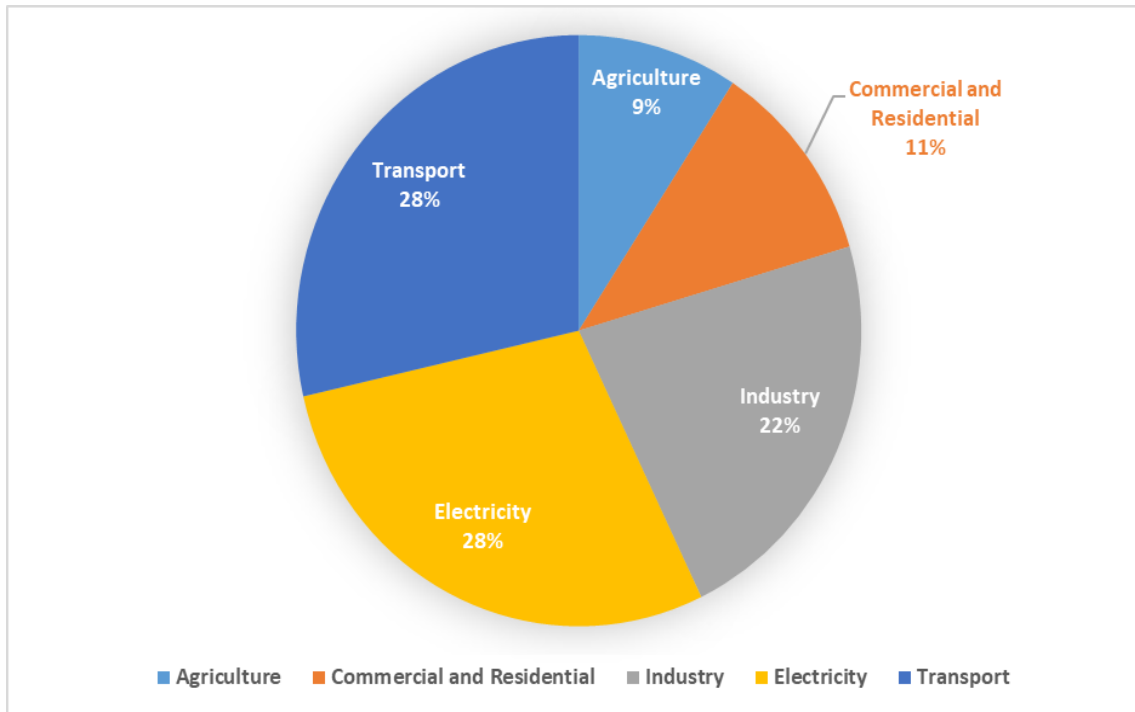




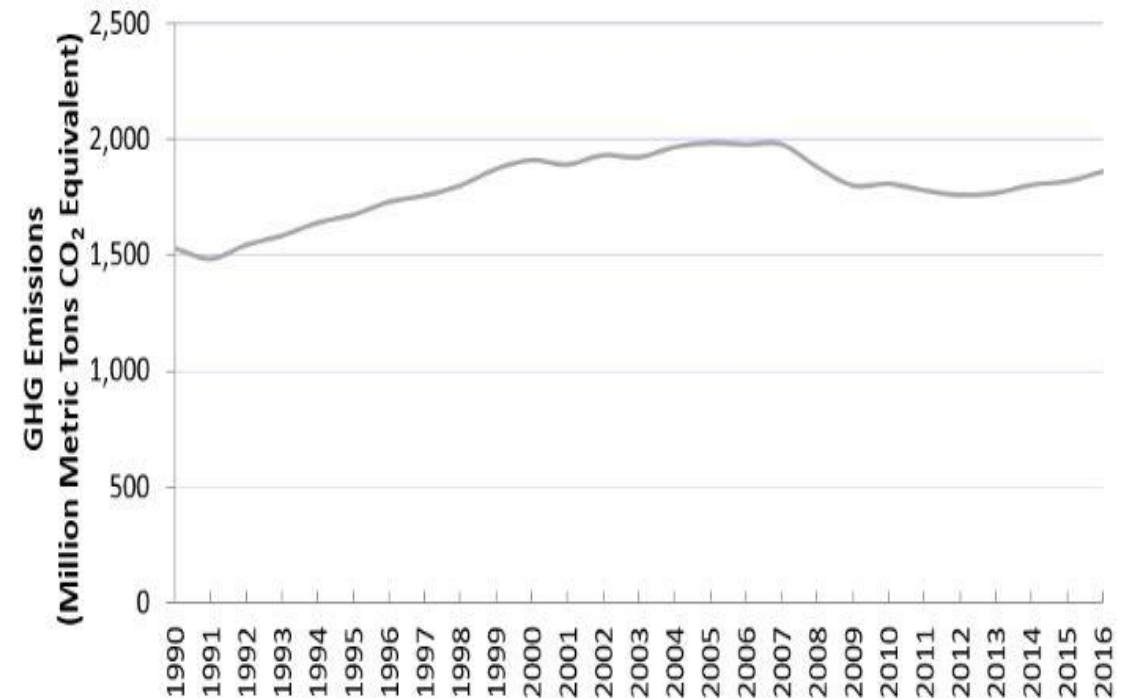
Greenhouse Gas Emissions



Total U.S Greenhouse Gas Emissions by Economic sector 2016



Greenhouse Gas Emissions from transportation ,1990-2016

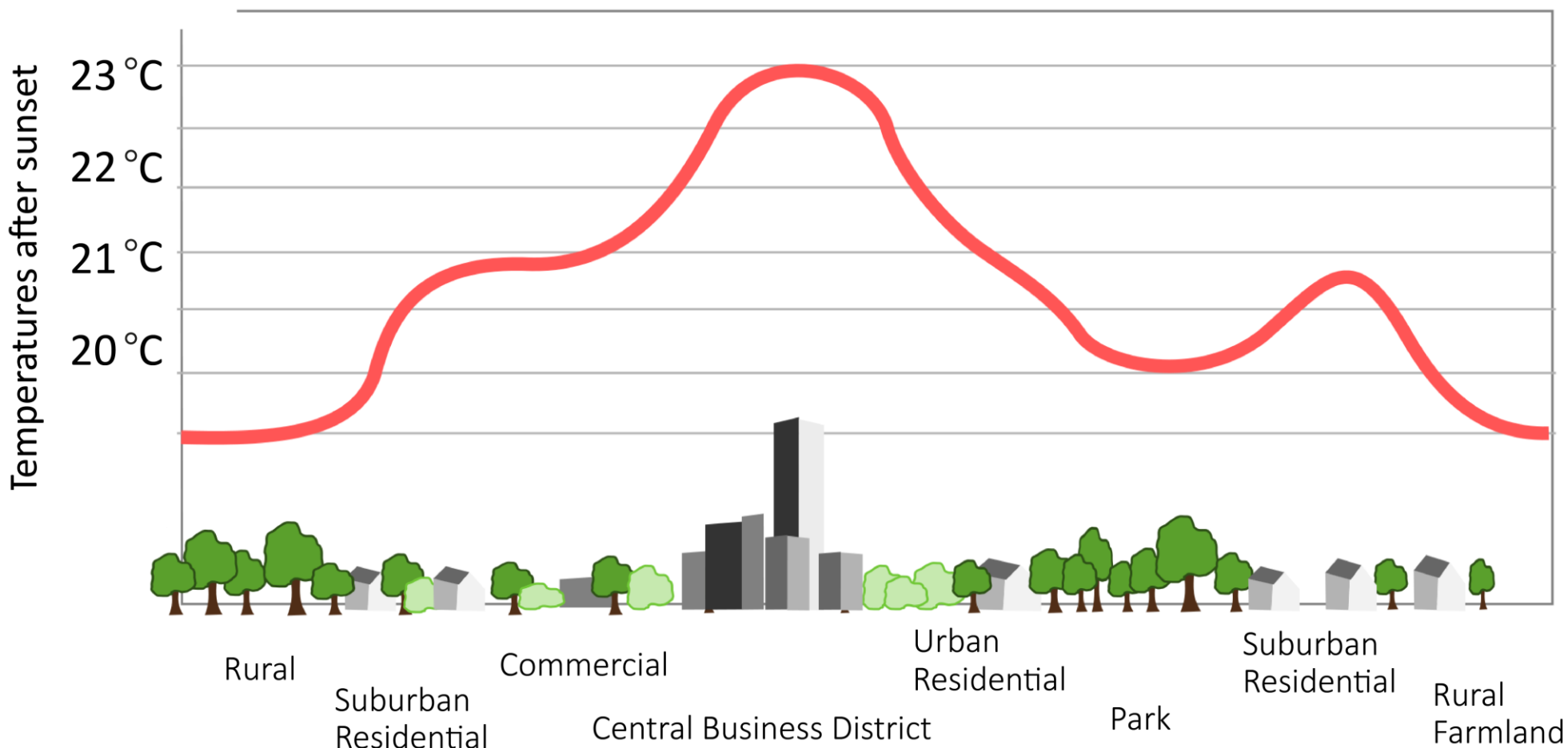


(Source: USEPA, 2018)

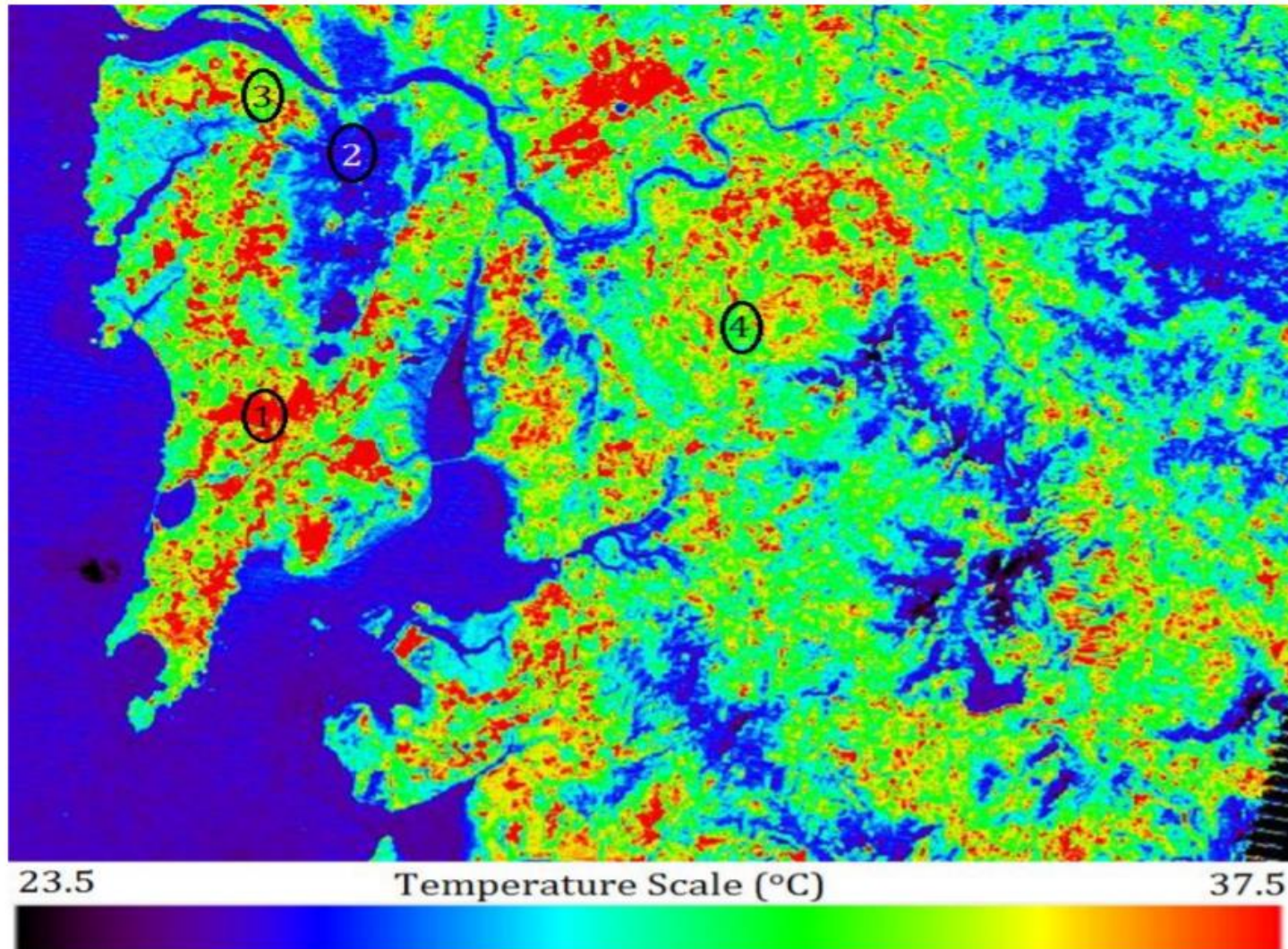


Urban transport also contributes to the formation of heat island

Urban Heat Island Profile



Urban Heat Island- Mumbai



Area	Temperature (°C)
Kurla Region	35.336
Sanjay Gandhi National Park	25.729
Outskirts of Mira Bhayandar	30.411
Kolegaon	29.749



Urban Heat Island- Contribution from Transport



Impact of Transportation on UHI

- Due to growth of fuel consumption increases air pollution, traffic congestion
- heat emission from vehicles

Impact of Pavement on UHI

- Solar reflectance of cement is 0.70 and reduces with time
- **Pavement shows Low Albedo** hence most of energy does not reflect back



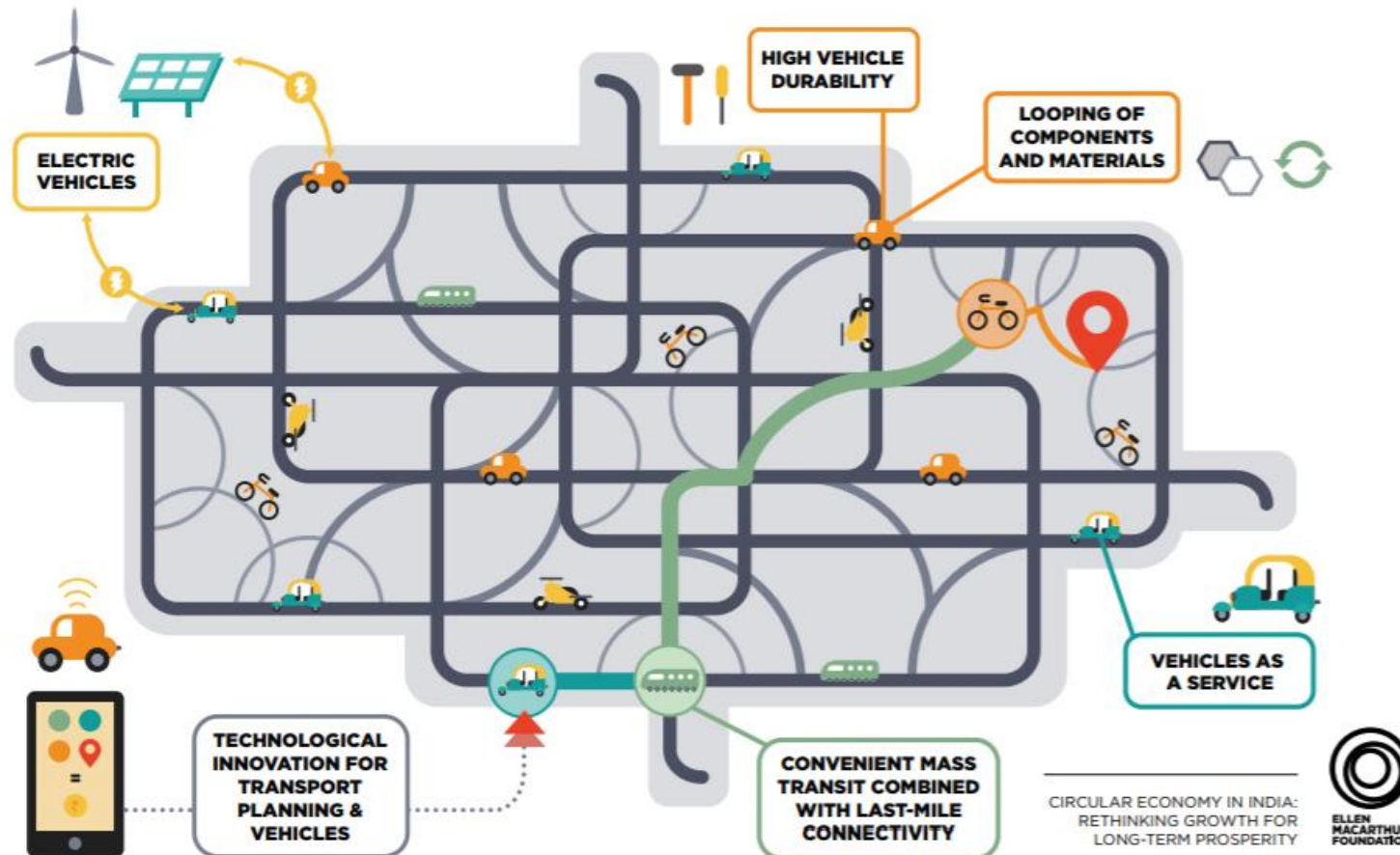
Pavements and UHI



- As per the study conducted in Bangkok shows albedo of asphalt and concrete pavements are low.
- Absorbs most part of solar radiation flux throughout the day, store the energy with respect to their heat capacity
- Released energy back to the lower atmosphere in contribution to the formation of urban heat islands.
- Descriptive statistics of asphalt pavement data showed the mean and standard deviation values of 0.045 and 0.002, respectively.
- The maximum albedo value was found to be 0.106 and there were 11 observations which had albedo value less than 0.02.
- These indicate that the observed asphalt pavements reflect on average only about 5% of the incoming solar radiation flux while the rest 95% was absorbed, stored, before released back to the lower atmosphere as heat.

Measures to Mitigate

- Applying concepts of Circular Economy: Short and circular networks, Pooling, Recycling





Measures to Mitigate



- Control of land use and city planning, restriction of high rise construction.
- Promoting transportation studies and plans for new roads and reorganization of the existing road network.
- Promoting public transport system.
- Removal of old vehicles from use
- Promotion pedestrianization in congestion city centers
- Use of technology like GPS and EVs to combat pollution locally



CSIR-NEERI has established a
Centre for Strategic Urban Management (C-SUM)
on 75th Foundation Day of
CSIR (September 26, 2016).

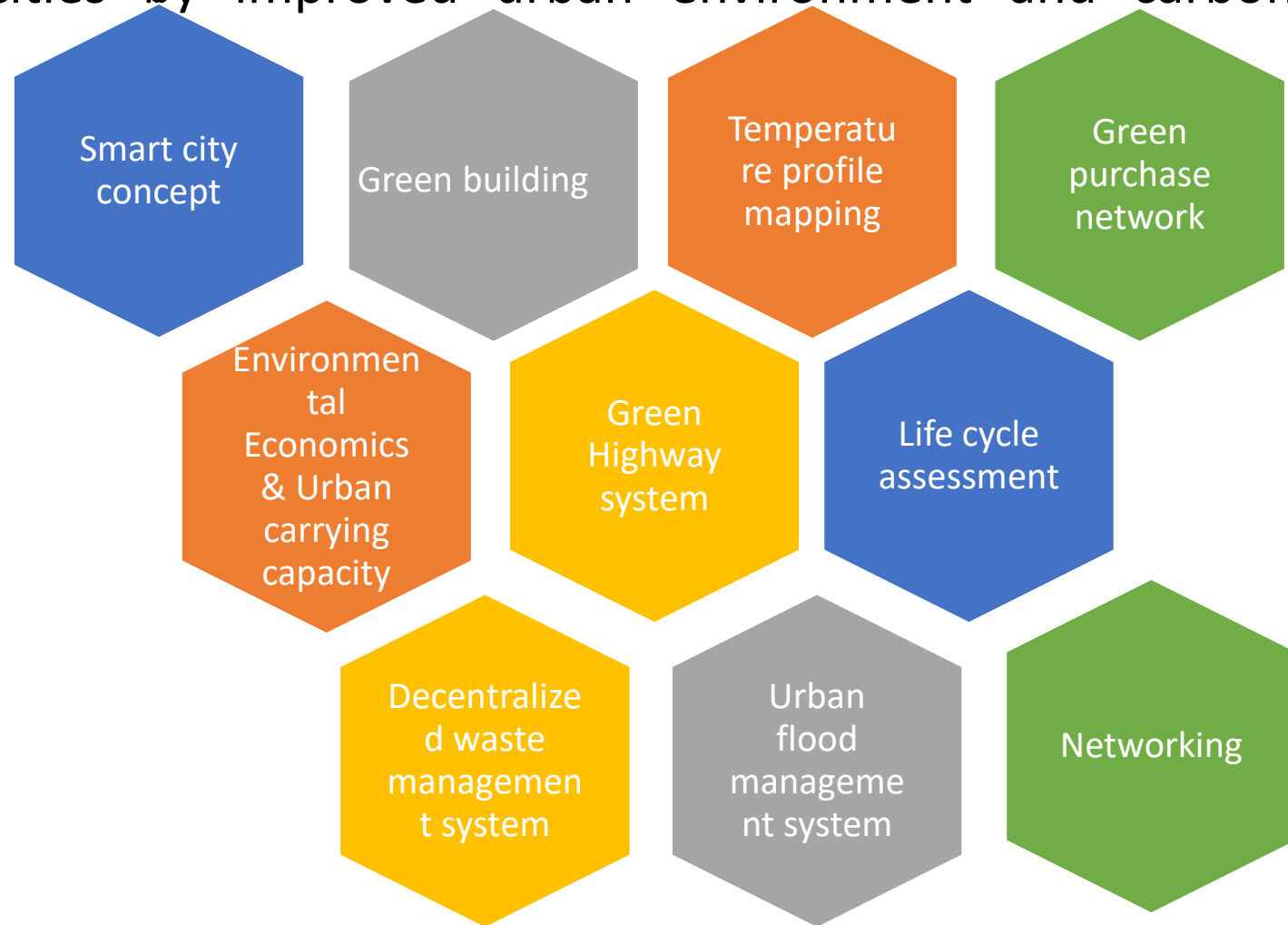


Centre for Strategic Urban Management (C-SUM)



- C-SUM aims to involve and interact with urban local bodies and stakeholders to help in building smart cities by improved urban environment and carbon reduction strategies.

Key Focus areas of C-SUM





Thank you

Email: director@neeri.res.in ; h.bherwani@neeri.res.in
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