

# GURUGRAM

## A FRAMEWORK FOR SUSTAINABLE DEVELOPMENT





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# 1 **Gurugram: The making of a sustainable city**

*The Guidance Framework for sustainable development of Gurugram takes the cue from a host of inspirations and sources, including the Sustainable Development Goals, the New Urban Agenda, ISO indicators, and national and state-level policies*

**G**urugram (erstwhile Gurgaon), a satellite town in the National Capital Region (NCR) and referred to as a ‘Millennium City’, is one of Haryana’s largest urban centres. It has experienced phenomenal growth – from a small population of 870,539 in 2001 to 1,514,085 in 2011. The current population of Gurugram is estimated to be close to 2.5 million and is expected to grow to 4.3 million by 2020. As the industrial and financial centre of Haryana, this city has witnessed the third largest increase in per capita incomes in India (after Chandigarh and Mumbai). Almost 45-48 per cent of Haryana’s revenue accrues from Gurugram by way of excise duty, sales tax, stamp duty and registration. This is the hub of the prolific and massive real estate development that is happening in the state today.



Vikas Choudhary / CSE

**Gurugram's population, 2.5 million today, will become 4.3 million by 2020. The township has seen India's third largest jump in per capita incomes, and contributes to 48 per cent of Haryana's revenues. This explosive growth brings in its wake concerns about sustainability**

Naturally enough, this explosive growth has brought in its wake concerns around sustainability. The question being asked is how can economic and social development be achieved without harming the environment, while improving the overall quality of life and well-being of urban dwellers. This *Guidance Framework* – prepared by Centre for Science and Environment (CSE) and Gurgaon First under the aegis of the Municipal Corporation of Gurugram – attempts to answer this: We believe it is possible to protect our air, water, soil, biodiversity and forests; promote sustainable mobility; and improve the living conditions of the poor even while meeting the needs of development, growth and poverty reduction. Effective intervention at the early stages of growth can be preventive, precautionary and cost-effective.

The *Guidance Framework* offers an action agenda for Gurugram to meet the sustainable development goals, by enabling greater efficiency in resource use; conservation of water, energy, materials and biodiversity; recycling and minimisation of waste and pollution; and allowing equitable access to resources. These integrated targets are designed to achieve the objectives of Sustainable Development Goals (SDGs) and the New Urban Agenda. They reflect the key guiding principles of both national and state-level policies related to resource efficiency and savings, and have drawn upon the lessons from best practices.

**Setting the context: The Sustainable Development Goals**

The *Guidance Framework* has integrated the key principles of the SDGs which were enshrined in *Transforming our World: The 2030 Agenda for Sustainable Development*. These are a set of 17 'Global Goals' with 169 targets that have been developed under the aegis of the United Nations. On September 25, 2015, the 194 countries of the UN General Assembly adopted the 2030 Development Agenda. These include ending poverty and hunger, improving health and education, making cities more sustainable, combating climate change, and protecting oceans and forests.

**Key SDGs related to sustainable urbanisation**

The United Nations' Sustainable Development Goals (SDGs) lay down some guiding principles for urban planning, design and management, which have to be met by 2030. These are as follows:

**GOAL 11.6:** Reduce adverse per capita environmental impact in cities. This seeks special attention to air quality and municipal and other waste management. Air pollution and public health finds a mention in SDG-3 (Health) and SDG-11 (Cities).

**GOAL 3.9:** Reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.

**GOAL 3.D:** Strengthen the capacity for early warning, risk reduction and management of global health risks.

**GOAL 11.2:** Envision that there should be safe access to affordable, accessible and sustainable transport systems for all in cities, by improving and expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.

**GOAL 11.3:** Aim for inclusive and sustainable urbanisation and building a capacity for participatory, integrated and sustainable human settlement planning and management.

**GOAL 11.b:** Envision cities and human settlements to adopt and implement integrated policies and plan towards inclusion, resource efficiency, mitigation and adaptation to climate change, and resilience to disasters.

**GOAL 9.4:** Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes.



The Government of India has adopted the SDGs to stimulate, align and accomplish action by 2030 in areas of critical importance. The SDGs are being integrated with the Central policies and schemes. State governments are also aligning their visions and plans with the Goals for implementation. Out of the 17 Goals, several have a direct bearing on sustainable urbanisation (see Box: *Key SDGs related to sustainable urbanisation*). This is an important opportunity to shape local action agenda to achieve sustainability in Gurugram. The *Guidance Framework* has, therefore, kept within its purview the key SDGs related to sustainable urbanisation.

### **The New Urban Agenda**

In 2016 came the New Urban Agenda – the global vision of sustainable urbanisation, an outcome document of UN Conference on Housing and Sustainable Urban Development-UN Habitat III. This Agenda recognises urban spaces and cities as the focal points of development, and is linked with social inclusion, accessibility, urban prosperity and safe and affordable housing. India has now been elected the president of UN-Habitat to steer the process of the New Urban Agenda.

In October 2016, India’s minister of housing and urban poverty alleviation, Venkaiah Naidu presented the ‘India Habitat III-National Report’ at the UN Conference in Ecuador, detailing the Indian government’s commitment towards the sustainability agenda. The key actions listed includes reducing water and electricity use by 50 per cent; enabling over 60 per cent of urban travel by public transport; generating half the power from renewable sources; promoting walking and cycling for last mile connectivity; compact and cluster urban development; promoting natural drainage patterns; reducing waste generation of all kinds; promoting greenery and public places; and construction of houses for the urban poor. The UN Habitat III talks about the “Right to City” – indicative of a collective right of all inhabitants, irrespective of their legal status, over the city’s resources and space. This is an integral part of sustainability.

### **ISO indicators for sustainable city**

This *Guidance Framework* has also taken cognizance of the international benchmark – the ISO indicators for sustainable city development – for delivery of high quality services to citizens.

For city sub-systems to operate efficiently, standards for urban planning, transport, affordable housing, water supply, sanitation, sustainable environment and pollution management are essential. ISO 37120 – published in 2014 by ISO’s Technical Committee 268 – was the first set of ISO standards on Global City Indicators. It defined performance indicators to set benchmarks for city services and quality of life: 100 indicators were developed around 17 themes.

Several state and local governments – including that of Gurugram – have begun referring to these set of indicators for effective planning.

### **Guiding principles of national and state policies**

The *Guidance Framework* has integrated and aligned with a wide gamut of Central and state-level policies related to resource conservation and efficiency, waste management and recycling, pollution and mobility management, energy efficiency and renewable energy, and environment clearance requirements and protection of biodiversity. It has also adopted elements of best practices for maximum impact.

**The New Urban Agenda recognises urban spaces and cities as the focal points of development, and is linked with social inclusion, accessibility, urban prosperity and safe and affordable housing**

The Government of India has already adopted policies that have a strong bearing on local action. These include the smart city programme; renewable energy targets and solar city provisions; the National Urban Transport Policy; National Habitat Standards; Transit-oriented Development Policy; decentralized environmental clearance procedure for buildings; the Energy Conservation Building Code; National Forest Policy and Forest Conservation Act; air quality standards and regulations; the National Climate Action Plan; the solid waste management rules and regulations; construction and demolition waste rules and regulations; and the water policy. Several of these interventions are backed by legislation to make them legally binding.

Following the 2016 amendment of the environment impact assessment rules by the Union ministry of environment, forests and climate change, environmental clearance for buildings has been devolved to municipal agencies. This is an opportunity to legally integrate the sustainability criteria with local building bye-laws to ensure implementation at scale. This is supported by the Model Byelaws 2016 of the Union ministry of urban development.

At the state level, the Government of Haryana has taken steps to enact its own laws and policies to translate several goals into action on the ground. These include the Haryana Non-biodegradable Act, 1998; Haryana State Urban Water Policy, 2012; the Solar Power Policy, 2014; notifications on solar water heating and street lighting; and the Haryana Municipal Corporation Act, 1994 (see *Annexure: Policies and regulations in Haryana that have a bearing on resource efficiency, savings and conservation*).

Thus, a wide gamut of policies, rules and regulations have created a legal mandate for sustainability and a foundation for future action.

The NCR, including Gurugram, has also been the focus of environmental action. Several court rulings by the Supreme Court, the High Court of Punjab and Haryana and the National Green Tribunal have defined a set of interventions to reduce air and water pollution and protect groundwater and forests. One such significant ruling has resulted in the Graded Response Action Plan that has notified a series of measures to check air pollution, based on daily air quality. A comprehensive action plan is now in the making under the Supreme Court's direction – the plan will identify short- and medium-term measures for each pollution source in the region.

Besides this, there are directives from the High Court of Punjab and Haryana related to the protection of forests and the use of groundwater in the construction industry.

This *Guidance Framework* will integrate the key directives and ongoing action to make this action agenda comprehensive.

#### **The way ahead**

The *Guidance Framework* is expected to harmonise and integrate the multi-sectoral action agenda, to comprehensively guide the future steps in Gurugram. Specific sectoral targets and strategies have been identified for each area of intervention.

This is an opportunity for multi-stakeholder participation for implementation. Gurugram is uniquely managed – the responsibility is shared by the Municipal Corporation of Gurugram, the Haryana Urban Development Authority (HUDA),

**The Government of Haryana has taken steps to enact laws and policies to translate several goals into action. These include the Haryana Non-biodegradable Act, 1998; Haryana State Urban Water Policy, 2012 and the Solar Power Policy, 2014**

private developers and resident welfare associations. The township is divided into old Gurugram (municipal limit area) and the HUDA areas that also include the industrial hub of Udyog Vihar. The state government and the local urban body are primarily responsible for implementation of the sustainability agenda. Haryana was the first state to adopt a policy on public-private partnership for urban development and enhancement. Formal private sector involvement and development was enabled by the Haryana Development and Regulation of Urban Areas Act of 1975. Private developers, who have a significant role as a partner in development, are responsible for several services within their built areas. If resource conservation and efficiency measures are integrated with their plans, it can make a significant difference.

The newly created Gurugram Development Authority (GDA) will be the key nodal agency; based on the notified Master Plan and defined parameters for standards of living, the Authority will prepare an infrastructure development plan for Gurugram that is also participatory. The plan will guide annual investments in infrastructure such as roads, water supply systems, sewerage, stormwater drainage systems, public transportation, traffic management and other urban amenities. The plan will include increasing the area under green cover, water conservation, wastewater treatment, water recycling, rainwater harvesting, energy conservation, adoption of renewable sources of energy, and provision of open spaces and city parks.

Gurugram's policies and laws also mandate developers to transfer the responsibility of maintenance to resident welfare associations (RWAs). The RWAs can also take voluntary action to adopt several resource-saving measures at the household and community levels; these, when scaled up, can help achieve the sustainability goals. With increasing public awareness, the resident groups can adopt wide-ranging sustainability measures that can be implemented at the building level or residential complex level to reduce the impacts of a resource-guzzling lifestyle.

This *Guidance Framework* and action agenda underscores that each of these stakeholders has a shared responsibility to deliver on the sustainability goals. It is, therefore, important to put in place an institutional process for coordinated strategy for implementation of the guidelines and action agenda to enable attainment of sustainability goals in a time-bound manner. This includes short, medium and long term action. The environmental sustainability will ensure inclusiveness and equity.

**The Guidance Framework offers an action agenda for Gurugram to meet the sustainable development goals, by enabling greater efficiency in resource use; conservation of water, energy, materials and biodiversity; recycling and minimisation of waste and pollution; and allowing equitable access to resources**



## 2 The sustainability challenges of a Millennium City

Gurugram faces an overwhelming challenge in the sheer urban explosion – along with aspirational pressures – that it is witnessing. This is triggering immense environmental and sustainability concerns. If not addressed at the early stages of growth, it can incite massive resource-guzzling with serious environmental and public health consequences. Mitigation will require appropriate regulations, codes, good monitoring and oversight, and public awareness. It will also require deeper understanding of the challenges across sectors of resource use, waste management and public health risk reduction in the city. But such an analysis is often constrained by the limited information and data in the public domain.

However, the available data, though limited, does help to indicate the challenges that Gurugram faces today.

## WATER

*The challenge: Providing clean and safe water to all; ensuring available water is used efficiently, and is distributed equitably*

Gurugram stares at a serious water crisis. With rapidly growing urban water demand, the township is failing to meet the established norms and indicators for a host of issues and concerns – per capita supply, quality, duration of supply, water pressure, groundwater levels, water infrastructure and equity of access.

Gurugram gets its water from the Yamuna river's Tajewala headworks near Yamunanagar. The Public Health and Engineering Department (PHED) is responsible for supplying water to the old city area (municipal limits), while HUDA supplies to the new city. The HUDA sectors receive water directly from the Authority; the PHED gets bulk water transfers from HUDA for supply in the old city limits.



Chinky Shukla / CSE

The supply system is designed to carry about 245 million litres a day (MLD) at its head at Kakaroi village. But about 50 per cent of this water is lost through evaporation and diversion to villages and a township *en route*. Result: The river manages to meet only 30 per cent of Gurugram's water needs. About two-thirds of residents have access to piped water, but the supply is irregular. Due to the gap in demand and supply, 70 per cent of residents – including a sizeable number of those with piped water connections – depend on groundwater.<sup>1</sup>

The gap between official demand and supply is estimated to be about 42 per cent.<sup>2</sup> According to an earlier estimate by CSE in 2005-06, Gurugram's water demand was expected to increase by 34 per cent by 2011 – which could lead to a further demand-supply gap of about 57 per cent. Based on these calculations, the city would have had to increase its supply substantially to meet this jump. The challenge is how to augment local sources of water to build water security. Deeper understanding of the water stress will help to further calibrate the action agenda.

### Groundwater blues

Gurugram is vulnerable to groundwater overuse and contamination. The average extraction rate from aquifers exceeds the average recharge rate. Even though rain is the most important source of recharge, sufficient harvesting and holding capacity has not been created to catch every drop of rainwater in the township. Much of the rain that is received, gets drained away quickly.

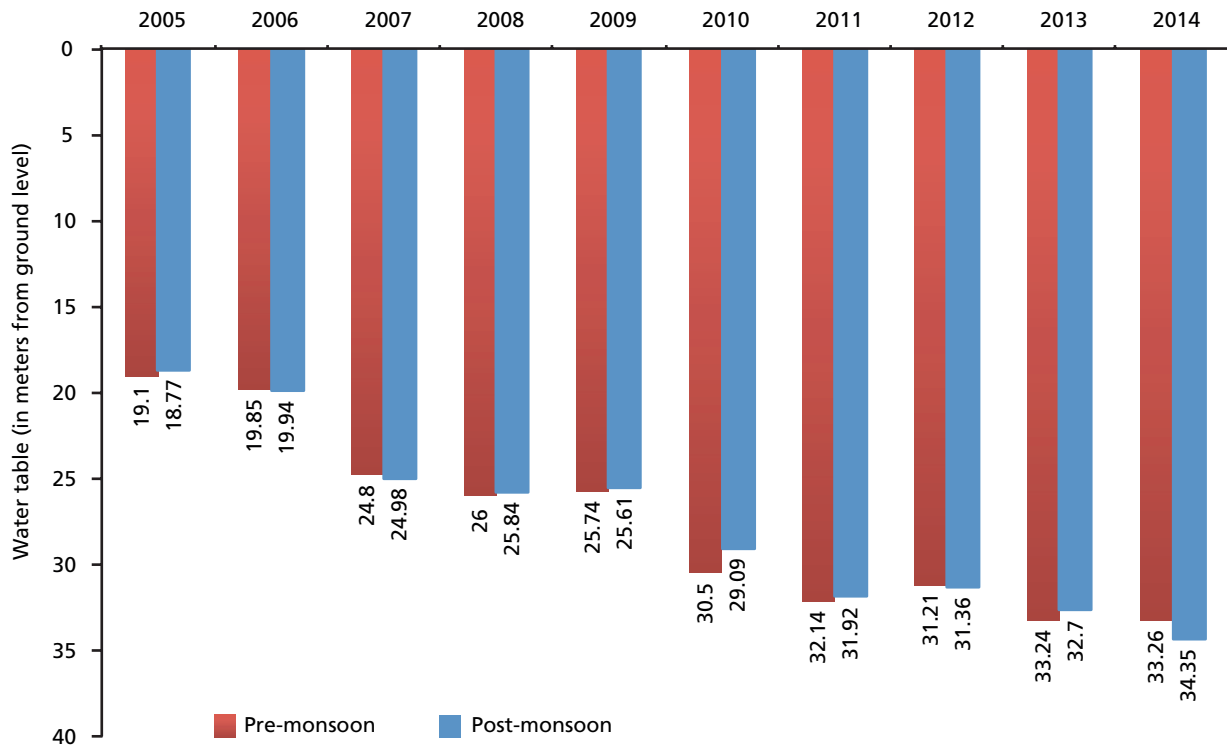
There is large-scale extraction of groundwater through private tubewells to meet both residential and commercial requirements, including for building construction projects. Gurugram's water table has fallen rapidly since it started expanding in the 1980s. While there is no recent data, Mission Gurugram Development has estimated that there could be 30,000 bore wells in Gurugram alone, with half of them without a legal sanction. An earlier estimate by CSE in 2006 had shown that the water table had dwindled to as low as 40 metre below ground level (m bgl) in the low-lying areas.

According to the Central Ground Water Board (CGWB), the water level in Gurugram has dropped from 43 m bgl in 2003 to 51 m bgl in 2006. Unchecked use of groundwater in the city has resulted in water table falling at a rate of 1-3 metres a year. According to the groundwater cell of the Agricultural Department, between 2005 and 2014, the water table has dropped by 74 per cent (*see Graph 1: Depleting water table in Gurugram (in meters below ground level) – 2005 to 2014*). According to one estimate, the city needs 184 MLD of water. The net supply by the municipality does not meet even half of this demand. The CGWB has warned that once the water table dwindles below 200 m, only rocks will be left.

Way back in 2000, the Central Ground Water Authority (CGWA) under the Union ministry of water resources had issued the following directions under Section 5 of the Environment (Protection) Act, 1986: “*No person / organization / agency shall undertake the operation of drilling, construction, installation of any structure and any scheme / project of groundwater development and management in Gurugram town and its adjoining industrial area, without prior specific approval of the Authority.*” It had also directed municipal authorities to register all existing groundwater abstraction structures. According to an earlier estimate of Jamia Milia Islamia University, Gurugram consumes around 30,000 hectare meters of groundwater every year, above the yearly cap of 20,000 hectare meters.<sup>3</sup>

**Gurugram's supply system is designed to carry about 245 million litres a day (MLD) at its head at Kakaroi village. But about 50 per cent of this water is lost through evaporation and diversion. Result: The river manages to meet only 30 per cent of Gurugram's water needs**

**Graph 1: Depleting water table in Gurugram (in meters below ground level) -- 2005 to 2014**



Source: Groundwater Cell, Agricultural Department, Gurugram

In July 2012, the Punjab and Haryana High Court restrained licenses for new constructions and renewal of license for old projects unless the project developers gave an affidavit that they will not use groundwater for any construction activities. The Court also directed builders to start using recycled treated water from government sewage treatment plants. According to the estimates of Gurgaon Citizens’ Council, builders illegally extract as much as 50 million gallons per day for construction.

Gurugram’s groundwater is also polluted: it contains high concentrations of nitrate and fluoride. This area has naturally occurring fluoride-bearing minerals in its rock strata. This puts at risk people who depend on wells and tankers that supply untreated groundwater. Aquifers are additionally contaminated by excessive and unscientific exploitation of groundwater, agricultural and industrial activities in the vicinity, poor sanitation, inadequate septage management and solid waste disposal. The Aravalli hills, responsible for one-third of the recharge, are also under severe environmental stress.

To ensure long-term sustainability of water sources for the city, rainwater harvesting is a simple and effective solution. It can be done using roads, roundabouts, parks, rooftops, paved areas – almost the entire city. A lot can be achieved by recharging the deep, confined aquifers and by storing water in tanks or ponds and water bodies.

According to a study by CSE, Gurugram has lost around 137 of its water bodies. It is projected that rejuvenation of some of the key water bodies and ponds can help Gurugram meet about 50 per cent of its water needs. The Ghata Jheel alone



has the potential of storing 12 billion litres – but only if its catchment is treated and encroachment is prevented. Village ponds can hold another 90 million litres. If a part of Aravalli is protected as a water sanctuary, it can harness yet another 21.6 billion litres. Such measures can contribute significantly to local water security in Gurugram.

## SEWAGE

***The challenge:*** *Water-intensive excreta disposal leading to pollution; sewage from areas unconnected to sewer lines dumped, leading to more contamination; unscientific management and ineffective treatment*

**G**urugram’s urban boom is riding high on flush toilet systems and water-intensive discharge pathways for excreta. This has become a source of water pollution and contamination, with serious risks to public health and water bodies. But there are also parts of Gurugram that are not connected to sewer lines; faecal sludge from these areas is usually physically disposed by dumping on land or into water bodies, causing more contamination.

Estimates of how much sewage Gurugram produces vary. One set of data says the city generates about 225 MLD of sewage, and its treatment plants can process only 148 MLD. In 2007, the official estimate put the quantum of sewage generation at 129.6 MLD while the Joint Association of Federation of Residents Welfare Associations (JAFRA) estimated it to be about 260 MLD. The official forecast for the year 2021 projects sewage generation of 533 MLD, but JAFRA projects a figure of 864 MLD.



Vikas Choudhary / CSE

The official forecast for the capacity to treat sewage is only 255 MLD – close to half of the official estimate and only 30 per cent of the unofficial estimates of actual quantum of sewage generation. This threatens to drown the city in sewage.

Around 79 per cent of the city's population is covered by the sewerage network, which is 502 km long and comprises of 200 mm dia and 900 mm dia pipes and two pumping stations. Gurugram has three sewage treatment plants (STPs), two of which are under HUDA and mainly treat the wastewater generated in the HUDA sectors. These plants are maintained by private agencies. Some of the sewage generated in 37 villages of MCG is also disposed into the main HUDA sewer line and hence, is treated in these STPs.

The sewage generated in the old city area is sent to the third STP owned and operated by the MCG.<sup>4</sup> According to the Corporation, the current water supply to the old city area is around 71.96 MLD, which implies that the area generates around 57.6 MLD of sewage. This sewage goes to two sewage pumping stations, from where it is pumped to the 30-MLD STP located across the railway line in Dhanvapour village. This STP was commissioned in the year 2000 and is currently overloaded – it disposes about 42 MLD of sewage.<sup>5</sup>

The condition is poor in the neighbouring villages. The daily sewerage generation is around 61 MLD, and only 31 MLD is sent to the HUDA STPs for treatment. The situation is better in the HUDA area (HUDA sectors and Real Estate Developer Area). The combined capacity of the two HUDA STPs (one located in Behrampur and the other in Dhanvapour) is 168 MLD; the HUDA area generates only 39 MLD of sewage – hence the STPs are treating additional sewage generated in the 37 villages of MCG.

Some of the new colonies in Gurugram remain either unconnected or partially connected to the main line; for example, just about half of the total DLF area is connected at present. The PHED is responsible for the old city area (municipal limits), and claims that about 80 per cent of the population in the old city is connected to the official sewerage system. The sewage collected is drained into the Khost drain along the Sohna road, which flows into the Najafgarh drain in Delhi, and finally into the Yamuna.<sup>6</sup> The Najafgarh drain, which carries both treated and untreated residential as well as industrial effluent, is highly polluted and is a potential source of groundwater contamination.<sup>7</sup>

The quality of water treatment is also a challenge. Random samples tested by the Haryana State Pollution Control Board (HSPCB) from the outlets of the STPs have raised doubts about the efficiency of treatment. In March 2012, the HSPCB had sent a notice for poor maintenance of treatment systems. While testing the samples, the Board found aqueous pollutants at 182 milligrams per litre, while the average for municipal sewage after a three-stage treatment process should be 20 milligrams per litre or less! Moreover, the water that is treated is wasted as it is drained out through dirty drains and is not reused within the city. The Board also noted that sewage is often allowed to bypass the plants, especially during the rainy season.

Private developers of apartment complexes and commercial parks have provided waste-treatment services in some complexes. Once the waste is treated, tanker trucks transport the waste to the Yamuna river or the treated effluents are disposed off into an unlined drain which travels about 8 km to meet the Najafgarh drain in Delhi. Some amount of the sewage that remains uncollected

**The official forecast for the capacity to treat sewage is only 255 MLD – close to half of the official estimate and only 30 per cent of the unofficial estimate of actual quantum of sewage generation. This threatens to drown the city in its own sewage**

gets accumulated at various places creating cesspools that percolate into the ground. Sewage from the surrounding rural areas is released in stormwater drains, including the Chakkarpur Nallah and Badshahpur Nallah.

There are also serious concerns around faecal sludge disposal in areas that are not connected with sewer lines. Toilets in these areas are connected to septic tanks or pits and the sullage or effluent is often discharged into road-side stormwater drains. Fecal sludge also often ends up in garbage dumps, water bodies or is used in agriculture – making it a source of serious health hazard.

There is an urgent need to carry out a thorough mapping of the entire network system, reassess sewage loads, perform hydraulic modelling and determine measures for augmenting the capacity. Two new STPs are coming up in Dhanvapour – an 100-MLD and a 68-MLD plant under HUDA. Besides, the MCG is ready to commission another new 50-MLD STP at Dhanvapour.

Additionally, a proposal for upgradation of the existing 30-MLD STP to 80 MLD capacity is under active consideration. For sewage management of its 37 villages, the MCG has adapted a decentralised approach under which around 17 stand-alone small scale STPs, along with augmentation of the sewerage distribution system, has been proposed.<sup>8</sup>

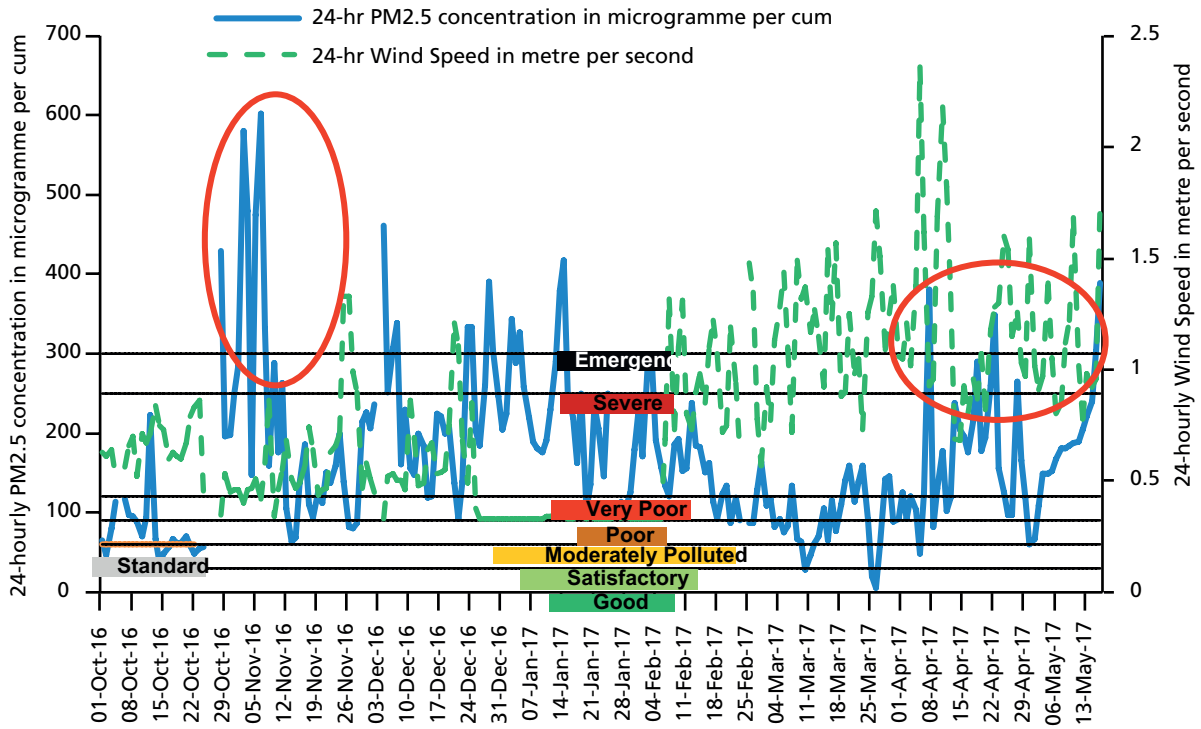
## AIR POLLUTION

**The challenges:** Gurugram is now one of the most polluted cities in the NCR. The challenges are explosive growth in vehicle fleet; massive use of diesel guzzling vehicles and generators; and sharing the toxic air shed of Delhi

Gurugram shares the challenges of a common air shed of the NCR, a region which is land-locked and extremely vulnerable to trapping of toxic air. There is only one real time air quality monitoring station in the office of the HSPCB – but it is not a representative site. Available data shows the air pollution level is very severe during winters when the wind speed is low and PM<sub>2.5</sub> levels are usually seven to nine times the standard (as opposed to three to four times during summers). According to the national air quality index (AQI), the number of days in ‘severe’ and ‘emergency’ categories increases during winters (see Graph 2: Trends in PM<sub>2.5</sub> levels in Gurugram -- October 1, 2016 to May 1, 2017); Graph 3: Categorisation of PM<sub>2.5</sub> on the basis of AQI categories for Gurugram; and Graph 3: Categorisation of PM<sub>2.5</sub> based on AQI categories -- April 19 to May 16, 2017). Moreover, the analysis of air quality data for the months of April and May 2017 shows that air pollution levels in Gurugram are among the worst in the whole of NCR.

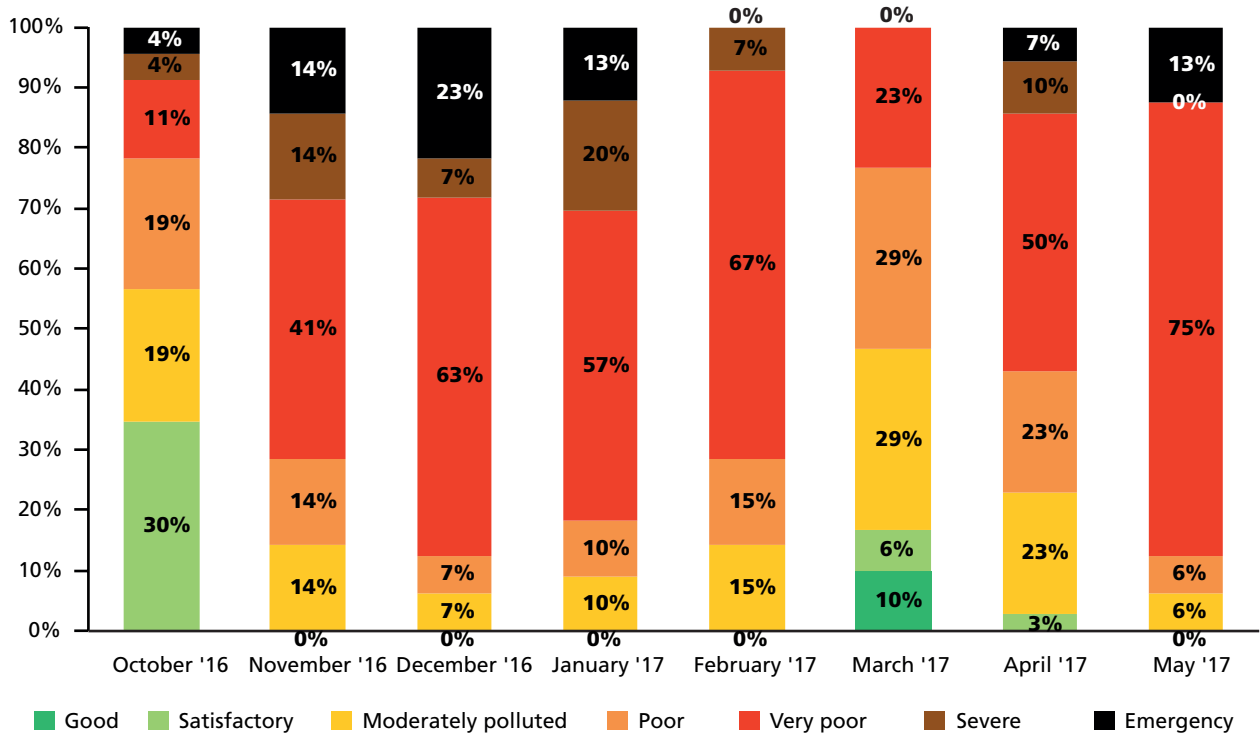


**Graph 2: Trends in PM2.5 levels in Gurugram – October 1, 2016 to May 1, 2017**



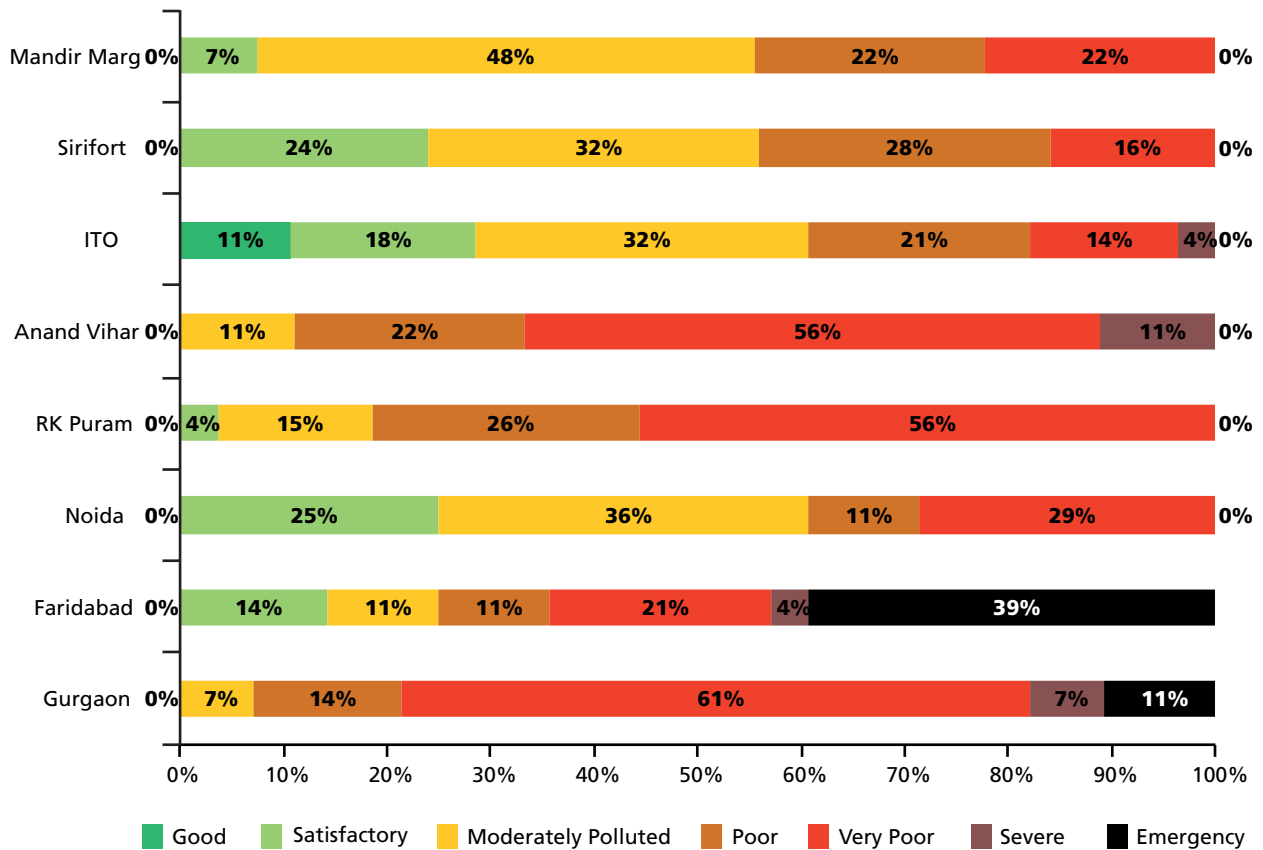
CSE analysis of air quality data from Central Pollution Control Board

**Graph 3: Categorisation of PM2.5 on the basis of AQI categories in Gurugram**



CSE analysis of air quality data from Central Pollution Control Board

**Graph 4: Categorisation of PM2.5 based on AQI categories – April 19 to May 16, 2017**



CSE analysis of air quality data from Central Pollution Control Board

The exposure monitoring carried out by several agencies during winter has also shown high night-time pollution; early morning inversion effect; and proliferation of pollution hotspots at busy intersections and commercial areas including Sadar Bazaar, old Gurugram, Udyog Vihar, and MGF Mall on MG Road.

There is no official pollution inventory or source apportionment study for the NCR or Gurugram to indicate the relative contribution of different pollution sources to overall pollution load and air quality. Assessment shows that the key pollution sources are vehicles, industrial areas, construction activities, high use of diesel generator sets, waste burning, road dust and biomass *chulhas*, among other things. Explosive growth in motorisation and extensive use of diesel generator sets are serious sources of direct toxic exposure.

About 450,000 vehicles ply on Gurugram roads daily. About 50,000 are added every year, while 900 trucks cross the city every day<sup>1</sup>. Diesel use is also very high because of the huge numbers of diesel cars and SUVs, as well as the 10-14 seater diesel autos that are used for shuttle services. In fact, it is said that pollution levels dip when there is an auto strike!

There are no local health studies in Gurugram to connect public health with air pollution levels, but evidences from Delhi – in the same air shed – are alarming: Every third child is reported to have impaired lungs<sup>2</sup> and a minimum of eight

premature deaths a day occur due to air pollution<sup>3</sup>. This risk transition in the city has serious implications for environmental monitoring strategies. The immediate risk from air pollution as well as the long latency period of cancer risk from exposure to toxic air pose serious dangers and need to be tracked and controlled immediately.



## MOBILITY AND ROAD SAFETY

**The challenges:** Massive use of private transport due to lack of comfortable public transport options, leading to severe traffic gridlock; an unfolding parking crisis; and insensitive urban design which lead to unsafe roads and pollution lock-in

### The challenge of mobility crisis

Originally, Gurugram was not designed to be integrated with a public transport spine. But there are huge risks of building such cities which depend entirely on personal transport. Personal vehicles overwhelm road infrastructure and public spaces for parking. Automobile dependence edges out the more sustainable modes of public transport – walking and cycling. A car-centric approach has been the bane of Gurugram, resulting in congestion, increased travel time and fuel costs, unsafe road conditions, rising number of fatalities (487 people died in accidents in 2013, of which 40 per cent were pedestrians and cyclists), and air pollution<sup>4</sup>.

According to the *Statistical Abstract of Haryana*<sup>5</sup>, while annual registration of cars and two-wheelers has increased significantly in the city, that of buses has declined sharply by 300 per cent between 2008 and 2015. While the annual



Agnimih Basu / CSE

registration of intermediate public transport in the city has declined by 39 per cent between 2006 and 2015, annual car registration has increased by 352 per cent and of two-wheelers by 69 per cent. Gurugram has one of the highest vehicle ownership rates in the country<sup>6</sup> – higher even than Delhi. In Gurugram, 43 per cent of the households own two-wheelers and 33 per cent own cars. In Delhi, only 20 per cent own cars. Vehicle density on Gurugram’s roads (232 cars and two wheelers per 1,000 people) is higher than in Delhi (120/1000). Gurugram is caught in a severe traffic gridlock that has earned the epithet of “gurujam”<sup>7</sup>.

The state of the city bus service is poor. According to the Gurgaon Integrated Mobility Plan 2010, the share of public transport in Gurugram is only 10 per cent, the average trip length is 7 km, and average traffic speed is 23 km per hour. With nearly 45 per cent of the trips are between 0-2 km long, the share of walking and cycling is 33 per cent. All this calls for building a strong non-motorised transport (NMT) infrastructure including cycle lanes, cycle stands, continuous footpaths and safe pedestrian crossings – all of which are practically absent in the city<sup>8</sup>.

Public transport ridership has declined rapidly. In 2010, the share of public transport, walk and cycle dropped from 58 per cent to 40 per cent; nearly 60 per cent of the travel trips was by personal transport — cars and two wheelers. Bus numbers have not increased appreciably and are 50 per cent less than the service level benchmark of 60 buses per lakh population (it was 31 per lakh in 2014-15)<sup>9</sup>.

Public transport penetration is poor as well. Currently, Haryana Roadways is providing city bus services on a few routes for a district which requires a minimum of 1,000 buses as per norms<sup>10</sup>. Gurugram has a metro line and a rapid rail. The Rapid Metro, the first private intra-city rail project (50:50 initiative of HUDA and IL&FS), is being extended to Udyog Vihar. The metro does not serve the old city. Last mile connectivity is poor. Private autorickshaws have started plying recently, although they are unmetered<sup>11</sup>.

**The mobility crisis is further aggravated by a parking crisis. The data available for key locations shows that 80-90 per cent of vehicles in the parking areas are cars and two-wheelers. More than 80 per cent of the vehicles are parked for less than one hour, especially in commercial areas**

The mobility crisis is further aggravated by a parking crisis. Parked cars are one of the biggest encroachers on urban space, using up valuable urban space for free or for a pittance. Supply of unlimited free parking space further incites motorisation. The data available for key locations including Cyber Park, HUDA Shopping Complex, Fountain Chowk, Sethi Chowk, Vishwakarma Road, MG Road etc shows that 80-90 per cent of vehicles in the parking areas are cars and two-wheelers. More than 80 per cent of the vehicles are parked for less than one hour, especially in commercial areas. Metro stations lack well organised parking of para-transit and feeder buses for last mile connectivity. With an effective and time-variable parking pricing, this parking pressure can be reduced.

Overall, the urban design of the city is not conducive to enable deeper penetration of public transport system into neighbourhoods. Poor last mile connectivity and lack of integrated design for public transport impedes easy access to the public transport system. Gated development blocks direct the shortest routes for walkers, cyclists and para-transit. The city now needs scale and integration of bus and other modes of transport, while maintaining reliability and frequency of quality service to attract people.

There is an opportunity in short travel distances that makes this city walkable and cycle-friendly. This strength needs to be leveraged. The maximum daily trip length is less than 5 km, as per the Integrated Mobility Plan for Gurgaon

Manesar Urban Complex, 2010<sup>12</sup>. Due to poor public transport connectivity, dependence on personal modes has grown. With appropriate and timely intervention, it is possible to reverse this trend and move people towards more sustainable and attractive alternatives. A fundamental shift in city planning, that brings everyone closer to their workplaces, homes, services and recreation will help reduce travel distances and travel time.

### **The challenge of unsafe roads**

The World Health Organization includes road injuries and road accident deaths in its calculations to estimate the health and disability burden associated with motorisation. Available evidence on road accidents and accident hotspots in Gurugram shows very high death and injury impact of the vehicle bulge in the city. Road accidents increase when cities prioritise high speed roads for vehicles over ensuring safe access for all road users.

According to data from the Traffic Police of Gurugram, the city records more than one death per 1,000 people in road accidents. In a day, more than 60 per cent<sup>13</sup> of injuries are reported during daytime. The major highways that cut across the city add to the accident risk, with 60 per cent of accidents occurring on the NH-8 expressway. Pedestrians, cyclists and two-wheeler drivers are the most vulnerable. While globally the trend is to reduce vehicular speeds inside cities with traffic calming measures and by providing safe infrastructure for walkers and cyclists, our cities are adopting road designs to increase the speed of vehicles and force people to use foot overbridges. This pushes up the accident risk.

Moreover, most roads in Gurugram are user-unfriendly. According to the Mobility Plan of 2010, street lights were available only on 20 per cent of the roads in the city, and waterlogging is acute. Less than 23 per cent of the roads have usable footpaths<sup>14</sup>. For a city that is aiming to significantly increase the share of public transport, walking and cycling for clean air and to protect public health, unsafe roads can be a serious barrier. Strategies are needed to move towards zero tolerance and zero accidents.

## ENERGY

**The challenges:** *Constantly rising energy demand, along with energy-intensive lifestyles and building construction, leading to pollution and climate change impacts; and slow transition to renewables*

### The challenge of energy guzzling

With the city bursting at its seams, the quantum and intensity of energy use in homes, offices, retail and infrastructure has increased rapidly. Lifestyle pressures are escalating energy demand with serious pollution and climate change consequences.

The main sources of energy in Gurugram are electricity, petrol, diesel, LPG and kerosene. According to the Draft Master Plan, 2014, diesel fuel use is the highest at 61 per cent, followed by electricity (19 per cent), petrol (10 per cent), LPG (7 per cent) and kerosene (3 per cent). Such high use of diesel for transport and captive power generation has become a significant source of air pollution. Changing the energy mix to improve clean energy access is, therefore, critical to reduce energy intensity and pollution.

Gurugram needs a multi-sector policy on energy efficiency and savings. Action



Meeta Ahlawat / CSE

is needed at the level of buildings as well as habitat and the city. Buildings and urban infrastructure, depending on their design and technology levels, lock in enormous carbon and pollution. To undo this structural lock, policies will have to ensure equity in access to clean energy so that the urban poor can also move away from biomass-based *chulhas* that contribute hugely to outdoor air pollution as well as to public health risk.

Haryana has an average demand of 4,500-5,000 MW of power, which goes up to 9,000 MW during peak hours in summers. Electricity demand is rising by 10 per cent every year.<sup>1</sup> According to the Draft Master Plan, April 2014 the industrial use of electricity is highest at 44 per cent, followed by residential use at 34 per cent, commercial at 21 per cent and municipal at 1 per cent. But across all the sectors, electricity consumption has increased by at least 55 per cent since 2005. According to Dakshin Haryana Bijli Vitran Nigam (DHBVN), electricity supply is about 25 per cent short of demand.

Residents and businesses in Gurugram expect the shortfall to be much higher because of 10-12 hour power outages, especially during summers, in several parts. In some parts, outages average at about half an hour. Residential associations or individuals generate most of the electricity, with diesel generators in their backyards, and there are no norms in place for regulation or monitoring of such generators. Air in Gurugram has high levels of particulate matter and nitrogen oxide, and one of the sources is these generators.

With growing affluence and changing lifestyle, building design and operations have become more energy-intensive. Massive increase in use of electrical appliances for lighting, refrigeration and space cooling and other uses can upset the energy budget not only of the household but also of the nation. Prolific building construction, especially that of high end buildings, has also led to increase in use of energy-intensive material like glass and steel. Gurugram is known for excessive use of glass in building façade that traps heat and increases cooling requirements and energy intensity. These are inappropriate in the local climate.

Demand for electricity is also rising from the city-wide infrastructure. Extensive street lighting, electricity to run motors and public facilities including water pumping etc can also increase energy usage.

Mandatory regulations and codes are needed to achieve energy efficiency benchmarks. Energy policy for buildings is a fairly new area of governance. The Energy Conservation Building Code (ECBC) is a Central government policy for energy regulations in buildings that the state governments will have to implement. The National Building Code, which sets the building principles and norms for building construction across the country, has also added a new chapter on sustainability criteria for the building sector.

The Haryana government has mandated implementation of ECBC in government buildings and is in the process of modifying municipal building bye-laws accordingly. It has amended the schedule of rates to include energy-efficient material; introduced CFL; promoted solar water heating systems and street light luminary systems; and initiated preparation of an energy-efficient building module for replication. It has also introduced monetary incentives for architectural firms and buildings that adopt energy efficiency measures, and has announced financial support to bear the energy audit costs of commercial buildings.

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**Haryana gets a high intensity solar radiation for 320 days in a year; the state's overall solar potential is 4.5 GW. The solar capacity target is 3,200 MW by 2021-22 -- of this, 1,600 MW will be from rooftop solar**

Regulations should be able to promote integrated design and creative use of passive architectural design to ensure energy efficiency and also meet energy efficiency targets during operations. Creative and efficient use of building orientation, day lighting, shading and ventilation can reduce thermal loading and dependence on mechanical cooling. After buildings are designed for energy efficiency, they also need to be operated at optimal efficiency. To enable this, the Bureau of Energy Efficiency (BEE) has introduced star rating of energy performance of buildings as well as energy efficiency labeling of electrical appliances used in buildings. The voluntary star rating programme is based on the actual performance or specific energy usage arrived at after an energy audit of the building. This creates an opportunity for setting energy performance targets for buildings.

It is important to note that the 2016 revision of ECBC by BEE has set three levels of stringency. These include minimum and compulsory efficiency requirement as per the ECBC requirements; energy-efficient building requirements in which buildings fulfill or exceed the energy efficiency performance levels stipulated in the ECBC code; and super energy-efficient buildings in which buildings fulfill or exceed the super energy-efficient performance levels stipulated in the ECBC code. Each of these has graded requirements. Adoption of such a strategy will help the building stock to improve energy performance levels quickly.

The Master Plan of Gurugram has set a goal of total savings of 298.97 MU, with 155.17 MU from renewable energy installation and 143.61 MU from energy efficiency measures. Eventually, with a robust roadmap that is also consistent with the global best practice, the Millennium City can move towards the goal of net zero or nearly zero energy buildings.

### **Moving towards renewable energy**

The energy roadmap for Gurugram needs to progressively increase the share of renewable energy resources and generation. Haryana is gearing up to contribute to India's ambitious target of generating 175 gigawatts of solar power by 2022, and Gurugram is in a position to leverage the state-level policies to scale up application and make more off-grid solutions possible. The plummeting cost curve of solar power generation is an opportunity. As energy demand and consumption grows steadily in the city, increased share of solar power will not only de-carbonise energy but also reduce toxic pollution from power generation.

Haryana gets a high intensity solar radiation for 320 days in a year; the state's overall solar potential is 4.5 GW.<sup>2</sup> Under the New Solar Policy of 2016, Haryana has set itself a target of solar renewable purchase obligation (solar RPO) which would be scaled up from the current 0.25 per cent to at least 8 per cent by 2021-22. The solar capacity target is 3,200 MW by 2021-22 -- of this, 1,600 MW will be from rooftop solar. The policy encourages setting up solar plants on barren panchayat lands and on canals; enabling mechanisms for off-grid solar applications; creating a green energy fund; and facilitating wheeling of solar through utilities.

The scaling up of solar power generation will happen in diverse ways. In particular, the target is expected to be achieved through rooftop grid-connected solar power through net metering; rooftop grid-connected solar power on clusters of government and public sector unit buildings; installation of ground-mounted MW scale solar power plants; installation of solar power plants by the Haryana Power Generation Corporation; development of solar parks through Saur Urja Nigam Haryana Ltd; installation of solar power plants under the

schemes of the Union ministry of new and renewable energy; purchase of power under the bundling scheme of National Vidyut Vyapar Nigam Ltd and NTPC; and installation of solar power plants on canal banks.

Haryana's solar initiatives are spearheaded by the Haryana Renewable Energy Development Agency (Hareda). Currently, Haryana's solar power installed capacity is about 25 MW through rooftops and small solar power projects.<sup>3</sup> Haryana is the second state after Tamil Nadu to have mandated the use of solar by buildings of and beyond 500 square yards. Recently, a new solar policy has been unveiled. Net metering has been operationalised and the local administration has launched a 'single-window' for all clearances and approvals for solar PV and solar thermal. Research and development on solar power is being done at the Gurgaon National Institute of Solar Energy (NISE).

In Gurugram, 17 MW of solar rooftops have been installed without subsidy, while 1 MW has been installed with subsidy. Gurugram district has been allocated a large target for providing subsidy to the tune of 11 MW till March 2017 for grid-connected rooftop systems. The subsidy will be 30 per cent of the project cost or Rs 20,000 per kW, whichever is less.

Haryana has put in place all the elements to operationalise net metering. The net metering regulations from Haryana Electricity Regulatory Commission (HERC) were issued in November 2014 and were further finetuned in July 2015. Net metering ensures that consumers can become power exporters by installing net meters at their premises and exporting surplus power to the grid – this enables them to get a discount on their power bill (after offsetting exported units) from the Dakshin Haryana Bidyut Vitaran Nigam Ltd (DHBVNL). The Gurugram administration has opened a single window system for all clearances and approvals for subsidy, net metering etc at the Renewable Centre in Leisure Valley, in Sector 29. The application for subsidy, net meters etc can be made online. As per the policy, the electricity generated from such systems will be cumulatively adjusted at 90 per cent of the electricity consumption during the financial year. In February 2016, Gurugram completed net metering of a 10-kWp rooftop grid-connected SPV power plant at Rajiv Gandhi Renewable Energy Park.

In addition, in 2015-16, an incentive at 25 paise per unit was also provided on bills on the solar power thus generated. This incentive will be reviewed by the Commission every year, and the amendments issued by it from time to time will be followed.

But there are several challenges to be addressed yet. Policies need to be strengthened for implementation, and the Hareda needs to build awareness about policies and incentives. Net metering has been slow to take off and has been non-operational for a long time. People fear that the grid is not robust enough for net metering to be effective. Some of the biggest impediments have been the high upfront cost of solar, limited financing schemes, lack of consumer awareness about policies and programmes of government as well as lack of knowledge about reliable vendors and service stations.

An order issued in September 2014 makes it mandatory for a plot size of 500 square yards or more to install solar systems by September 2015. In November 2014, the HERC's regulations for rooftop solar grid interactive system based on net metering came out. It may be noted that energy provisions laid down under 2016 Environmental Impact Assessment notification already require solar or

**There are several challenges to be addressed. Some of the biggest impediments have been the high upfront cost of solar despite the dip in the cost curve, limited financing schemes, lack of consumer awareness about policies and programmes of government as well as lack of knowledge about reliable vendors and service stations**

other renewable energy to be installed to meet electricity generation equivalent to 1 per cent of the demand load or as per the state level / local building bye-laws requirement, whichever is higher.

Residential buildings are recommended to meet their hot water demand from solar water heaters, as far as possible. Earlier, through a notification in 2005, installation of solar water heating was made mandatory. But this guideline has now been removed. Solar water heating will now be provided to meet 20 per cent of the hot water demand of commercial and institutional buildings or as per the requirement of the local building bye-laws, whichever is higher.

The Haryana government has set its own targets for installation. Several policy initiatives are in place – what is now needed is a time-bound implementation plan. The optimistic sign is that increasingly, solar photovoltaics are getting cheaper for large scale deployment. A study carried out by CSE shows that in cities like Gurugram it will be cheaper to install rooftop solar power generation for buildings than using diesel generator sets; this CSE study assesses the feasibility of solar rooftops in residential societies.

Currently, the dependence on diesel generator sets is very high for captive power generation and meets the local demand for electricity. In fact, there are a number of buildings that are not grid connected and are dependent almost entirely on diesel gen-sets. If people are made aware of the falling cost curve of installing rooftop solar systems, the application of solar rooftop can be scaled up dramatically. The new policy requires that a new building should be able to generate 5 per cent of its annual electricity demand from rooftop solar. This should also be extended to older buildings through retrofitment. Once this is established the requirement can be progressively enhanced.



## SOLID WASTE

*The challenges: High volumes of waste generation; inefficient collection and transportation practices; and limited disposal options*

Without a framework for decentralised and segregated collection, reuse and recycle, there is a major clamour for land for disposal and dumping of waste. Availability of land for disposal is extremely limited. Real estate demand and the ‘not in my backyard syndrome’ have further limited the availability of land. More than 90 per cent of solid waste in Gurugram is being disposed off at landfills, which have become the cheapest way of disposal as the cost of land and its scarcity value are not accounted for. Field observations indicate that large volume of waste is being generated per day within the urban area, of which only a very small portion is being collected and disposed in accordance with the Waste Management Rules of India.

Data on waste generation is limited. Available information shows that Gurugram generates over 1,000 tonne per day (TPD) of solid waste – of this, about 600-700 TPD goes to the Bhandwari landfill, located on the Gurugram-Faridabad



Vikas Choudhary / CSE

**Table 1: Test results on physical parameters of solid waste samples from Gurugram (on moisture-free basis in percentage)**

Physical parameters	Civil Lines area (MCG)	Station area (MCG)	Vyapar Sadan MG Road (HUDA)	HSIDC area (HUDA)	DLF area (private developer)	Present dumping site	Weighted average
Paper	1.8	2.0	1.42	1.87	3.3	4.5	2.341
Plastic	3.63	3.33	3.57	3.75	2.5	2.7	2.912
Metal	-	1.33	3.57	6.25	8.3	4.5	3.715
Glass	-	3.33	-	9.37	-	0.9	1.693
Cloth	27.2	6.63	7.14	25	16.6	18.2	15.84
Stone	2.0	20	-	6.29	2	2.27	5.69
Sand and grit	2.72	2.6	-	2.5	2.4	1.46	1.94
Rubber	1.8	3.4	5.71	1.25	2.5	1.8	2.987
Wood	1.8	0.66	4.28	2.5	3.3	2.7	2.868
Leather	4.54	3.33	2.85	3.75	5.0	4.5	3.969
Wax	-	-	-	-	-	-	-
Organic matter	54.5	53.3	71.4	37.5	54.1	56	56.01

**Table 2: Solid waste projections for Gurugram**

Year	Population	Per capita waste generation (gm/capita)	Total waste (MT/day)
2006	1,250,000	320	400
2011	1,514,085	350	525
2021	2,600,000	400	1040

Source for both tables: Municipal Corporation of Gurugram, 2013

road. The Bhandwari plant was set up as a landfill-cum-waste treatment facility under the JNNURM in 2010-11. But the plant has remained non-operational since November 2013, and functions only as an open dumping site.

With generation growing at 5 per cent annually, it is projected that by 2041, Gurugram would be producing 2,839 million tonne of waste. An estimate available from ICLEI shows Gurugram generates about 700 TPD of construction and demolition waste and 1.5 TPD of biomedical waste; the city also produces 70,000 tonnes of e-waste annually.

The official estimate of per capita waste generation in Gurugram is about 320 gm/day, which includes residential, commercial and institutional waste. About 400 MT of municipal waste is collected every day within the controlled area, of which about 75-80 MT is generated within the municipal area and rest in HUDA sectors, private developers' area, and urban villages. About 50-52 per cent of municipal solid waste is biodegradable, 12-15 per cent is dry recycles and 30-35 per cent inert component (see Table 1: Test results on physical parameters of solid waste samples from Gurugram and Table 2: Solid waste projections for Gurugram). According to the data of the MCG, future waste generation for Gurugram is calculated based on the estimated population carrying capacity of the city – the per capita increment in waste generation has thus been estimated at 1.33 per cent per annum, based on available national data.

In 2016, the National Green Tribunal had ordered that the mixed waste dumped in Bhandwari be treated to avoid air pollution, bad odour and groundwater pollution (because of the leachate percolating into the ground). A tender to address this was issued in October 2016. But there are concerns about the tender as it selects single operator to collect and transport waste from entire Gurugram and treat it in Bhandwari, through composting, recycling and producing a minimum of 10 MW of electricity. Bhandwari has become a health hazard and needs urgent sanitary cleaning up of the site and scientific ways of waste disposal.

This, however, is a centralised solution. But there is a growing recognition of the benefits and effectiveness of decentralised waste disposal systems. Decentralised solutions have worked for many closed colonies where RWAs have taken the lead – examples are Richmond, Regency Park, Garden Estate, Magnolias, Vaastu Apartments, World Spa etc. Gurugram has open colonies, especially in the old city, where getting the community to participate in segregation of waste has remained a challenge. A few pilot projects have been started, including in Sector 15 and Palam Vihar, but it has shown mixed results at best. Waste segregation will have to be initiated in open colonies.

The Municipal Corporation of Gurugram has incentive schemes but benefits of these schemes have not been properly articulated to all RWAs yet. Initial hand-holding help of Rs 2-3 lakh for putting sheds for composting are some of the available incentives. Only a few progressive RWAs are aware and have come forward. Waste burning is a common practice leading to release of harmful gases and several health hazards.

However, over the last one year the MCG has stepped up efforts to expand composting capacity. Within a year of setting up composting capacity by the MCG, it has increased from 2.5 tonnes per day to 7.5 tones per day. MCG has created composting facilities in Nasikpur and Gaushala and is starting in Police Line. As on May 12, 2017, 7195 kg per day was taken for composting in Nasikpur and 3240 kg/day in Gaushala. This will be scaled up across the city.

Community action in form of an online portal with a handbook titled *Gurugram Handbook for Waste Management* has been published on the website of the MCG. It is an online portal enabling RWAs to collaborate with the MCG for effective waste management. The RWAs register on the portal, notify a spot or zone for local composting. The MCG trains residents and domestic helps in segregation and composting. This has also been effective in sensitizing residents against waste burning. However, the MCG will also require capacity building, training, staff, and professional consultants to support the process of household level segregation, recycling and reuse.

### **Construction and demolition waste is a resource**

Construction and demolition (C&D) of buildings causes enormous waste – often estimated to be about half of all materials used – that degrades the land and environment. C&D waste is inert but bulky waste. These are either dumped in city landfills or in open spaces, water bodies and flood plains. Yet C&D waste is not a waste but a resource that can be brought back to construction again as reusable material. But this requires rules and regulation and also infrastructure for recycling.

There are serious concerns around dumping of C&D waste that is dumped

**There is a growing recognition of the benefits and effectiveness of decentralised waste disposal systems. Decentralised solutions have worked for many closed colonies where RWAs have taken the lead**

**The first construction and demolition waste treatment plant is proposed to be built at Basai. This will process 500 tonnes of waste a day. Gurugram generates 700 TPD of C&D waste. There are around 161 big construction sites and more than 488 small and mid-sized construction sites in and around Gurugram**

along the roads, in the water recharge bodies and the Aravallis. The C&D waste poses serious civic, health and traffic related problems in the Millennium City, besides adversely impacting the environment.

The Municipal Corporation of Gurugram has issued a notification dated November 18, 2015 identifying eight dumping sites<sup>1</sup> for C&D waste disposal. The notification mandates that dumping of C&D waste in any other area other than the designated dump sites will attract penal charge. A penalty of Rs 5,000 will be charged for the first violation and additional penalty of 20 per cent will be levied for subsequent transgressions on any offender under the Haryana Municipal Act, 1994. There is also a provision for confiscation of the machinery and vehicles used for illegal waste dumping.

According to this order the waste will be segregated at the premise in six different streams including brick and masonry, concrete and steel, soil sand and gravel, wood and plastics, other metals, and miscellaneous. Waste generators will pay a charge of Rs 360 per tonne for each kind of waste and Rs 720 per tonne for un-segregated waste for disposal. The waste can be disposed off only at the eight designated spots. All developers will have to submit plan for the cleanup. Violation of the conditions will be punishable under sub-section (1) of section 15 of the Environment (Protection) Act, 1986. Each failure is punishable with imprisonment for a term which may extend to 5 years or fine upto Rs 1 lakh or both and with repeated violation additional fine will be imposed at Rs 5,000 for every day and for as long as the contravention continues.

Moreover, the Construction and Demolition Waste Management Rules, 2016<sup>2</sup> makes it mandatory for developers or waste generators to submit a waste management plan along with their building plan, non-deposition of which, may lead to non-grant of permission to the building. Under the C&D Rules, state government or construction agencies will have to utilise 10-20 per cent of material from C&D waste in municipal and government contracts for construction. All cities will have to mandatorily set up facilities in phased manner to procure and utilize 10-20 percent materials made out of C&D waste. The municipal and government contracts, non load bearing application like kerb stones, drain covers, paving blocks in pedestrian areas can use these recycled material.

The first construction and demolition waste treatment plant is proposed to be built at Basai<sup>3</sup>, which is around 5 km from the city of Gurugram. According to MCG, this will be spread across 3.5 acres of land and will process 500 tonnes of waste a day. Gurugram generates 700 TPD of C&D waste. There are around 161 big construction sites and more than 488 small and mid-sized construction<sup>4</sup> sites in and around Gurugram.

All large generators of waste will have to pay charges for transportation, collection, processing and disposal. They will be responsible for segregating construction and demolition waste before disposal<sup>5</sup>. All large waste generators need environment management plan

Local authorities will have to give appropriate incentives to waste generators for salvaging, processing, and recycling preferably in-situ. Recycling facilities will have to be created at safe distance from habitation with adequate buffer zone. Recycling and reuse of C&D waste is important for sustainability as this can reduce environmental damage and also mining of virgin construction material.

## SUSTAINABILITY FOR ALL

*The challenges: Ensure the right of the urban poor to the city and its resources – affordable housing and reliable basic services*

**H**ousing and equitable access to resources for all, especially the urban poor, has to be the defining parameter of sustainability. Only inclusive urban planning can keep the urban poor within the urban core, have access to affordable housing, reliable basic services, and workplace. The urban poor who are part of the informal economy contribute substantially to the urban economy. They have a legitimate right to the city.

According to the 2009 Haryana Development Report<sup>1</sup> of former Planning Commission of India, about 16.64 percent of the population of the state lives in slums. According to realtors, around 70 per cent of the demand for housing in the state is from economically weaker sections (EWS) and low income groups (LIG) categories; 20-25 per cent from mid-segment and 5 per cent from the luxury sector. In 2011, Gurugram had 10.2 per cent share of state's slum population.

Gurugram does not have squatter settlements in the conventional sense. In fact slums are not allowed to emerge inside the city. Most urban poor and the poor migrants live in rental accommodation in private lands and houses of urban villages. The urban villages of Gurugram are an important source of housing of



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**According to the Gurgaon Development Plan of 2031 new allocations for affordable housing have been made in the land restored back to the municipality from the industry department. Approximately 50 hectares of land has been reserved for affordable housing in sector adjoin newly proposed university site**

urban poor. A study by Centre for Policy Research on informal rental housing typologies and experiences of low-income migrant renters in Gurugram shows that there are about one million migrant workers in Gurugram in addition to the 1.5 million people counted in the Census 2011. Most of the informal settlements are clustered around commercial hubs or source of livelihood. Their living condition is sub optimal. As many as 72 per cent migrants use shared toilets. In the main clusters of informal housing in Gurgaon Central, Kapasehra cluster, Chakkarpur, and Badshahpur the share of migrant workers in the local population range from 60 per cent to 90 per cent. Demand for rental accommodation is very high among the migrant workers. Most of these informal housing has been provided by the tenant or contractor built in private land or gram sabha land, and land lord built private land. These are largely located at the periphery or intermediate zones. Migrants largely use informal rentals. This allows them to be close to the place of work. This will continue remain an important source of housing for the poor that requires policy support.

Acquisition of land is the biggest challenge for affordable housing and basic services. The prohibitive cost of urban land significantly impedes progress in affordable housing projects. Limited access to housing finance for low-income groups further exacerbates this gap between available housing and those in need of affordable housing.

According to the Census of 2011, between 2011 and 2021, additional 2.9 lakh houses will be required in urban Gurugram to match the population increase<sup>2</sup>. But a great part will have to be in the affordable housing sector. According to the information from Haryana Pradhan Mantri Awas Yojana (PMAY) and Central Sanctioning Cum Monitoring Committee (CSMC) currently there are 16721 EWS plots in residential colonies and 35833 EWS flats in group housing colonies. About 1673 EWS plots have been transferred to Housing Board Haryana (HBH) and 5104 of EWS plots are yet to be transferred to HBH. Under the State Housing Schemes there are 560 Dwelling Units<sup>3</sup>.

There are several central policies on affordable housing and housing for the poor including Housing for All- Pradhan Mantri Awas Yojana. Under the Deen Dayal Jan Awas Yojna - Affordable Plotted Housing Policy 2016 for Low & Medium Potential Towns, the Governor of Haryana has issued the 'Affordable Plotted Housing Policy for Low and Medium Potential Towns' known as "Deen Dayal Jan Awas Yojana" under the provisions of Section 9A of the Haryana Development and Regulation of Urban Areas Act, 1975 and any other corresponding statute governing development of plotted housing colonies on the subject. 'Deen Dayal Jan Awas Yojana aims to encourage development of high density plotted colonies in low and medium potential towns of the State where small plots are made available through a liberal policy framework. All such projects will be required to be completed within a stipulated time. Moreover, Priyadarshini Awaas Yojana is a demand based 100 per cent state funded scheme of Haryana Government, that aims to provide pucca houses to two lacs poor families, living in rural areas. All selected beneficiaries will be provided financial grant of Rs. 90100 (81000 for house and 9100 for construction of sanitary latrine).

According to the Gurgaon Development Plan of 2031<sup>4</sup> new allocations for affordable housing have been made in the land restored back to the municipality from the industry department. Approximately 50 hectares of land has been reserved for affordable housing in sector adjoining newly proposed university site. An area of 16021 hectares has been reserved for residential purpose. The Haryana Urban Development Authority and licensed colonizers have

developed residential area of 8000 hectares in various residential sectors of this Development Plan. In sector-68, a pocket of approximately 50 hectares of land with density of 1125 persons per hectare has been reserved for construction of smaller flats for providing housing to low and medium income group. Minimum plot size is fixed at 35 sq. meters for residential plot. Subsidies for industrial housing and slum dwellers housing scheme has been approved by the government. Further a developer is required to reserve 20 per cent of the housing provision for EWS and the LIGs; another 25 percent can be sold in the market in no profit no loss basis while the remain 55 per cent can be sold freely in the open market, provided that the overall profit is limited to 15 per cent.

Under the Haryana Urban Development and Regulations of Urban Areas Act 1975, a condition of allotting 20 per cent of the number of plots in the colony to EWS category of persons having a family income upto the prescribed limit by draw of lots, was imposed. The rates of such plots are fixed by the Government while lifting external development charges.

The formal housing sector has so far not been able to meet the growing demand for housing for the poor. It is also not clear to what extent the new policy on affordable housing that is based on incentive for the developer will be able to cater to the requirements of the poor.

Self construction by the poor themselves has therefore become an important source of housing especially in urban villages and marginal land. But being informal and often illegal as these are built on encroached land they do not have access to basic municipal services.

There are issues of inclusive principles of property rights, participatory planning, in-situ development, upgraded housing, and fiscal support. In most cases city authorities are not able to provide land inside the city for in-situ development as these lands have high commercial value. This pushes housing for the poor to peripheral and marginal areas. This defeats the purpose of keeping poor people closer to their sources of livelihood and adds to their hardship and loss of income. Even the new housing policy Housing for All 2022 is based on in-situ slum development through public private partnership and credit linked subsidy scheme.

Housing for the poor and affordable housing sector will also require guidelines for housing construction. There is considerable scope of promoting passive architectural design for creative use of shading, day lighting etc to improve overall thermal comfort for of the dwelling units of the poor; use of low cost sustainable housing material and provisions of common and basic services. Local skills can be enhanced to meet the local demand for construction and secure local livelihoods. It is possible to facilitate professional help to the poor households to ensure safe and comfortable houses are built.

There are concerns that with rapid development in the area and gentrification, the current informal renting system can get eroded. As part of the inclusive policy the local government will have to find ways of leveraging the current system of informal rental accommodation being provided by the landlord to augment the stock and their unique requirement. Also as part of the formal affordable housing policy it is important to create affordable rental housing stock to meet the diverse requirement of poor households. Diverse building typologies are needed – from small individual dwelling units to those with shared facilities to rentals and dormitories.

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## FORESTS AND GREEN AREAS

*The challenges: Depleting green spaces and an imperiled Aravallis*

Multiple benefits of natural forests, green spaces, open areas and their ecosystem services need recognition in the planning for sustainability. In Gurugram forests have a critical role to play to arrest desertification; act as a sink for noxious pollution and for heat trapping global warming gases, enhance water recharge capacity to augment groundwater and revive water bodies; reduce heat island effect and the impact of extreme weather events. These are already serious threats in the Millennium city.

According to the Forest Survey of India (FSI), only 8.35 per cent of the total geographical area of Gurugram comes under forests at present. Gurugram city has 2,600 acres of forest area, which is about 4 per cent of the city's total geographical area<sup>1</sup>. A major part of the city forest is situated off Gurugram-Faridabad Road. Gurugram's forest cover is under constant threat due to civic expansion, construction projects, road widening as well as infrastructure development. Mangarbani, a sacred grove is under threat.



Sunita Narain / CSE



The Aravalli Ranges have been designated as Natural Conservation Zone in accordance with the 2031 Master Plan issued in 2012 and Sub Regional Plan 2021, except the urbanisable area. The attempt to exclude Aravallis from the Natural Conservation Zone was not agreed by NCR Planning Board. For longer term sustainability of Gurugram it is important to safeguard Aravallis and not allow any escape route to divert this land for development purpose. In the Sub Regional plan Haryana 2021 the Aravalli ridge is included as environmentally sensitive area. This is also demarcated as Natural Area Conservation Zone in the Regional Plan, 2021. In designated areas agriculture, horticulture, fishery, social forestry, afforestation and regional recreational activities with construction not exceeding 0.5 per cent of the area are the permissible activities.

It is a matter of concern, as evident from the draft Sub Regional Plan 2021<sup>2</sup>, forest cover in Gurugram has only marginally increased to 8897.27 ha in 2014 from 8888.9 ha in 2010. While reserved forest has remained the same at 214.89 ha, the area under protected forest has declined from 1588.27 ha in 2010 to 1575.61 ha in 2014. Unclassed forest has increased from 22.66 ha to 31.11 ha. According to the Forest Survey of India 2015, there has been an overall negative change in forest cover of the state due to rotational felling and diversion of land for non-forestry purpose. But due to active initiatives on afforestation and social forestry the forest area is increasing in the sub region (Gurugram and nearby regions). But these afforested areas are not reserved or protected, so the sustainability of the forested areas is at risk.

In April 2013, the Gurugram forest department completed a 19-month-long exercise to geo-reference the ecologically fragile Aravali belt, mapping five districts in southern Haryana. The task was undertaken to check encroachments and illegal constructions in notified areas.

The Haryana Vision-2030 commits to increase its tree cover, derived from SDG-15 Life on Land, by 8 per cent (of gross area) by 2019, by 9 per cent of the gross area by 2022 and 10 per cent by 2030<sup>3</sup>. Commitment towards afforestation involves planting 150 lakh plants annually from 2019-2030.

The Ministry of Environment and Forest Climate Change to protect the Aravallis has prohibited tree cutting, electrification, construction of roads and buildings, mining etc except with permission through a directive<sup>4</sup>. All projects will have to obtain mandatory environmental clearance as per the notification dated September 14, 2006. The areas notified under section 4 and/or 5 of Punjab Land Preservation Act, 1900 and areas covered under Aravalli plantation are also shown as “forest”. Further, pumping of ground water in and from an area upto 5 kilometres from Delhi-Haryana Border in the Haryana side of the ridge and also in the Aravalli hills will be prohibited in accordance with the orders of the Supreme Court. Notification issued by MOEFCC from time to time will be applicable and binding.

Large open spaces have been proposed near village Basai, Dhanwapur, Medawas and flowing greens in other residential areas. On Mehrauli-Gurgaon Road, the land between Sector 24 and Haryana-Delhi State Boundary measuring approx. 135 Hectares has been designated as bio-diversity park. In the open space shown in sector 72 and sector 72 A, the storage of water in the form of artificial water body will be planned for recharging ground water and avoid flash floods<sup>5</sup>. This will also enhance aesthetics.

In response to public demand and judicial intervention<sup>6</sup> important steps have

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## Citizen's initiatives in Gurugram

**GURGAON FIRST** is a think tank created in 2012 by a group of progressive citizens of Gurugram. It mobilises the collective strength of all stakeholders, including residents, RWAs, corporates and non-governmental organisations to improve the city's infrastructure, encourage sustainable and smart solutions, facilitate inclusive and participatory growth, build regulatory capacity, bring corporates closer to decision-makers and promote best practices and learning.

Through an extensive public engagement process, Gurgaon First brings together stakeholders to showcase progress, highlight issues and suggest solutions in an effort to improve both living and working experience in the city of Gurugram. It has made significant interventions in areas of finding traffic solutions for Gurugram, revamping the city's electricity sector, promoting green buildings and waste management. It has been instrumental in launching Haryana Fresh to bring consumers of fruits and vegetables close to farmers. Based on analysis and investigation, Gurgaon First has published reports on waste management and renewable energy strategies for Gurugram -- these are the Gurgaon -- Handbook on Solar and Waste Handbook for Gurugram.

**iamgurgaon** is a citizens' initiative that promotes ecological restoration of local biodiversity of the Aravalli hills, and protects native species in the 350 acres of city forest which was earlier abandoned as a mining site. This has now been converted into the Aravalli Biodiversity Park. About 85,000 saplings of 160 species have been planted within the park, which serves to address various problems related to dwindling forest cover, water recharging and restoration zones, green spaces and urban wilds to help people connect with nature. It provides a platform for people to connect and work together to make a difference. It also has a campaign on 'Carry your own bag' for shopping.

'Revive a bandh' is another important iamgurgaon project. In November 2015, when the Forest Department planned to revive the bund in DLF IV, iamgurgaon developed a part of it. This initiative has been executed under a public-private partnership. The Forest Department and iamgurgaon with American Express's support have worked in the stretch opposite Paras Hospital. Under this initiative extensive planting of trees and shrubs -- that are native to the Aravali region -- was carried out.

This rejuvenation of public place has given ecological benefits. The bund is lined with walking path, cycling track, wheel chair access, and tactile tiles for the visually impaired. The 5 km stretch connects one end of Gurugram to the other and is designed for mobility. The plastic dump in the bund was removed and sent off for recycling instead of being dumped elsewhere and the malba lying in the vicinity was reused as a base for the path instead of buying bricks and breaking them. The porous areas ensure that the rain water seeps into the soil, the slopes also help to harness water. This is a seamless stretch for non-motorised transport.<sup>10</sup>

**RAAHGIRI DAY** is a car-free citizen initiative that began in Gurugram on November 17, 2013. The movement was conceived and is trademarked with the Raahgiri Foundation, consisting of local citizens from five organizations -- EMBARQ India,

been taken to protect the Manger Bani area on the Aravallis. After the recent court judgment the State Government will not permit fragmentation of the areas falling in village Mangar. A joint committee has been set up to identify the forest and identify nearby forest areas, and its exclusion from agricultural land. No change in land use of the area falling under the category of forest and gair mumkin pahar is possible. Environmental compensation when deposited shall be used only for the restoration of the environment of the area. State of Haryana and Department of Forest are directed to take action on any unauthorized cutting of trees or any non-forest activity in "gair mumkin pahar".

The June, 13, 2016, the Haryana Government has demarcated Mangar Bani<sup>7</sup> in the Aravalli hills as forest area, with a 500 meter buffer area as a no construction zone. Tracts of land in Aravalli commons are still under private ownership, giving owners right to sell forest land. The area around Mangar Bani, the villages of Mangar, Kot and Bandhwari are recorded as panchayat deh or community land, categorized as gair mumkin pahar or not fit for cultivation. Bandhwari village had however restored these lands back to panchayat ownership in mid 2000s.

iamurgaon, Pedalyatri, Heritage School Gurugram, and Duplays Gurugram. In a quest to make Gurugram accessible for its residents, organizations and activists have come together to implement 'Raahgiri Day' to encourage cycling, walking and public transport in the city. Parts of street network are temporarily closed to cars so that only people can use. It is a weekly event. With a strong backing from the local administration of Gurugram – MCG, PWD, HUDA and Traffic Police, the streets identified for Raahgiri day are cordoned off and only non motorized transport users are allowed between 6 am and 12 noon.

**UTHAAN:** Uthaan works in the area of vermiculture, organic cultivation, herbal planting, animal welfare, green movement and conservation. It has planted about three lakh saplings of jatropha plant on Faridabad- Sohna belt and Gurugram-Faridabad belt. It has taken steps to preserve local medicinal plant guggal used for treating joint pain and cholesterol, that has got nearly extinct. Other medicinal plants include Buch, Gwar-patha, Reetha, Arjun, Meetha-neem, Sarp-gandha, Tulsi, Agave, Beal patra, Bamboo, Saptarni, Gudhal, Peepal, Gudmaar, Champa, Teak, Mint, Poplar, Senjana that have been planted in the herbal park maintained by the group. Tree planting is done with the help of schools. Various workshops have been organised for school students.

**HARYALI** works to preserve open spaces and biodiversity. It has created new urban parks to revitalize the city. It organizes plantation. In response to a petition filed by Vivek Kamboj of Haryali the National Green Tribunal gave the order to restrain HUDA and MCG from dumping industrial waste and construction debris in any green area. They are also fighting for clean drinking water and clean public transit.

**SOCIETY FOR URBAN REGENERATION OF GURGAON AND ITS ENVIRONS (SURGE):** This group works on water management, traffic management, effective utilization of external development charges and solid waste management. SURGE has worked closely with RWAs and institutions to implement several rainwater harvesting initiatives. They have designed a cost effective rainwater harvesting solution and are scaling up these solutions along with other institutions. The rain water harvesting system that they have designed has a capacity to handle over 3000lts/hr and has the ability to remove both bio-degradable and non-degradable waste using natural filtration techniques.

**MISSION GURGAON DEVELOPMENT:** The Union Ministry of Environment and Forests and Climate Change, acting on a letter by the Mission Gurgaon Development — a group of conservationists — directed the State government to put the Mangar Bani plan in abeyance until a geo-referenced map of all natural and recorded forests of the area is prepared in accordance with the Supreme Court judgment. Though the State government has appointed a nodal officer for doing this, no district has so far identified the 'forest' areas apart from those already existing in revenue records.

**GREEN GURGAON** a citizen initiative has been active in coordinating with authorities on clearing the waste dumps in the city.

**NCR WASTE MATTERS:** This group has launched the citizen initiatives on Why Waste Your Waste. They are creating public awareness on segregation.

Many citizen groups and activists are filing petitions in the NGT to safeguard the city's depleting green cover against rampant violations and encroachments. Tree cutting for road building and development projects has become a matter of serious local concern. This loss of green cover will adversely affect the environment.

Steps are needed consistent with the objectives of the Haryana Forest Policy 2006 that aims to promote afforestation for maintenance of environmental stability and restoration of ecological balance; conservation of bio-diversity in natural forests; containing genetic resource base of the rare species; conservation and development of water resources in forests; checking denudation of forests; increasing productivity of forests to meet the essential needs of people; and better management practices.

To improve liveability per capita availability of green spaces will have to be increased. The statement of intent of the newly created Gurugram Development Authority (GDA) states that there is need for an explicit commitment on green

spaces. The GDA would be the first such Authority mandated under law to do so, requiring it to meet international standards on green spaces. The WHO prescribes a requirement of 9 square metres per person and ISO 37120<sup>8</sup> lays down standards for city indicators for livable cities. These would form the GDA's benchmarks for urban environment management. The Haryana Forest Policy (2006) <sup>9</sup>sets a forest and tree cover target of 10 per cent by 2010 and 20 per cent by 2020. The Regional Plan of 2021 also sets a forest cover target of 10 per cent in the NCR. In contrast forest cover in NCR is only 3.6 per cent or about one sixth of the state target of 20 per cent.

## CLIMATE CHANGE

*The challenges: Extreme weather events like floods and the capacity and preparedness to cope with them*

### Risks from extreme weather events

The new urban planning will have to take cognizance of increased incidence of extreme weather events due to climate change. Gurugram has already experienced intense flooding paralysing life. With climate change extreme weather events such as high intensity rains, storm surge and floods will make road infrastructure increasingly more vulnerable with serious public health consequences. This will have also damaging impacts on public assets in cities and vulnerable regions. This requires detailed mapping of high risk areas, and more deliberate adoption of adaptation measures to make the infrastructure more climate resilient to reduce risk.

Road design guidelines are needed to promote sustainable roads to minimize ecological footprints, environmental degradation, resource depletion, and negative impacts on safe access, health and pollution burden. These connections need explicit recognition in road design guidelines to prevent and mitigate potential damage in climate and pollution constrained world.



Vikas Choudhary / CSE

## Setting sustainable goals for Gurugram

### Clean water for all

- Reduce overall water demand by at least 25 per cent from current levels through water efficiency and conservation measures while maintaining quality of life.
- Ensure equitable access to clean water for all and prevent water guzzling.
- Promote decentralised wastewater treatment for reuse and recycling.
- Conserve rainwater and increase groundwater recharge in Aravallis, water bodies, *nullahs* etc to augment local availability of water to meet daily water needs and reduce dependence on water supply from longer distances.

### Clean air for all

- Meet the national ambient air quality standards for all pollutants in a time-bound manner to protect public health.
- Map the exposure levels and local pollution sources across the city for stronger local action to reduce public health risk.
- Take an integrated approach towards controlling outdoor air pollution sources as well as indoor pollution sources like biomass *chulhas* as these also contribute hugely to outdoor pollution.

### Sustainable and affordable mobility for all

- Ensure that at least 90 per cent of daily motorised travel trips are carried by affordable, reliable and modernised public transport systems, efficient para-transit and extensive non-motorised transport.
- Eliminate traffic fatalities and road injuries.
- Make commuting safe and accessible for women.
- Promote universal road design for the differently-abled.
- Promote compact city design to reduce distances and vehicle-km travelled and increase public transport and walking.
- Preserve and build open public spaces and enable equitable access.

### Reducing the energy footprint

- Reduce energy intensity of the built environment of the city by at least 30-35 per cent to prevent energy guzzling and contribute towards India's INDC commitment of reducing energy intensity of growth.
- Improve energy savings in buildings by setting energy performance targets and adopt enabling strategies.

### **Building a solar city**

- Make Gurugram a solar city – enhance the use of renewables.
- Promote rooftop solar power in all new and existing residential, commercial, and institutional buildings and link it to reduced use of diesel generator sets.
- Install renewable energy solutions to meet electricity generation equivalent to 5 per cent of the demand load.

### **Promotion of zero landfill development – minimise and reuse solid waste**

- Aim for near zero landfill development with not more than 10 per cent of waste to go to landfill sites.
- Promote mandatory decentralised segregation and collection in all residential colonies and institutions, and composting sites at colony and ward levels.
- Promote properly designated and operated construction and demolition waste sites and recycling facilities that are well audited.

### **Sustainability agenda to include poor**

- Sustainability demands equitable access for all -- including poor households, renters and slum dwellers -- to basic resources and services including water and sanitation, energy and waste management; adequate, safe and affordable housing; appropriate housing typologies for all income classes; and policy support for self constructed housing of the poor.
- Develop urban villages as model villages with all sustainability parameters.

### **Protecting and expanding forests and green areas**

- Earmark at least 10 per cent of the land area as forests.
- Earmark another 15 per cent as additional green areas – such as tree cover, parks, roadside green belts etc.
- Protect at least 5 per cent of Gurugram as a wildlife sanctuary, national park or community reserve or conservation reserve.
- Earmark wastelands in and around the Aravalli hills as forests to increase the forest cover.
- This will help sequester greenhouse gas emissions; trap toxic pollution and prevent heat islands; help recharge groundwater and revive aquifers; protect local biodiversity and meet community requirements. Currently, only 8.28 per cent of Gurugram’s geographical area is under forest cover and about 3 per cent under tree cover.

# 3 An agenda for action

## MANAGING WATER AND SEWAGE

### Water

- **All new and existing building complexes and colonies must implement an area-wide plan for rainwater harvesting.** According to the revised Environment Impact Assessment Guidelines of 2016, there should be one bore-well for groundwater recharge for every 5,000 sq m of floor area. In areas where groundwater recharge is not feasible, rainwater should be harvested and stored for reuse.
- **Introduce a groundwater abstraction and use permit system that can cap extraction and use at sustainable yield of groundwater only from the shallow aquifer in each sector.** This can define water allocation, abstraction technology, metering technology, etc. All groundwater extraction must be strictly regulated and limited to the shallow aquifer, so that it can be recharged by rainwater easily.
- **At least 20 per cent of open spaces in a building complex should be pervious.** Use of grass pavers, paver blocks with at least 50 per cent opening, landscaping etc can create pervious surfaces.
- **Meet per capita daily water requirement targets from a judicious mix of municipal supply, locally harvested rainwater and treated wastewater:** This can help the municipality save almost half the water it supplies -- 75 litres per day per person (assuming that the city is supplied with 150 lpcd). The balance requirement can be met through harvesting of rain and reuse of treated wastewater.
- **Monitor sector-wise bulk water consumption:** The process of putting meters at the supply pipelines has been started by the MCG. This will be implemented city-wide to assess the pattern of water consumption across sectors. This can help the authorities plan for more efficient water metering.
- **Implement periodic (pre-monsoon and post-monsoon) inspection, maintenance and monitoring programmes for rainwater harvesting structures:** Monitoring will help understand the impacts of the structures on groundwater quantity and quality. The groundwater level and quality data monitored during pre-monsoon and post-monsoon periods should be available in the public domain. This is also needed to ensure rainwater harvesting structures are being properly operated without any negative fallouts.
- **Conserve and revive water bodies and enhance storage and retention capacity in the city.** Identify and map water bodies to conserve and enhance storage capacity. According to the National Capital Region Plan 2021, it is mandated for the NCR towns to reserve 2-5 per cent of land area for water bodies – natural or constructed. The key water bodies in



Gurugram including Ghata Jheel, Basai, Sukhrali, Faizalpur Jharsa, and Samasthpur can be conserved and rejuvenated. Besides, *johads* such as the Sikanderpur pond, Badshahpur *johad* etc need conservation, rejuvenation and augmentation.

- **Create new ponds/tanks in different sectors:** Storage structures can be built in the form of tanks in commercial and institutional areas and as ponds in green areas. Harvesting rainwater and storing it in large ponds will ensure sustainable supply of water for green areas and neighbourhoods.
- **Leverage drainage networks and road design to enhance water holding and retention capacity of the city:** Roads can be designed to integrate natural stormwater infiltration and absorption through bio-filtration beds, swales and detention ponds. Such guidelines have been prepared for Delhi<sup>1</sup>.
- **Tap stormwater drain networks for rainwater harvesting.** Implement strategies to stop rainwater from flowing out of the city. By making recharge structures along the stormwater drains, the water can be used to recharge aquifers. Structures can be built next to the stormwater drain by tapping the water from it and using rainwater to recharge the aquifer after proper filtration. This will also reduce flooding which happens due to overloading of the stormwater drains.
- **Drainage network to become eco-mobility zone:** As demonstrated in Gurugram by the Forest Department and iamgurgaon, drainage networks can be rejuvenated as green public spaces for water retention and conservation as well as eco-mobility networks. This can promote zero emissions mobility through walking and cycling, while expanding green areas.
- **Landscaping across the city should be done with drought-tolerant native plants:** Adaptive species techniques like hydro-zones should be used extensively. Develop and implement a plan to retrofit poorly designed landscapes across the city with local indigenous plant species.
- **Need water-wise, legal and administrative measures and incentives to promote water conservation measures in buildings.** Make water conservation measures mandatory, with the support of financial and administrative incentives such as rebates on water bills, property taxes, award programmes etc. Public and commercial buildings must implement water conservation measures in a targeted manner. Penalise if water conservation structures are not implemented.
- **Create Rainwater Harvesting or Water Conservation Cell to coordinate all water conservation and augmentation measures.** Undertake capacity building for plumbers, masons, contractors etc – generate lists of accredited RWH implementers. Database of implemented rainwater harvesting structures should be available with the Cell.

1 The UTTIPEC DDA in Delhi in its street design guidelines has stated several approaches. On narrower roads drains can be used to convey water to nearby large green areas for storage or recharge. Road design can include effective filtration systems of gravel or vegetative filters. Bioswale can use bio retention media to improve water quality, reduce and moderate peak run off, and manage excess run off. Even on-street parking can have pervious paving to capture water. Water sensitive road design can allow integration of biological processes for removal of pollutants, flow control, treatment in the Right of Way (ROW) itself.

- **Promote and mandate water-efficient fixtures in buildings.** Make it mandatory to replace old fixtures that use more water with water-efficient fixtures. Policy initiatives like labelling of water-efficient fixtures, rebates on the fixtures, rebates on water bills etc can help.<sup>2</sup>
- **Promote water-efficient irrigation systems** with features such as automatic sub-soil drip irrigation systems with timer controls.

### Sewage

- **Set up decentralised sanitation systems at building and colony level for treatment, recycling and reuse of water.** Treated wastewater can be reused on-site for landscaping, flushing, cooling tower, and other end uses. Excess treated water can be discharged as per CPCB norms. Natural treatment systems need to be promoted. On-site sewage treatment which can treat 100 per cent of the wastewater needs to be installed.
- **Promote options of separating grey and black water with dual plumbing system or single stack system with separate recirculation lines for flushing.** Sludge from on-site sewage treatment, including septic tanks, can be collected, conveyed and disposed as per the Central Public Health and Environmental Engineering Organisation's (CPHEEO) *Manual on Sewerage and Sewage Treatment Systems, 2013*.<sup>3</sup> The alternative is to design the sewage treatment system for reuse in industry.
- **Monitor water quality to ensure sewer lines do not contaminate stormwater drains:** There is already a plan afoot in which the MCG will test -- every month -- the biological oxygen demand (BOD) of the key stormwater drains every 5 km, to ensure there is no contamination from leakage of sewage. These tests will be carried out in the Chattarpur Nallah (Leg 1), Leg 2 Nallah, and the Badshahpur Nallah (Leg 3). This plan needs to be implemented.
- **Need safe management and disposal of fecal sludge through the sanitation service chain:** Adopt guidelines and standard operating procedures for fecal sludge management to enable septage management, cleaning, construction and operations, treatment through sludge drying beds, composting, etc. The MCG needs to build treatment capacities, and ensure safe disposal and

2 It may be noted that low flush toilets use 6 litres per flush as against 14-15 litres of conventional flush toilets and Ultra low-flush toilets use 3 litres per flush. The savings in water use can be up to 40-50 per cent. Conventional faucets have a flow rate of about approximately 11-19 litres per minute (LPM) and water efficient faucets have a flow rate of 7.5 lpm. Installation of pressure reducing devices such as aerators can reduce the flow further. Sensor taps automatically shut off. Refer parameters like Baseline Flow Rates / Consumption for plumbing fixtures in Uniform Plumbing Code of India.

3 For dual piping purpose, one pipe carries fresh water (from bore well, tube well, overhead tanks etc.) and the other recycled grey water (from local treatment systems). The grey water should be completely separated from black water before treatment. Separating grey and black water is essential but expensive. Recycled grey water can be used for flushing purpose and not recycled black water. Recycled black water may clog the flushing system. The treated grey water will be used for flush tanks. The black water coming out of the toilets will be treated and used for green areas. The grey and black water coming out of the toilets, bathrooms and kitchen can also be treated together through reed bed/microbe beds to the level of irrigation standard.

transport of fecal sludge. It should map how excreta flows are managed within the city; and develop a revenue model based on user fees. This can be added to property tax or a pay-and- use system.

- **Mandate industry and construction industry to re-use treated water.** Also, promote use of treated water for city beautification and greening
- **Initiate a public awareness and outreach programme.** Create awareness in the community about the importance of water and incentivise them to use water carefully and wisely (including school awareness programmes). Prepare model demo projects, water information centres etc.
- **Estimate sustainable yield of groundwater for each sector based on natural recharge rates.** Monitor one to five observation wells (piezometers for checking groundwater level) in each sector. Water supply calculations must also include the groundwater slabs. During the planning of urban water supply, groundwater source needs to be included in the calculations.
- **Set up an online register of tubewells/borewells:** This needs to record location, depth, logging records of all bore wells, decommissioning, and safety steps etc. Make existing bore wells public assets. There should be GPS based tracking system for bore well drilling machines and water and sewage tankers.
- **Demand forecasting to be done for augmenting city water supply** and to bring water source near the demand centre. This will save pipeline laying cost, maintenance cost and also reduce water losses due to leakages.
- **Need hydrological assessment of aquifers of Gurgaon and comprehensive water database and assessment of climate change on water resources:** This is needed assess natural recharge zones.
- **Database of water bodies (existing, encroached and polluted) should be prepared and placed in public domain. The database should be updated every five years.** This will estimate the loss of water bodies. Mapping of catchment and conveyance systems carrying rainwater to the waterbodies should be restored. Before giving permission for buildings, assess that the hydrogeology of the area is not disturbed due to such constructions.
- **Develop high water recharge zone maps as well as high contamination zone maps:** This is needed to refine intervention to augment ground water recharge and also control water pollution.

## ENSURING CLEAN AIR FOR ALL

### Air quality monitoring

- **Set up real time air quality monitoring systems** and grid with public information system to disseminate daily air quality levels and index and put out health alert.
- **Implement graded response action plan** notified by the Ministry of Environment and Forests and Climate Change according to daily air pollution levels.
- **Map air pollution hotspots** in the city for local interventions.
- **Assess relative contribution of air pollution sources** in the city to refine the integrated plan.
- **Undertake satellite-based monitoring for tracking and enforcing agriculture waste burning** to develop time bound action plan to curb this problem in the hinterland and prepare for this seasonal problem.

### Industrial air pollution

- **Enforce emissions standards and restrict use of dirty fuels:** Prevent and restrict use of dirty industrial fuels like furnace oil and pet coke with high sulphur and heavy metals content if there are no emissions standards and control measures in industries.<sup>1</sup> These measures may be implemented in the industrial areas in and around Gurugram. Strict enforcement of air pollution control measures in all industries and including those in unauthorized areas is crucial.
- **Ensure calibration and working of Continuous Emission Monitoring System (CEMS) for transparent monitoring of all industries in the NCR:** This real time monitoring of industrial stack emissions need to be robust. The emissions data should be publicly accessible. Ensure CEM are operated with correct protocol for credible data.
- **Ensure strict implementation of emission norms, use state of the art technology** and provide emission data to State Pollution Control Boards.
- **Develop and implement siting and zoning policy for large developments, industrial units and other polluting activities.**
- **All power plants in the region should meet the new emissions standards and also move to natural gas.**

### Vehicular emissions and clean fuels

- **Ensure on-schedule implementation of BS VI fuel and emission standards from April 1, 2020.** This will not only reduce emissions significantly but also reduce the current gap in emissions from diesel cars and petrol cars.

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<sup>1</sup> The Supreme Court in its order of May 2, 2017 has directed the Central Pollution Control Board to fix the standards for sulphur dioxide, sulphur oxides and nitrogen oxide for 35 categories of industry by June 30, 2017 and the industries are required to meet the standards by December 31, 2017.

- **Expand CNG programme for public transport buses, taxis and autos on CNG and control toxic diesel emissions:** Move public transport vehicles including buses, taxis and autos to CNG to cut public health risk from toxic diesel emissions that is a class I carcinogen. Phase out diesel run auto rikshaws.
- **Promote zero emissions battery operated vehicles as feeder for integration and in targeted commercial areas to be pedestrianised:** Notify commercial areas with high footfalls and good public transport connectivity to be pedestrianized. These areas can be supported by zero emission battery-operated shuttle and feeders, electric three-wheelers and buses. Plan infrastructure for charging and battery disposal.
- **Install vapour recovery systems in fuel refueling outlets** to reduce evaporative emissions of benzene which is very harmful. CPCB has already issued direction for installation of stage I and Stage II vapor recovery system in all retail outlets with capacity 3000 klm and more in 46 million plus cities by December 2017. All retail outlets should comply with this.
- **To ensure 100 per cent compliance with the Pollution Under Control (PUC) programme link PUC certificates with annual vehicle insurance.**
- **Ensure stringent and regular auditing of PUC centres and calibration of PUC equipment with strong penal action against defaulters.**
- **Enforce all emissions testing parameters:** As provided by the Notification of 2004 of Ministry of Road Transport and Highways implement testing of all parameters for petrol vehicles that include concentration of carbon monoxide and hydrocarbon along with lambda measurements. Ensure smoke test for diesel vehicles are conducted properly. State government to coordinate with the central government for further tightening of PUC norms.
- **Create a roadmap for introducing centralised and mechanized emissions testing centres** for all commercial vehicles for advanced testing. Coordinate with the central government to tighten PUC norms especially for diesel vehicles.
- **Enforcement of law against visibly polluting vehicles:** impose penalty, launch extensive awareness drive against polluting vehicles.
- **Control and divert truck traffic from the city. Check overloading**
- **Ensure periodic hydro testing of CNG cylinders**

### Dust pollution

- **Phase-in mechanical and vacuum-based street sweeping wherever feasible and selective sprinkling of recycled water** (without compromising other water uses); and other appropriate measures. Introduce wet and mechanized vacuum sweeping of roads. Appropriate technology may be adopted.
- **Make construction bodies accountable for adopting dust control measures for road digging:** All road digging agencies to adopt appropriate dust dousing techniques and be made accountable and responsible for restoring the dug area with adequate dust control measures during and after construction.

Maintain pot hole-free roads for free flow of traffic to reduce emissions and dust.

- **Implement truck loading guidelines:** Use of appropriate enclosures for haul trucks and promote gravel paving for all haul routes.
- **Increase green cover in the city.** Undertake greening of open areas, gardens, community places, schools and housing societies to control windblown dust.
- **Enforcement of air pollution control in concrete batching** (use of water spray and wind breakers, bag filter at silos and enclosures, hoods, curtains etc)
- **Enforce series of directives from the Supreme Court and National Green Tribunal on ban on agricultural burning and recycling and reuse of straw waste.** Though this matter is not relevant within the municipal jurisdiction of Gurugram, coordinated action with the state government is needed to control agricultural stubble burning in the region as the air of Gurugram is extremely vulnerable to this seasonal problem. Ensure strict enforcement of ban on burning of agriculture waste and crop residues in the rural areas.
- **Increase subsidy for purchase of equipment that eliminates the need for burning stubble and straw. Promote reuse and recycling of waste straw from agricultural field**
- **Control episodic pollution. Fire crackers** – the Supreme Court order of November 25, 2016 that has banned fire crackers in Delhi and NCR should be enforced with stringency. Monitor its implementation and enforcement. Build public awareness to stop its use on all social occasions and events.
- **Open public spaces** will be provided to meet the URDPFI (Urban and Regional Development Plans Formulation & Implementation) Guidelines of 10-12 sqm per person, to create comfortable and healthy urban spaces.
- **Affordable housing** integrating EWS (15 per cent within influential area of the metro) will be included ensuring equity close to transit lines.

### Use of gen-set

- **Eliminate *chulha* burning in homes and eateries. Improve clean energy access to reduce air pollution public health risk.** Ensure access to clean energy -- LPG and electricity, in slums, low-income neighborhoods, urban villages as well as roadside eateries, *dhabas*, restaurants etc. Issue of commercial license for eateries should include conditional use of clean fuels. Maximise electricity generation in the state to ensure universal access. A targeted programme can be developed for wider distribution of LPG to all especially with improved ID documents for the urban poor.
- **Prohibit use of coal in hotels and restaurants**, and eliminate use of kerosene for cooking and incentivize move to LPG to reduce air pollution and public health risk.
- **Ensure that only those DG sets that meet the emissions standards are allowed to operate.**

- **Promote roof top solar power at building level to minimize use of DG sets.**  
Alternate power systems should be promoted in cell towers. The cost curve of rooftop solar power is already competitive vis a vis diesel generator sets.
- **Operating time of very large DG sets should be regulated according to graded response action plan** notified by the Ministry of Environment and Forests and Climate Change other than those meant for emergency and hospital services.
- **Only approved clean fuels should be allowed to operate big DG sets.**
- **Discourage DG sets in social events as per graded response action plan.**

## FACILITATING MOBILITY

### Walking and cycling

- **Design and implement network plan for footpaths on all roads, as per the revised code of Indian Road Congress (IRC).** Target specific network and kilometers of footpaths to be completed in a phased manner and cover the entire city. Identify roads where dedicated and wide footpaths and also cycle tracks, as per the people friendly street design guidelines. Adopt traffic calming measures for all streets.
- **Implement plan for more secondary street networks and un-gated streets to provide direct shortest routes for pedestrians and cyclists.** Vehicular traffic can also be redistributed from major junctions through multiple routes to decongest. Signal-free corridors should be avoided as far as possible as such road design impedes people's and public transport movement.
- **All traffic intersections will have safe pedestrian crossing facilities, with priority given to at-grade crossing facilities with pedestrian signals and signages.** These should be at-grade. Reduce block sizes to reduce walking and cycling distances.
- **Micro mapping of areas and commercial hubs with high footfall areas for pedestrianisation and also locally appropriate safe access solutions**
- **Synchronization of signals should be implemented on a priority basis with an integrated IT-based traffic management system** so that inspite of having frequent at-grade pedestrian crossings, traffic can move swiftly across signals.
- **Cycle sharing systems to be introduced as feeders to public transport** and expanded to cover entire city. Bicycle sharing schemes will be supported and promoted in partnership with the private sector. The MCG to set up shared infrastructure for bicycle stands for cycle users.
- **Make safety and walkability audits of walking and cycling infrastructure mandatory.**
- **Encroachment especially parking encroachment on walking and cycling lanes to be made punishable offence under the current provision of law**

### Bus services

- **Augment the bus fleet:** Currently there are 31 buses per lakh population serving the city of Gurugram. This fleet size will be increased to attain a ratio of 100 buses per lakh population. The fleet will feature an adequate mix of air conditioned buses.
- **Rationalise bus routes:** The bus route plan will be rationalized to ensure all households in Gurugram are within 200 m of a bus stop.
- **Introduce IT based system for passenger information service, monitoring and electronic ticketing:** The buses will feature hand held electronic ticket vending machines and will be fitted with GPS units for tracking and monitoring. Implement IT system in buses, bus-stops and control centre and passenger information systems for reliability of bus services, and



service monitoring. Integrate ITS in bus systems in cities of NCR including automated vehicle location, passenger information system, fare collection system.

- **Develop bus depot for bus parking and other developments:** Develop adequate parking space and depots to prevent on-street parking of buses. Multi-level bus parking in depots can more efficiently use available land area. Multi-modal, multi-use bus depots to provide high-class bus services and terminal experience to passengers. Integrated passenger terminals to be created with mixed use and multi-modal facilities for passenger comfort, integrating regional and local public transit systems.
- **Fare integration and common ticketing:** Bring ETVMs into all local buses. Common mobility cards to be the mandatory access card for buses. Need bus fare policy to ensure that it is affordable and remains competitive vis-a-vis the operational cost of two-wheelers.
- **Give right of way to buses:** Accord priority to buses through dedicated lanes and signal priority. Enforce bus lanes and keep them free from obstruction and encroachment.
- **Proper regulations and organization of para-transit including driver-training, certification**

### **Metro and multi-modal integration**

- **The existing metro and light rail systems will be extended to cover key long distance commuting corridors. The rationalized bus route plan will integrate metro and light rail system.**
- **The metro and light rail system will have state-of-the-art facilities for feeder systems including cycle rickshaws, auto rickshaws, feeder buses and cabs.**
- **Intermodal integration** (physical, information and fare) will be targeted to include the metro, light rail, city bus, non-motorised transport and para transit system.
- **Demarcation and development of Influence Zones around Metro stations as per transit oriented development policy** of Government of India to improve access to the public transport system and reduce dependence on cars.
- **NCR connectivity for public transport** – need bus and Metro plans. Rationalize routes and augment public transport in NCR on CNG mode.
- **Coordinate with the state government to rationalize entry taxes in NCR** under the NCR reciprocal agreement to lower costs of travel by public transport. This is needed to improve public transport connectivity.
- **Implement traffic impact assessment of infrastructure project for planning and management.**

### **Intermediate public transport**

- **Plan efficient deployment** of auto-rickshaws, e-rickshaws as efficient feeder system to connect all doorsteps, neighbourhoods, and public transport

nodes efficiently.

- **A signage system will be adopted to designate halting, parking and pick-drop locations** for cycle rickshaws and auto-rickshaws and taxis. Introduce GPS monitoring
- **Build para-transit based on zero emission electro mobility.** Support this initiative with network of charging stations.
- **Appropriate regulatory frameworks will be devised to enable cab and bus aggregators to complement and support the city's vision of its mobility system**

### Parking

- **Implement parking policy as a travel demand management measures:** This policy will seek to address the parking supply and enforcement issues, pricing of parking spaces, management of parking at neighbourhood level through techniques such as parking district management, introduction of proof of parking, etc.
- **Physically demarcate legal parking areas.** Equip them with metering systems, proper signages, IT for information to parkers on parking availability to reduce cruising time and on-street management.
- **Strict penalty for violation of parking regulations and walkway encroachment.** Parking on footpaths should be made a cognizable offence under the Delhi Municipal Corporation Act of 1957 and Police Act of 1978. Prevent and penalize parking of vehicles in the non-designated areas. Penalties related to parking should be charged 10 times the parking fee along with impounding of vehicles after a certain level of violation.
- **Existing and planned public parking facilities and on-street and off-street parking (including multi-level) facilities should be bundled for management by a single agency/ operator.** New stand-alone parking only sites are mostly not required since parking is permitted in all use zones.
- **Parking facilities within developments (e.g. commercial/ residential/ institutional) should be shared, common and priced** for enabling use by different types of users during different times of the day, thus bringing down total parking space demand.
- **Implement parking provision for buses, commercial vehicles and IPT-NMT modes, and for the differently-abled.**
- **Introduce and further upgrade variable time-based pricing, as per market demand.** Coordinated off-street and on-street / surface pricing in commercial and residential areas, and parking permits in residential areas. Parking should be charged as per duration, location in city and size of the vehicle.
- **Reform parking lease agreements to increase parking revenue for local area development and public transport improvement.**
- **Traffic impact including parking impact assessment and management will be integrated as a necessary component** of building permission system.

- **Use other fiscal measures like taxation, user fee, pollution tax etc for travel demand management**

### **Road safety**

- **Road safety audit system will be institutionalized** with systematic audits conducted for all major roads and intersections at regular intervals. Solutions to be implemented in time bound manner.
- **Specific audits for vulnerable sections of society will be conducted** along with road safety audits to ensure streets are safe for women, children and the elderly.
- **Street designs will be modified in tandem with audit results. Reduce vehicular speed with traffic calming measures while allowing people to use roads safely at grade**
- **Spatial database of road traffic collisions will be maintained** to inform the process of making streets safer for travel.
- **Stringent enforcement of traffic rules related to speed, lane driving etc.** Violations to attract stringent penalty.

### **Inclusive urban design**

- **Street-level activity and well-watched streets will be promoted.** This will include mixed-land use, transparent boundary walls without setbacks, hawking/vending zones and round-the-clock activities to have eyes on the street. Eliminate dark alleys, dead ends and entrapment areas, and other obstacles. Construct clean, well lit and walkable pavements, streets, parks, subways and other open spaces with well maintained public toilets.
- **Carry out periodic risk assessment and gender safety audits of public transport and public transport locations like bus stops, metro stations.** Adopt women safety protocols that will have to be followed by all including private public transport operators. Carry out annual survey of women commuters to calibrate action.
- **Design bus shelters to ensure visibility of passengers. Placement of advertisements and other utilities should not hinder visibility for passengers.**
- **Improve safety measures for commuting:** Facilities like public phone booths and panic alarm buttons to be made available at the bus stops. Bring greater gender sensitivity in operational schedule and rules related to usage of bus during nights. Training on women's safety and gender sensitivity should be made compulsory for implementing agencies. CCTV cameras should be made compulsory for all passenger vehicles carrying more than 20 passengers.
- **Adopt and mandate street design guidelines for differently-abled.** Indian Road Congress guidelines have been revised to integrate elements and principles for universal road design. These need to be mandated for all road development projects.
- **Promote compact city design and plan to reduce travel distances:** Compact

urban design that brings jobs, housing, services and recreation closer will be adopted to shorten travel distances and enable greater use of public transport, walking and cycling. Adopt high density mixed land use and mixed income development within the influence area of transit corridor. The street oriented buildings will have ‘active uses’ at ground floor with minimum 50 per cent un-tinted transparent frontage for enhancing safety of streets.<sup>1</sup> This will reduce energy and pollution intensity of transport.

- **Adopt and mandate active street design guidelines** to ensure safe, well designed and continuous pedestrian and cycling facilities without encroachment.<sup>2</sup> Integrate appropriate people friendly street design principles that are also sensitive to differentially-abled. Street design will be appropriate for large scale walking and cycling activities, enable traffic calming measures, integrate tree and vegetative cover for shading, water percolation and dust control, street furniture and amenities, and public art interventions. This will be implemented across the city and at neighbourhood scale with community participation.
- **Develop urban villages as part of compact mixed-use and mixed income city design:** Develop key urban villages like Sikanderpur as a model urban village. This may demonstrate an integrated project that includes multiple principles including non-motorised access, mixed-use development, efficient access to transit corridor, participative design, affordable rental housing for poor and migrants, and public space design.
- **Implement street design guidelines for footpaths and cycle tracks with adequate vegetative buffers and paving of roads.** Take steps for blacktopping and paving of road shoulders to avoid road dust. The Supreme Court order dated December 16, 2016 has directed repair and building of pavements and vacuum cleaning of roads. This needs to be expedited and implemented.

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1 Ensure effective implementation of Transit Oriented Development (TOD) policy notified by the Government of India for management of overall city development. Transit oriented development, being a multi- disciplinary concept, requires cooperation and co-ordination of different authorities as well as public and a reliable fund generating mechanism for effective management.

2 In Delhi, UTTIPEC under Delhi Development Authority has framed comprehensive street design guidelines.

## PROMOTING ENERGY-EFFICIENT LIVING

- **Enforce Energy Conservation Building Code:** Haryana government has made implementation of the Energy Conservation Building Code (ECBC) mandatory, in all its departments and organizations as well as commercial complexes, shopping malls, hotels, restaurants, banquet halls, cinema halls, auditoriums, clubs, convention centres, concert halls, office buildings, IT parks, BPOs etc. This will be implemented within a stringent compliance framework. Quickly adopt the revised ECBC of the Bureau of Energy Efficiency that has reformed some critical parameters including temperature setting for heating, ventilation and air conditioning; reduced use of glass in façade to below 40 per cent, introduced energy efficiency targets for buildings among others. ECBC is mandatory for all new commercial buildings having a connected load of 100 kW.
- **Extend the coverage of ECBC to Multi-Storey Residential Buildings.**
- **Set operational energy efficiency target for buildings based on BEE's energy star rating programme for buildings.** Moreover, the new ECBC has also introduced graded energy efficiency levels including – minimum energy efficiency as per the ECBC requirement; energy efficient buildings that are better than the ECBC requirements and the super efficient buildings.
- **Perform mandatory energy audit for new and existing commercial buildings with connected load of 100 kW and existing government and institutional buildings:** Reduce energy expenditure over previous year, and provide graded levy of connection charges and relaxed tariff for compliant buildings to encourage energy performance monitoring of buildings.
- **Use of glazing should be within 30-40 per cent of the building façade to prevent trapping of heat and increased demand for cooling.**
- **Actively promote passive architectural and design features for efficient use of energy in housing, commercial and industrial sector.** Actively promote appropriate orientation, use of day lighting, shading techniques, ventilation, among others to leverage local climatic advantages to improve level of comfort and reduce dependence on mechanical cooling.
- **Build awareness through dissemination to promote more energy efficient cooling systems**
- **Leverage the green energy conservation fund set up by Haryana Government.** This may be leveraged to scale up implementation of new solutions.
- **Promote energy efficient appliances:** Promote super-efficient household appliances, implement Indian Seasonal Energy Efficiency Ratio (ISEER) for room air conditioners, promote solar based efficient water-pumps in different sectors, outdoor and common area lighting with LED, and build consumer awareness. Simultaneously, promote use of refrigerants with global warming potential less than 100.
- **Promote use of environment friendly and recycled material:** Promote material with low embodied energy that includes material that are locally available and therefore do not require high energy wastage in importing

them over long distances; or material that do not involve processing with high energy intensity etc. Also about 20 per cent of materials should be from recycled waste. Consider use of fly ash bricks, hollow bricks, AACs, fly ash lime gypsum blocks, compressed earth blocks, and other environment friendly materials.

- **Promote open spaces:** Maximize Open Space by providing a high ratio of open space to development footprint to promote biodiversity and reduce Heat Island Effect.
- **Open parking areas** - More than 50 percent of the total paved area shall have pervious paving or open grid pavement or grass pavers, or a minimum 50 percent of the total paved area (including parking) shall have shading by vegetated roof or pergola with planters, or high-albedo surface materials and use cool roofing materials for the available roof space with high SRI.
- **Street lighting:** Mandate the use of LEDs in street lighting. LEDs consume less wattage and provide efficient lux level for the specified space. The use of efficient lighting infrastructure can help reduce energy usage between 25 to 60 per cent.
- **Sensors for automatic on/off of street lights** - Automatic street lights ensure that energy is not wasted by lights turned on during day time. Many streetlights in India face this problem due to faulty manually controlled street lights. Manual control involves labor costs, energy wastage and poor efficiency. MCG needs to install automatic sensors. Operational optimization such as use of twilight switching controls, dimming and voltage optimization, can lead to an energy savings of 15-20 per cent.
- Installation of power savers in street lights can substantially reduce the energy consumption. The use of power savers in street lights can reduce 30 per cent of electricity consumption.
- **Proper pump-system design (efficient Pump, pumps heads with system heads) and installation of variable speed drivers:** Adjusting pump speed or using Variable Speed Driver to adjust speed is a way to decrease losses in pumping processes.
- **Power saver installation in pump house:** Plugging of leakages in the water supply system and use of efficient pumps and motors is very important. Often electricity use and bills from water pumping can be burdensome for municipality. Water pumping is one of the major utility practices which consume high energy. BEE in its Manual for Development of Municipal Energy Efficiency Projects states that 25 per cent energy savings can be obtained from initiatives in water systems alone. Pumping systems are utilized in water treatment plants of the municipal corporations whose energy efficiency can also be determined through efficient system design. A considerable amount of energy can be saved taking suitable measures in STP.
- **Implement on time and with scale the existing notification No. 22/52/2005-5 Power** under the Energy Conservation Act, 2001 of Haryana Government that has specified the minimum capacity installation of solar photovoltaic power plant for different category of buildings and areas and these are mandatory. The requirement will be progressively increased. These include:
  - All new residential buildings built on a plot size of 500 square yards and

above falling within the limits of Municipal Corporations, Municipal Councils, Municipal Committees, Haryana Urban Development Authority (HUDA), Haryana State Industrial and Infrastructure Development Corporation (HSIIDC) sectors will install capacity of solar photovoltaic power plant. The minimum capacity will be of 1 Kilo Watt peak (KWp) or 5 per cent of sanctioned load, whichever is higher.

- All private educational institutes, schools, colleges, hostels, technical/ vocational education institutes, universities etc with sanctioned load of 30 Kilo Watt (KW) will install minimum 5 Kilo Watt peak (KWp) Or 5 per cent of sanctioned load, whichever is higher.
- All government buildings and offices, government colleges, district institute of education and training (DIET), government educational institutions, universities, with sanctioned load of 30 Kilo Watt (KW) and above will install minimum 2 Kilo Watt peak (KWp) or 5 per cent of sanctioned load, whichever is higher
- All private hospitals and nursing homes, industrial establishments, commercial establishments, malls, hotels, motels, banquet halls and tourism complexes, with sanctioned load (i) of 50 Kilo Watt (KW) to 1000 Kilo Watt (KW); (ii) above 1000 Kilo Watt (KW) will have to install minimum 10 Kilo Watt peak (KWp) or 5 per cent of connected load, whichever is higher; (ii) Minimum 50 Kilo Watt peak (KWp) or 3 per cent of sanctioned load, whichever is higher.
- All new housing complexes, developed by group housing societies, builders, housing boards, on a plot size of: (i) 0.5 Acre to 1.0 Acre; (ii) More than 1.0 Acre to 2.0 Acres; (iii) More than 2.0 Acres to 5.0 Acres; (iv) More than 5.0 Acres. They will install (i) Minimum 10 Kilo Watt peak (KWp) (ii) Minimum 20 Kilo Watt peak (KWp) (iii) Minimum 30 Kilo Watt peak (KWp) (iv) Minimum 40 Kilo Watt peak (KWp).
- All water lifting stations of Irrigation Department with connected load of 100 Kilo Watt (KW) and above will install minimum 50 Kilo Watt peak (KWp) or 3 per cent of connected load, whichever is higher.
- All the organizations and user categories will have to ensure compliance within six months from the date of issue of concerned department's new guidelines and notification at their own cost, failing which, the penal action may be initiated by the respective departments.
- **Solar rooftop programme to be expanded and leveraged to minimize use of diesel generator sets**
- **Solar water heating shall be provided to meet 20 per cent of the hot water demand** of the commercial and institutional building or as per the requirement of the local building bye-laws, whichever is higher. Residential buildings are also recommended to meet its hot water demand from solar water heaters, as far as possible.
- **It is mandatory to use the Solar Water Heating System in all the buildings stated above and also in case of all other buildings having plot area more than 1000sq.m and all public buildings. Promote solar water heating systems in residential buildings.**

- **The sharing concept shall be introduced**, whereby a consumer who owns multiple properties in the state can install a solar plant in one location and wheel the excess power to the other locations with a reasonable wheeling charge.
- **Energy generated under this model to be considered for DISCOMs Renewable Purchase Obligation (RPO).**
- **Develop Gurugram as a ‘Solar City’:** The Solar Cities programme of Ministry of New and Renewable Energy (MNRE), aims at minimum 10 per cent reduction in projected demand of conventional energy at the end of five years. Out of this 5 per cent should be from renewable energy source.
- **Implementation of stringent norms and enforcement of RPO to ensure implementation of more projects under the REC mechanism:** Solar Purchase Obligation will be hiked to 3 per cent by 2021-22, which may further increase to 8 per cent under the ambitious plans of MNRE to promote Solar Generation by adding 100 thousand MW of Solar Power Nationwide, this would mean the installed capacity in Haryana would rise up to 3200 MW.
- **Promote development of Solar Parks** through a joint Venture company has been formed by HSIIDC and HPGCL named “Saur Urja Nigam Haryana Limited” (SUN Haryana). State Government shall provide Capital / generation subsidy/ incentives to Schools, Private and Public Institutes hospitals and commercial buildings for installation of rooftop solar power plants.
- **Creation of separate fund to develop required infrastructure to attract more renewable energy projects**



## MANAGING URBAN WASTE

- **Take stringent action against open burning** of biomass, leaves, tyres etc to control such activities. Impose a complete ban on garbage burning.
- **Ensure proper collection of horticulture waste (biomass) and composting-cum-gardening approach:** Municipal offices should be responsible for controlling burning of leaves and garbage on roads and parks. All horticulture agencies should have compost pits in parks. MCG has started setting up of composting facilities. This has to be scaled up and expanded across the city. Involve RWAs in composting and reusing the compost locally.
- **Action on decentralised solid waste disposal, reuse and recycle should be strengthened to prevent open disposal and burning of waste.**
- **Implement the order of 21 April 2017 of the Municipal Corporation of Gurugram (MCG) that directs all C&D waste generators to be responsible for collection, segregation and storage of C&D waste.** MCG has already issued order related to segregation of C&D waste streams, identified eight dumping sites for collection of C&D waste, and specified all developers to submit plan for the cleanup. Violation of the conditions will be punishable under sub-section (1) of section 15 of the Environment (Protection) Act, 1986. Each failure is punishable with imprisonment for a term which may extend to 5 years or fine upto Rs 1 lakh or both and with repeated violation additional fine will be imposed at Rs 5000 for every day and for as long as the contravention continues. This needs to be enforced with stringency.
- **Set up strong monitoring and surveillance system for implementation of the C&D rules and on-site dust control measures:** Implement inspection of construction sites for enforcement of dust control measures. Adopt appropriate measures for control of fugitive emissions from construction and material handling, conveying and screening operations. This can be done with water sprinkling, curtains, barriers and dust suppression units. Impose stringent penalty that acts as a deterrent.
- **For material handling and construction demolition, it should be obligatory on part of the developers to provide evidence of debris disposal at designated sites.** Promote recycling of construction material. Implement provision of Central regulations for construction and demolition waste.
- **Promote reuse and recycling of construction and demolition waste.** The MCG is setting up a C&D recycling plant in Gurugram. Expand capacity for recycling waste.
- **Urban local body to make an action plan on waste management** in accordance to the Solid Waste Management Rules of 2016 with a time bound strategy. There are several policies and rules that govern this sector.<sup>1</sup>

<sup>1</sup> The state government has already enacted the Solid Waste Management (SWM) Rules 2016, C&D Waste Management Rules 2016, The Plastic waste Management Rules 2016, Biomedical waste management rules 2016, Hazardous and Other waste Rules 2016, and E-waste Rules 2016, waste is operationally handled in Haryana under. Moreover, the Haryana Municipal Corporation Act 1994 is also powerful. This provides strong legal backing and mandate for decentralized waste management at the local level.

This plan will include the following key elements:

- **Adopt the approach of near zero landfill city and initiate bio-remediation of the Bhandwari landfill.** The MCG has already targeted to reduce the current outflow of daily solid waste to the Banwari landfill site on Gurugram-Faridabad Road from close to 700 tonnes per day to 100 tonnes per day. This should be progressively reduced to near zero level.
- **Promote waste segregation at source:** Segregate waste streams at household level into wet, dry and domestic hazardous waste. Introduce appropriately coloured bins. The first step for the municipality would be to ensure segregation at source while creating processing facilities. Many localities in Gurugram already have composting units, but for running them successfully segregation at source is necessary.
- **User fee to be paid by generator:** Refer to draft sanitation bye-laws issued by the Union Ministry of Urban Development. Also, all resident welfare and market associations and gated communities with an area above 5,000 sq m will have to segregate waste at source. The mechanism for enforcement of user fee along with billing system will be defined and enforced.
- **Bio-degradable waste should be processed, treated and disposed of through composting or bio-methanation within the premises as far as possible and the residual waste shall be given to the waste collectors** or agency as directed by the local authority. Municipal Corporation of Gurugram has started to implement composting infrastructure in targeted areas. This will have to be augmented and scaled up across the city.<sup>2</sup>
- **Spot fines on littering**
- **Mapping and integration of concerned stakeholders with solid waste management:** Include urban local bodies, RWA's, market associations, commercial centres, hotels, NGOs and CBOs, academicians and informal sector.
- **Composting at the community and RWA level to be promoted:** Composting in schools and commercial areas should also be promoted under PPP model. The MCG can help create a market for compost sale under the MDA guidelines. Offices and commercial centres would need to adopt decentralized waste management in their campus/surroundings.
- **Build public awareness programmes:** MCG in assistance with NGOs, RWAs to conduct demonstration and awareness programmes. Ensure involvement of children in the process.
- **Inclusion of informal sector in waste management and disposal**
- **Waste to energy plants may be set up based on best available technology, and minimal population exposure to pollution.** Currently, one waste to

<sup>2</sup> Within a year of setting up composting capacity by the MCG, it has increased from 2.5 tonnes per day to 7.5 tones per day. MCG has created composting facilities in Nasikpur and Gaushala and is starting in Police Line. As on May 12, 2017, 7195 kg per day was taken for composting in Nasikpur and 3240 kg/day I Gaushala. This will be scaled be scaled up across the city.

energy plant is coming up in Banwari.

- **Implement roadmap to reduce plastic use.** Ban plastic use as far as possible and especially plastic below 50 microns and disposable plastic.
- **Aggressively promote use of biodegradable** plastics and cotton cloth and jute bags to be initially supplied by the MCG.
- **Recognise the recyclers and dealers in the city** and authorising them.
- **Encourage collection centres** under the EPR model as per the plastic waste management rules, 2016
- **Introduce spot fines on littering and for usage of disposable plastic.** Give decentralize power to different authorities to impose the ban.
- **Integration of informal sector in the EPR framework of the city for plastic waste management.**
- **Incentives to be given to consumer for depositing used plastic bottles (PET),** other articles in the form of coupons- a vending machine system to be created.
- **For an integrated solution, a waste pickers audit should be conducted and they should be induced in the formal waste system** with ID cards as “sanitation workers of MCG”. They should have greater respectability with right to education and health facilities in the city. Some of them should be encouraged to open waste recycling facilities.
- **Need better equipments of waste workers, better and well-maintained dustbins, better processes and more motivation and training.** Waste recycling facilities need to be started. One C&D facility is being started by IL&FS. We need more decentralised scientific recycling facilities than just the kabadiwallas conducting informal recycling. Regular, e-waste drives are the need of the hour.
- **Municipal Corporation of Gurugram has launched a waste management portal that enables RWAs to collaborate** with MCG for effective waste management. MCG is expected to impact training on segregation and management. This may be actively and effectively utilised.

***Note: Construction and demolition waste to be regulated and addressed as discussed in section on air pollution from C&D waste.***

## ENSURING SUSTAINABILITY FOR ALL

- **Master plan and land use plan to earmark zones for affordable housing and self constructed housing for the poor that are accessible and have adequate basic services.** Land needs to be earmarked with no change of land use requirements. As appropriate, land and property entitlements and titles will be worked out for the poor households. Haryana Government schemes for affordable housing will offer subsidized rates and loans, to better cater to low income groups. Self constructed housing will also require policy and fiscal support.
- **Ensure infrastructural services including water supply and sanitation, health and educational facilities. Connectivity to the work place, proximity to transport systems should get priority.**<sup>1</sup>
- **Promote appropriate building typologies and promote affordable rental housing options for the poor to provide wider choices and flexibility to live close to workplace:** Urban poor households are highly stratified – from chronically poor and shelter less to low income households. This requires different approaches to building typologies – small affordable dwelling units, small rental accommodation, dormitories with shared facilities and night shelters. Also provide common area facilities, and utilities, along with basic services.
- **Promote appropriate architecture and low cost material to provide comfortable and safe dwelling units to the poor.** Support and provide professional help to poor households to build safe houses with adequate thermal comfort.
- **Develop model urban villages as an integrated part of compact and inclusive city sensitive:** It is reiterated here that urban villages should be part of compact mixed-use and mixed income city design. Urban villages are the key source of rental housing for the poor. These urban villages like Sikanderpur should be developed as model urban villages that are sensitive to the needs of the poor households and demonstrate multiple principles including non-motorised access, mixed-use development, transit corridor, participative design, affordable rental housing, and public space design in an integrated project.
- **Appropriate fiscal strategy and incentives to fund and support affordable housing development.** Informal urban settlements of the poor emerge out of the informal economy that contributes to the overall urban economy of the city. Poor households have unique housing and livelihood requirements that should be addressed through appropriate building typologies and be kept within the affordable range.

1 The new industrial licensing policy provides more than 20 per cent of the total area earmarked for worker housing, to promote a walk-to-work culture. In order to provide affordable housing for workers in industrial estates of HSIIDC, a special scheme is being formulated which leverages a central government scheme of making available, dwelling units at less than 10 lakh and/or EMI of maximum 4,000 per month ( Haryana 2031 Vision Statement). Need to improve existing infrastructure in terms of road network, water, power, sewage disposal and solid waste disposal infrastructure.

## PROTECTING THE GREENS

- Implement strategies for protection of the Aravallis:** The entire Aravalli area need to be recorded as Natural Conservation Zone as is required by the Regional Plan 2021 and the Haryana Sub Regional Plan 2021, and the Gurgaon Final Development Plan 2031. The forests should be surveyed and demarcated by fixing permanent boundary pillars. *Gairmumkinpahar* and wastelands in the Aravalli hills should be recorded as forest and earmarked for enhancing forest cover and forest lands while protecting the interest of the local community. Protect common land, including those in Panchayat land. Identify and protect wild life areas. The core area and buffer of Mangar Bani sacred grove that falls entirely in the Aravalli hills should to be accorded the highest level of permanent protection possible. Aravalli Biodiversity Park in Nathupur will be protected as part of Natural Conservation Zone.
- Protection of bund lands:** The bunds of Gurgaon are notified forests and some of them have storm water drains adjacent to them. Because of moisture availability, these have become well wooded and are a linear habitat for birds and wild life. These bunds and associated water channels will be treated as a composite whole and protected as linear green belts and may be used as cycle ways and walkways.
- At least 20 percent of forests need to be in dense category (at present there is barely any dense forest).** The Aravalli Biodiversity Park in Nathupur, Gurgaon, will be earmarked as a forest or protected area or Natural Conservation Zone. The stretch of Aravalli hills from Nathupur, Sikandarpur, Chakkarpur, Wazirabad, Hyderpur Viran, Ghata, Gwalpahari, Bandhwari needs to be protected as a linear stretch to prevent fragmentation.
- Green belts and planting of trees alongside roads, railway lines, canals, and other unutilised lands.** Green belts should be raised in urban and industrial areas. At least 70 percent of its roads (equal to or above 30 feet width) to have avenues of trees at least 5 meters high with at least 5 meters spacing between trees measured linearly. Incentivise sectors to increase green cover.
- All resident families need to have green space within 2 km of aerial distance of at least 5 hectares area for providing multiple forest ecosystem services.** Efforts will be made to achieve the international standards on green spaces. WHO prescribes a requirement of 9 square metres per person and ISO 37120 lays down standards for city indicators for livable cities.
- Develop mandatory guidelines for the protection of areas providing eco system services:** This plan needs to include ground water recharge zones, stream buffers, flood plains, water bodies, forest and vegetation areas, ponds lakes, and sacred groves. This is important to protect water catchment of this water stressed city.
- Mapping of natural forests and plantation and protection of linear strip of vegetation**
- Beneficiaries of mining and quarrying should be required to repair and re-vegetate the area in accordance with established forestry practices.**

- **Infrastructure and road building projects need to minimize requirement of tree felling and ensure replanting:** Approval for road and infrastructure project should be granted based only after the construction agencies have indicated the planned alignment and design interventions that will minimize the need to fell full grown trees in the city. This planning should be done based on actual tree counting in the project affected areas before and after completion of the project. Area should be earmarked for compensatory afforestation and plantation much in advance, and survival of plantation should be strictly monitored.

## ENABLING AND SUPPORTING COMMUNITY ACTION

- **Community is a major stakeholder and partner** in change to meet sustainability goals in Gurugram. Powerful change is possible if community is incentivized to take action, undertake monitoring and reporting.
- **Involve Resident Welfare Associations and local residents for participatory planning** of neighbourhood and resource management including water, waste, and energy management and protection of greens. There can be joint campaigns such as the recent one in which MCG along with citizens group has initiated jaljagruti campaign to promote and maintain rain water harvesting systems. More such initiatives can be taken forward.
- **RWAs can be rewarded publicly and recognised for their efforts.** They may enjoy rebates on taxes and utility bills based on efficiency gains and resource savings. RWAs can self-monitor and declare their sustainable initiatives as per a checklist to be prepared.
- **Involve local universities** in documentation as well as conceptualising and monitoring of new project.

## Annexure

### Policies and regulations in Haryana that have bearing on resource efficiency, savings and conservation

#### Forest

Forest Policy 2006  
 Indian Forest Act, 1927,  
 Forest Conservation Act, 1980,  
 Punjab Land Prevention Act, 1900

#### Land/ Building

The Punjab Urban Immovable Property Tax (Haryana Validation) Act, 1981  
 The Haryana Public Premises and Land (Eviction and Rent Recovery) Act, 1972  
 The Haryana Registration and Regulation of Societies Act, 2012  
 The Haryana Requisitioning and Acquisition of Immovable Property Act, 1973  
 The Haryana Special Economic Zone Act, 2005  
 The Haryana Urban (Control of Rent and Eviction) Act, 1973  
 The Haryana Urban Development Authority Act, 1977  
 The Haryana Urban Development Authority Act, 1977  
 The Punjab Consolidation of Land Proceedings (Validation) Act, 1957  
 The Punjab Land Improvement Schemes Act, 1963  
 The Punjab Village Common Lands (Regulation) Act, 1961  
 The Punjab Village Common Lands (Regulation) Act, 1961  
 The Societies Registration (Haryana Amendment) Act, 2001  
 The Haryana Building Code, 2017  
 Urban Local Bodies Department (Group A) Service Rules, 2009  
 Urban Local Bodies Department (Group B) Service Rules, 1997  
 Urban Local Bodies Department (Group C) Service Rules, 1997  
 Urban Local Bodies Department (Group D) Service Rules, 1996

#### Building construction

Haryana Municipal Service Rules, 2010 & Amendment, 2013  
 Haryana Slum Clearance Board Rules, 1990  
 Haryana Urban Infrastructural Development Boards Rules, 2002  
 Haryana Building Code 2016  
 Energy Conservation Building Code, 2007  
 HUDA (Erection of building) amendments regulations 2008: Guide Lines regarding Registration of Independent Floor (March 2009)

#### Power/Renewable

The Indian Electricity (Haryana Amendment) Act, 1987  
 Energy Conservation Act 2001  
 Haryana Solar Power Policy, 2016

#### Water Supply/ Sanitation

The Haryana Municipal Act, 1973  
 The Haryana Municipal Act, 1973  
 The Haryana Municipal Corporation Act, 1994  
 The Haryana Municipal Corporation Act, 1994  
 The Haryana Rural Sanitation Board Act, 1972



**Transport**

Haryana Motor Vehicle Rules 1993  
Carriage by Road Act, 2007  
Carriage by Road Rules, 2011  
Haryana Motor Vehicles Taxation Act 2016  
Haryana Motor Vehicles Taxation Rules, 2014  
The Haryana Motor Transport Vehicles (Toll Tax) Act, 1991  
The Haryana Motor Vehicles Taxation Act, 2013  
The Motor Vehicles (Haryana Amendment) Act, 1977

**Solid waste management**

Municipal Solid Waste Management Rules 2016  
Construction and Demolition Waste Management Rules 2016  
The Haryana Non-Biodegradable Garbage (Control) Act, 1998  
The Haryana Non-Biodegradable Garbage (Control) Act, 1998

## Endnotes, references and bibliography

### Endnotes

#### SEWAGE

- 1 Sunita Narain and others 2012, *Excreta matters volume 2*, Centre for science and environment, New Delhi
- 2 Sunita Narain and others 2012, *Excreta matters volume 2*, Centre for science and environment, New Delhi
- 3 David Emanuel Andersson 2014, *Cities and private planning*, UK
- 4 Gurgaon First, 2017, Gurugram Handbook on Waste Management: A handbook on waste management: Issues and solutions and key stakeholders in the industry
- 5 Gurgaon First, 2017, Gurugram Handbook on Waste Management: A handbook on waste management: Issues and solutions and key stakeholders in the industry
- 6 Sunita Narain and others 2012, *Excreta matters volume 2*, Centre for science and environment, New Delhi
- 7 Gurgaon First, 2017, Gurugram Handbook on Waste Management: A handbook on waste management: Issues and solutions and key stakeholders in the industry
- 8 Gurgaon First, 2017, Gurugram Handbook on Waste Management: A handbook on waste management: Issues and solutions and key stakeholders in the industry

#### AIR POLLUTION, MOBILITY AND ROAD SAFETY

- 1 Gurgaon First, 2017, "Issues and Solutions in Smart Mobility" for Workshop on Smart Mobility Solutions for NCR, Mimeo
- 2 Anon, 2008, Study on Ambient Air Quality, Respiratory Symptoms And Lung Function Of Children In Delhi, [http://cpcb.nic.in/upload/NewItems/NewItem\\_123\\_children.pdf](http://cpcb.nic.in/upload/NewItems/NewItem_123_children.pdf) as accessed on May 8, 2017
- 3 2010, Health Effects Institute, Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects, Special Report 17, Health Effects Institute, Boston, USA
- 4 Gurgaon First, 2017, "Issues and Solutions in Smart Mobility" for Workshop on Smart Mobility Solutions for NCR, Mimeo
- 5 Anon, 2005-15, Statistical Abstract Haryana, Department Of Economic And Statistical Analysis, Haryana 2015, Government of Haryana, <http://esaharyana.gov.in/Default2.aspx?PName=State%20Statistical%20Abstract%20of%20Haryana> as accessed on May 8, 2017
- 6 Economic survey of Delhi-2014-15, Statistical Abstract of Haryana- 2014-15 and Census of India- 2011
- 7 Chetna Choudhary, July 30, 2016, The Times of India, <http://timesofindia.indiatimes.com/india/After-20-hour-Gurujam-nightmare-now-Haryana-Delhi-blame-game/articleshow/53458206.cms> as accessed on May 8, 2017
- 8 Gurgaon First, 2017, "Issues and Solutions in Smart Mobility" for Workshop on Smart Mobility Solutions for NCR, Mimeo
- 9 Anon, 2014-15, Statistical Abstract Haryana, Department Of Economic And Statistical Analysis, Haryana 2015, Government of Haryana, <http://esaharyana.gov.in/Default2.aspx?PName=State%20Statistical%20Abstract%20of%20Haryana> as accessed on May 8, 2017
- 10 Gurgaon First, 2017, "Issues and Solutions in Smart Mobility" for Workshop on Smart Mobility Solutions for NCR, Mimeo
- 11 Gurgaon First, 2017, "Issues and Solutions in Smart Mobility" for Workshop on Smart Mobility Solutions for NCR, Mimeo
- 12 Anon, 2010, Integrated Mobility Plan for Gurgaon Manesar Urban Complex, Department of Town and Country Planning (DTCP), Government of Haryana, <http://www.wricitieshub.org/sites/default/files/Integrated%20Mobility%20Plan%20for%20Gurgaon%20Manesar%20Urban%20Complex.pdf> as accessed on May 8, 2017
- 13 Press Release, December 23, 2014, Concern over poor air quality and traffic congestion in Gurgaon: action must gather momentum to protect public health, Centre for Science and Environment, New Delhi, <http://www.cseindia.org/content/concern-over-poor-air-quality->

[and-traffic-congestion-gurgaon-action-must-gather-momentum-pro](#) as accessed on May 8, 2017

- 14 Anon, 2010, Integrated Mobility Plan for Gurgaon Manesar Urban Complex, Department of Town and Country Planning (DTCP), Government of Haryana, <http://www.wricitieshub.org/sites/default/files/Integrated%20Mobility%20Plan%20for%20Gurgaon%20Manesar%20Urban%20Complex.pdf> as accessed on May 8, 2017

#### ENERGY

- 1 Indian Power Sector.Com
- 2 Ministry of New & Renewable Energy, Solar R&D division, *State wise Estimated Solar Power Potential in the Country*
- 3 Haryana Renewable Energy Development Agency (Hareda) Haryana Government Renewable Energy department Order dated 21st March, 2016

#### SOLID WASTE

- 1 Order Dated 18.11.2015, "Places designated for disposal of Construction & Demolition Waste", Municipal Corporation, Gurgaon. Found at: <http://www.mcg.gov.in/PDF/C&DWasteandUserChargesofSWM.pdf> Accessed on 8<sup>th</sup> May 2017
- 2 Notification Gazette of India G.S.R 317(E), dated 29<sup>th</sup> March 2016: Ministry of Environment, Forest and Climate Change. Found at: <http://www.moef.gov.in/sites/default/files/C%20&D%20rules%202016.pdf> Accessed on 8<sup>th</sup> May 2017
- 3 Shilpy Arora, "Gurugram's First Debris Recycle Plant at Basai", The Times of India, published on 06 April, 2017. Found at: <http://timesofindia.indiatimes.com/city/gurgaon/gurgaons-first-debris-recycle-plant-at-basai/articleshow/58037576.cms> as accessed on 9<sup>th</sup> May 2017
- 4 Common Floor: Ongong projects in Gurgaon. Found at: <https://www.commonfloor.com/gurgaon-property/projects/status-ongoing>. as accessed on 09, May 2017
- 5 OA 317 of 2013: NGT Bar Assc v. Municipal Corporation of Gurgaon and Ors: National Green Tribunal, Delhi. Found at: <http://www.indiaenvironmentportal.org.in/files/construction%20waste%20Gurgaon%20NGT.pdf> As accessed on 9<sup>th</sup> May 2017

#### SUSTAINABILITY FOR ALL

- 1 Anon, 2009, Haryana State Development Report 2009, Planning commission of India. Found at: [planningcommission.nic.in/plans/stateplan/sdr/sdr\\_haryana1909.pdf](http://planningcommission.nic.in/plans/stateplan/sdr/sdr_haryana1909.pdf) as accessed on 9<sup>th</sup> May 2017
- 2 Census of India 2011
- 3 Proceedings of CSMC Meeting held on 11.08. 2016: Pradhan Mantri Awas Yojana, Haryana. Found at: <http://www.mhupa.gov.in/writereaddata/csmc11Haryanappt.pdf> as accessed on May 08 2017
- ix Mukta Nair, 2015, *Informal Rental Housing Typologies and Experiences of Low-income Migrant Renters in Gurgaon, India*, Environment and Urbanization Asia, published by SAGE. Found at: <http://www.gmda.in/wp-content/uploads/2016/gda/Feedbacks/MuktaNaikMigrantsAndInformal.pdf> as accessed on 9<sup>th</sup> May 2017
- 4 Anon, 2012 "Gurgaon Development Plan 2031", Town and Country Planning Department, Haryana Government. Found at: <https://www.tcpharyana.gov.in/Notification/1662016Mangar%20Bani%20notification-Annexures-13.6.2016.pdf> as accessed on May 03, 2017

#### CLIMATE CHANGE

- 1 Anon, 2015, *India State of Forest Report-2015*, Forest Survey of India, New Delhi. Found at: <http://fsi.nic.in/isfr-2015/isfr-2015-tree-cover.pdf> as accessed on 9<sup>th</sup> May 2017
- 2 Anon, 2010 "Preparation of Sub-Regional Plan for Haryana Sub-Region of NCR", Department of Town and Country Planning, Haryana. Found at: <https://www.tcpharyana.gov.in/ncrpb/Draft%20Final%20Report-Haryana%20Sub-Regional%20Plan%202021.pdf> Accessed on May 08 2017
- 3 Anon, 2017 "Haryana Vision 2030" Government of Haryana. Found at: [http://esaharyana.gov.in/Data/Planning/UNDP\\_2030.pdf](http://esaharyana.gov.in/Data/Planning/UNDP_2030.pdf). Accessed on May 05, 2017
- 4 Notification 7, May 1992: [No. 17/1/91-PL/IA: Ministry of Environment & Forest. Found at: <http://www.envfor.nic.in/legis/eia/aravalli.pdf>. As accessed on 8<sup>th</sup> May 2017
- 5 Anon, 2012 "Gurgaon Development Plan 2031", Town and Country Planning Department, Haryana Government. Found at: <https://www.tcpharyana.gov.in/Notification/1662016Mangar%20Bani%20notification-Annexures-13.6.2016.pdf> Accessed on May 03, 2017

- 6 OA No 167/2014 Lt. Col Sarvadaman Singh Oberoi v. Union of India & Ors: National Green Tribunal, New Delhi. Found at: <http://www.indiaenvironmentportal.org.in/files/gair%20mumkin%20pahar%20Aravalli%20NGT%20order.pdf> as accessed on 9<sup>th</sup>
- 7 Gazette Notification: 13 June 216, by Town and Country Planning Department, Haryana Government. Found at: <https://www.tcpharyana.gov.in/Notification/1662016Mangar%20Bani%20notification-Annexures-13.6.2016.pdf> as accessed on 8th May 2017
- 8 ISO 37120: 2014: Sustainable Development of Communities: Indicators for city services and quality of life. International Organization for Standardization, Geneva, Switzerland. Published on 2014-05-2015. Accessed on May 04 2017
- 9 Anon, 2006 “Haryana Forest Policy”, Forest Department, Government of Haryana, Panchkula. Found at: <http://haryanaforest.gov.in/pdf/Forest%20Policy%202006.pdf> as accessed on 9<sup>th</sup> May 2017
- 10 Planting at the Bund, Blog by Veena Padmanabhan *who volunteered with planting at the Bund on August 10, 2016*. <http://iamgurgaon.org/planting-at-the-bund/>

### References

Anon, 2009 “Haryana Development Report”, Planning Commission, Govt of India. Found at: [http://planningcommission.nic.in/plans/stateplan/sdr/sdr\\_haryana1909.pdf](http://planningcommission.nic.in/plans/stateplan/sdr/sdr_haryana1909.pdf) Accessed on May, 04, 17

Anon, 2010 “Preparation of Sub-Regional Plan for Haryana Sub-Region of NCR”, Department of Town and Country Planning, Haryana. <https://www.tcpharyana.gov.in/ncrpb/Draft%20Final%20Report-Haryana%20Sub-Regional%20Plan%202021.pdf> Accessed on May 08 2017

Anon, 2012 “Gurgaon Development Plan 2031”, Town and Country Planning Department, Haryana Government. Found at: <https://www.tcpharyana.gov.in/Notification/1662016Mangar%20Bani%20notification-Annexures-13.6.2016.pdf> Accessed on May 03, 2017

Anon, 2017 “Haryana Vision 2030” Government of Haryana. Found at: [http://esaharyana.gov.in/Data/Planning/UNDP\\_2030.pdf](http://esaharyana.gov.in/Data/Planning/UNDP_2030.pdf). Accessed on May 05, 2017

Research and Information System for Developing Countries, 2016 “India and Sustainable Development Goals: The Way Forward”. Found at: [http://ris.org.in/pdf/India\\_and\\_Sustainable\\_Development\\_Goals\\_2.pdf](http://ris.org.in/pdf/India_and_Sustainable_Development_Goals_2.pdf) Accessed on May 05, 2017

Niti Aayog, 2016, “Status Report on Sustainable Development Goals”. Found at: [http://niti.gov.in/writereaddata/files/Mapping-SDGs%20V19-Ministries%20Feedback%20060416\\_0.pdf](http://niti.gov.in/writereaddata/files/Mapping-SDGs%20V19-Ministries%20Feedback%20060416_0.pdf) Accessed on May 04, 2017

Prime Minister’s Council on Climate Change, GoI, “National Action Plan on Climate Change”. Found at: <http://www.moef.nic.in/downloads/home/Pg01-52.pdf> Accessed on May 08, 2017

Technology and Action for Rural Advancement, 2015 “Achieving the Sustainable Development Goals in India: A Study of Financial Requirements and Gap” Submitted to the MoEF & CC. Found at: [http://www.devalt.org/images/L3\\_ProjectPdfs/AchievingSDGsinIndia\\_DA\\_21Sept.pdf?mid=6&sid=28](http://www.devalt.org/images/L3_ProjectPdfs/AchievingSDGsinIndia_DA_21Sept.pdf?mid=6&sid=28) Accessed on May 09 2017

MOEF & CC, 2014, “India’s Progress in Combating Climate Change: Briefing Paper for UNFCCC COP 20 Lima, Peru”. Found at: [http://envfor.nic.in/sites/default/files/press-releases/Indian\\_Country\\_Paper\\_Low\\_Res.pdf](http://envfor.nic.in/sites/default/files/press-releases/Indian_Country_Paper_Low_Res.pdf) Accessed on May 10, 2017

Ministry of Statistics and Programme Implementation, 2015 “Millennium Development Goals India Country Report”, Central Statistics Office New Delhi. Found at: [http://mospi.nic.in/sites/default/files/publication\\_reports/mdg\\_2july15\\_1.pdf](http://mospi.nic.in/sites/default/files/publication_reports/mdg_2july15_1.pdf) Accessed on May 10 2017

Economic Survey of Haryana 2015-2016. Found at: <http://esaharyana.gov.in/Default2.aspx?PName=Economic%20Survey%20of%20Haryana> Accessed on May 08 2017

Department of Economic and Statistical Analysis, Government of Haryana, “Statistical Handbook of Haryana 2015-2016”. Accessed on May 07 2017

Mrs. Minakshi, “Slums in Haryana: A Geographical Study”, International Journal of Recent Research Aspects, September 2015. Found at: <http://www.ijrra.net/Vol2issue3/IJRRRA-02-03-21.pdf> Accessed on May 06, 2017

Government of Haryana, 2011, “State Action Plan on Climate Change (SAPCC)”. Found at: [http://www.nicra-icar.in/Action%20Plan%20on%20Climate%20Change%20Haryana\\_April25\\_2012.pdf](http://www.nicra-icar.in/Action%20Plan%20on%20Climate%20Change%20Haryana_April25_2012.pdf) Accessed on May 04 2017

Dr. J.S. Bedi, 2014” Background Paper on Issues related to Land Economics: Urbanization, Development and Housing Requirements in the NCR”, National Council for Applied Economic Research. No 105,.Accessed on May 06, 2017

ISO 37120: 2014: Sustainable Development of Communities: Indicators for city services and quality of life. International Organization for Standardization, Geneva, Switzerland. Published on 2014-05-2015. Accessed on May 04 2017

Smart Cities Sectional Committee CED 59, 2016, “Draft on Smart Cities Indicator”, Found at: [http://www.bis.org.in/sf/ced/CED59\(10000\)\\_30092016.pdf](http://www.bis.org.in/sf/ced/CED59(10000)_30092016.pdf) Accessed on May 04 2017

Anon, 2013, “Policy for Promoting Generation of Electricity Through Renewable Energy Sources”, Haryana Department of Renewable Energy. Found at: <http://hareda.gov.in//writereaddata/document/hareda159404632.pdf> accessed on May 06, 2017

Urban News Digest, 2017, “Gurgaon to develop its own Solid Waste Management Plan”, published on May 05, 2017. Found at: <http://www.urbannewsdigest.in/?p=7566> accessed on May 06 2017

Haryana Government New and Renewable Energy Department Directions: No.19/21/2016-5P. Found at: <http://hareda.gov.in//writereaddata/document/hareda177998167.pdf> accessed on May 09 2017

HAREDA Scheme: Financial Assistance for Energy Conservation Measures. Found at: <http://hareda.gov.in//writereaddata/document/hareda020386051.pdf> accessed on May 05 2017

Regional Plan document on Solid Waste Management Sector, National Capital Region Planning Board, Found at: [http://ncrpb.nic.in/pdf\\_files/13bmodified\\_ch09swm.pdf](http://ncrpb.nic.in/pdf_files/13bmodified_ch09swm.pdf)

International Centre for Environment Audit and Sustainable Development, March 2007, “Audit Report (Civil) on Waste Management in India: Environment Department”, (Haryana State Pollution Control Board). Found at: <http://iced.cag.gov.in/wp-content/uploads/2014/02/8.-PA-on-Waste-Management-in-Haryana.pdf> Accessed on May 06 2017

Lt. Col SS Oberoi vs Union of India & Ors:OA No.269/2013 National Green Tribunal. Found at: [http://greentribunal.gov.in/Writereaddata/Downloads/269-2013\(PB-II-Judg\)OA20-7-2015.pdf](http://greentribunal.gov.in/Writereaddata/Downloads/269-2013(PB-II-Judg)OA20-7-2015.pdf) accessed on May 05 2017

Haryana Town and Country Planning Department, 2013, “Affordable Housing Policy” 2013.. Found at: [http://greentribunal.gov.in/Writereaddata/Downloads/269-2013\(PB-II-Judg\)OA20-7-2015.pdf](http://greentribunal.gov.in/Writereaddata/Downloads/269-2013(PB-II-Judg)OA20-7-2015.pdf) Accessed on May 09 2017

Proceedings of CSMC Meeting held on 11.08. 2016: Pradhan Mantri Awas Yojana, Haryana. Found at: <http://www.mhupa.gov.in/writereaddata/csmc11Haryanappt.pdf> Accessed on May 08 2017

Chapter sustainable Development and Climate Change, Union Budget 2015-16. Accessed on May 10 2017

Union Budget 2016-2017 Press Release by Ministry of Finance, Press Information Bureau, Government of India, February 2016. Found at: <http://pib.nic.in/newsite/printrelease.aspx?relid=136981> accessed on May 10, 2017

Haryana Solar Power Policy, 2016, Haryana Department of Renewable Energy, Government of Haryana. Accessed on May 10, 2017.

Anon, 2014, Development of Gurgaon as a Solar city, Draft Master Plan, Municipal Corporation Gurgaon, I.C.L.E.I

Gurgaon First 2017, Gurugram handbook on waste management - A handbook on waste management; issues and solutions and key stakeholders in the industry, Gurugram

Gurgaon First 2017, Gurugram Renewable energy - A handbook, Gurugram

Anon, 2010, Preparation of Sub-regional plan for Haryana sub-region of NCR, Department of town and country Planning, Haryana, <https://www.tcpharyana.gov.in/ncrpb/Draft%20Final%20Report-Haryana%20Sub-Regional%20Plan%202021.pdf> as accessed on May 8, 2017

Anon, 2012, Press release, Instead of groundwater, Gurgaon builders can use treated sewage, Center for Science and Environment, <http://www.cseindia.org/content/instead-groundwater-gurgaon-builders-can-use-treated-sewage-cse> as accessed on May 8, 2017

Ajay Sura *et al*, 2012, New construction in Gurgaon put on hold to tackle water problem in The Times of India, TNN, Chandigarh/ Gurgaon, <http://timesofindia.indiatimes.com/city/gurgaon/New-construction-in-Gurgaon-put-on-hold-to-tackle-water-problem/articleshow/15011124.cms> as accessed on May 8, 2017

Vikas Kahol *et al*, 2012, Gurgaon builders left high and dry in India Today, Chandigarh/ New Delhi, <http://indiatoday.intoday.in/story/gurgaon-builders-left-high-and-dry/1/208705.html> as accessed on May 8, 2017

Hansa Malhotra, 2016, From Gurugram to Gurujam: Heavy Rains, Traffic and Twitter Outrage in the quint, <https://www.thequint.com/social-buzz/2016/07/28/gurgaon-gurugram-heavy-rain-traffic-jam-waterlogging-people-took-to-twitter-to-express-anger-gurgaon-administration> as accessed on May 9, 2017

Chetna Choudhary, 2016, After 20-hour Gurujam nightmare, now Haryana-Delhi blame game, Gurgaon The Times of India, <http://timesofindia.indiatimes.com/india/After-20-hour-Gurujam-nightmare-now-Haryana-Delhi-blame-game/articleshow/53458206.cms> as accessed on May 9, 2017

Anon, 2007-08, Statistical Abstract Haryana, Department Of Economic And Statistical Analysis, Haryana 2009, Government of Haryana, <http://esaharyana.gov.in/data/StatisticalAbstract.pdf> as accessed on May 4, 2017

Anon, 2013-14, Statistical Abstract Haryana, Department Of Economic And Statistical Analysis, Haryana 2015, Government of Haryana, [http://esaharyana.gov.in/Data/StateStatisticalAbstract/StatisticalAbstract\(2013-14\).pdf](http://esaharyana.gov.in/Data/StateStatisticalAbstract/StatisticalAbstract(2013-14).pdf) as accessed on May 4, 2017

Liju Mathew, 2013, Planning For Bicycle Infrastructure-- A Case of Gurgaon City, 6th Urban Mobility India Conference & Expo-2013, Manekshaw Centre, Near Dhaula Kuan, New Delhi, <http://www.urbanmobilityindia.in/Upload/Conference/1e0c98ee-9128-4c59-a6d3-09be84e3858a.pdf> as accessed on May 4, 2017

Anon, 2010, Integrated Mobility Plan for Gurgaon Manesar Urban Complex, Department of Town and Country Planning (DTCP), Government of Haryana, <https://tcpharyana.gov.in/CIM/Doc/gurgaon%20mobility%20plan.pdf> as accessed on May 4, 2017

Priyavrat Bhati *et al*, 2017, Solar Rooftop- Replacing Diesel Generators in Residential Society, Center for Science and Environment, <http://cseindia.org/userfiles/Policy-Brief-Solar-Rooftop-Replacing-Diesel-Generators-in-Residential-Societies.pdf> as accessed on May 9, 2017

Govt. of Haryana December 2011, *Haryana State Action Plan on Climate Change*

Azizur Rehman 2014, *Making Haryana smart* , Confederation of Indian industry and PricewaterhouseCoopers India Private Ltd

Gurgaon - Manesar master plan 2031

ICLEI 2014, *Development of Gurgaon as a Solar City - Draft Master Plan*

Group of secretaries 2015, *Energy conservation and efficiency – 11 point action plan*, PricewaterhouseCoopers India Private Ltd

Bureau of Energy efficiency 2016, *Energy Conservation Building Code*

Air quality data from CPCB and state website

Anumita Roychowdhury, 2014 “*Building Sense: Beyond the Green Facade of Sustainable Habitat*”, Centre for Science and Environment, New Delhi

Suresh Kumar Rohilla, Mahreen Matto, Shivali Jainer and Chhavi Sharda 2017, *Water- Sensitive Urban Design and Planning : A Practitioner’s Guide*, Centre for Science and Environment, New Delhi

Suresh Kumar Rohilla, Mahreen Matto and Shivali Jainer 2017, *Mainstreaming rainwater harvesting in Noida*, Centre for Science and Environment, New Delhi

Dr. Vishal Narain December 2010, *Water security in peri-urban south Asia - Adapting to climate change and urbanization, Scoping study report- Gurgaon*

Sunita Narain and others 2012, *Excreta matters volume 2*, Centre for science and environment, New Delhi

*Base paper for workshop on waste management in Gurgaon*, July 10, 2013

Sanhita Bandyopadhyay, *Solid Waste Management, an Environmental Challenge in Millennium Cyber City in India, Gurgaon*

## **Bibliography**

Mukta Naik 2015, *Informal rental housing typologies and experiences of low income migrant renters in Gurugram, India*, Environment and urbanisation Asia, SAGE publication

Anon, 2016, Request for proposal for preparation of DPR on reducing GHG and mitigating climate change, Municipal Corporation, Gurugram, Haryana, India, <http://mcg.etener.in/tpoimages/mcg/tender/tender3513.pdf> as accessed on May 28, 2017

Anon 2017, Gurgaon’s Factsheet, Gurgaon First, Gurugram, Haryana, India, <http://www.gurgaonfirst.org/factsheet.php> as accessed on May 28, 2017

**How should Gurugram develop? Polluted air, depleting groundwater, crippling electricity outages, gurutams, choking waste burden, and receding forests... Is this the Gurugram we want?**

**We believe it is possible to protect air, water, soil, biodiversity, and forests and promote sustainable mobility even while meeting the needs of development, growth and poverty reduction. Effective intervention at the early stages of growth can help Gurugram to attain sustainable development goals without compromising growth and achieve wellbeing for all.**

