



URBAN UTOPIA

Powering urban development with
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**SOCIAL
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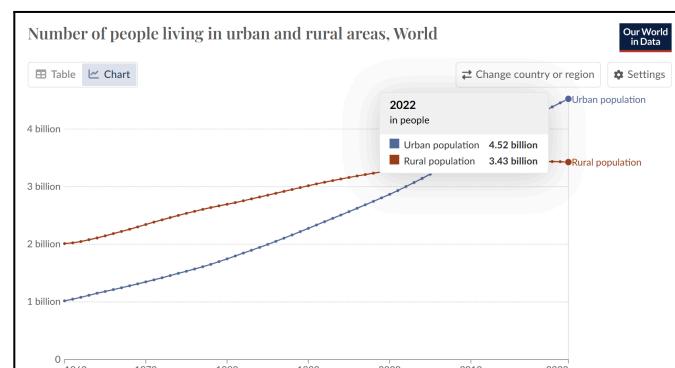
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INTRODUCTION TO AGENDA

Cities today have evolved from small towns with sparse populations to bustling urban centres, with crowded populations and advanced infrastructures driving global growth and innovation. This transformation in human settlements has deep historical roots, beginning thousands of years ago. Urbanisation first started in ancient Mesopotamia and the earliest city in this region is considered to be of Uruk, around 4500 BCE. It is considered to have emerged as the largest urban centre in the world with over 40,000 residents and an additional 80,000 - 90,000 residents in surrounding regions which facilitated trade networks and was a prominent cultural and economic centre¹.

The first traces of urban regions in India date back to the Indus Valley Civilisation, which existed from approximately 3300-1300 BCE. It included some of the world's oldest-known cities, such as Mohenjo-daro and Harappa. These cities were renowned for their systematic town planning, advanced grid system layout, and extensive use of burnt bricks, which was unusual for that time period². This set the foundation for one of the world's first urban cities in India.

Over the years urbanisation has grown at an incredible rate. According to the United Nations, the world's urban population rose from 751 million in 1950 to 4.2 billion in 2018³. India being no exception to the phenomenon, had a population of 377 million Indians living in cities in 2011,



¹ Mark, J. J. (2025, January 3). *Urbanization*. *World History Encyclopedia*. <https://www.worldhistory.org/urbanization/>

² Drishti IAS. (2019, July 8). *Indus valley civilization*. <https://www.drishtiias.com/to-the-points/paper1/indus-valley-civilization>

³ United Nations. (n.d.-a). *68% of the world population projected to live in urban areas by 2050, says un | UN Desa Department of Economic and Social Affairs. United Nations*. <https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>

making up 31.2% of the total population which is expected to grow to 590 million by 2050, accounting for 40% of the total population according to analytics.

As in most countries, India's towns and cities make a major contribution to the country's economy. With less than 1/3 of India's people, its urban areas generate over 2/3 of the country's GDP and account for 90% of government revenues. Urbanisation in India has expanded rapidly as increasing numbers of people migrate to towns and cities in search of economic opportunity.

Urbanisation has definitely boosted economic growth, but it also comes with several environmental challenges that must be pondered. Even though cities only cover about 3% of the Earth's land, they consume about 60-80% of the world's energy and are responsible for 75% of carbon emissions. This problem is prevalent in rapidly developing regions like Asia and Africa where farmlands are being lost to unplanned urban growth. As a result of this sudden urbanisation, the environment is greatly affected as practices such as over-exploitation of resources and deforestation are becoming common.

In developing countries such as India where energy demands are constantly rising as a result of rapid urban growth and a booming economy, the environment is greatly suffering. With rapidly increasing industries, shifts from a primary to a secondary and tertiary economy and improving standards of living, the country's need for energy is rising.

While cities provide jobs, education, markets and several other opportunities, these densely populated regions have a significant environmental impact, hence it is essential to balance the growing energy needs with an urgent need to save the environment as well by adopting sustainable urban development strategies specifically by powering urban development with renewable energy to create sustainable cities.

The idea of sustainability focuses on development that doesn't harm aspects of future generations and achieving long-term developmental goals which could be economical, social, or infrastructural etc while also

taking the environment into account. By integrating green infrastructure, renewable energy, and eco-friendly practises, cities can achieve economic growth and development without compromising the planet's health or future generations' needs.



RENEWABLE ENERGY

Renewable energy refers to the energy derived from natural resources that can be restored at a higher rate than they are consumed⁴. Solar energy is one of the many types which is produced by capturing sunlight and turning it into usable energy, such as in the form of heat, electricity, or hot water⁵. Technologies such as Photovoltaic systems and semiconductor-based solar cells absorb light to convert it into electrical energy utilising the photovoltaic effect, which can then be used to power homes, and businesses or also be stored in batteries for future use.

Similarly, another type is wind energy which converts the kinetic force of winds into electricity using turbines, helping reduce greenhouse gas emissions and advancing sustainable development. Wind energy systems can range from commercial-grade installations which can power entire communities to individual turbines fuelling individual needs.

⁴ United Nations. (n.d.-a). *What is renewable energy?*. United Nations.
<https://www.un.org/en/climatechange/what-is-renewable-energy/>

⁵ Just Energy. (2024, April 10). *7 types of renewable energy: The Future of Energy*.
<https://justenergy.com/blog/7-types-renewable-energy-future-of-energy/>

Hydropower is another important renewable energy source which utilises the kinetic energy of flowing water to generate electricity. One of the most common forms is pumped storage hydropower where water is pumped through a dam's turbines to produce electricity. Other techniques include run-of-river hydropower which does not require large dams to produce energy but instead utilises the natural flow of the river to generate electricity.

Bioenergy is another form of renewable energy produced from biomass. Biomass is organic material derived from plants and animals and they can be used to produce energy through several methods, such as burning or capturing methane gas from natural decay in ponds or landfills. Examples of bioenergy include the use of starchy crops such as potatoes, wheat and corn to create bioethanol, an eco-friendly alternative to gasoline.

Lastly, geothermal energy is derived from the heat beneath the Earth's surface. The heat is produced as a result of the formation of the planet billions of years ago and the radioactive decay of the core elements. This heat can reach the surface as a result of volcanic eruptions, through hot springs and geysers, and this energy can be harnessed by accessing underground reservoirs and using the steam to drive turbines and generate electricity.

All these renewable energy sources are available in all countries, but their potential is far from being completely utilised. While constructing green urban settlements, it is essential to adopt these sources of energy considering all their benefits – reduced carbon emissions and air pollution, enhanced reliability, and expanded access for remote, coastal or isolated communities.⁶

Globally, renewable energy is being adopted at a faster rate than previously, as world leaders are focusing on sustainability due to the

⁶ United Nations. (n.d.-a). *Renewable energy – powering a safer future*. United Nations. <https://www.un.org/en/climatechange/raising-ambition/renewable-energy>

rapidly depleting environment. In 2022, annual U.S. renewable energy generation surpassed coal for the first time in history and by 2025, domestic solar energy generation is expected to increase by 75%, and wind by 11%.

According to IRENA (International Renewable Energy Agency), India currently ranks at the 4th position globally for installed renewable energy capacity. There has been an increase of 265.89% in energy generation from solar, wind, bio and small hydropower since 2014-2015 which highlights significant progress in India's renewable energy sector. In 2023, the Indian renewable energy sector achieved another milestone by creating 1.02 million jobs according to the 2024 Annual Review by IRENA, a major contributor to the growth of the worldwide workforce in renewable energy, which increased from 13.7 million in 2022 to 16.2 million in 2023.



In 2023, the renewable energy sector in India saw significant job creation, with hydropower being the largest employer, providing around 453,000 jobs (20% of the global total) and the solar PV sector followed closely, employing 318,600 people, with 238,000 working in grid-connected systems and 80,000 in off-grid systems. The wind sector employed 52,200 people, primarily in operations, maintenance, and construction and other sectors like liquid biofuels, solid biomass, biogas, and solar heating and cooling also contributed to job creation, with 35,000, 58,000, 85,000, and 17,000

jobs, respectively.⁷ These numbers show how renewable energy holds immense potential to fuel the creation of green urban spaces and combat climate change.

URBAN CHALLENGES: THE GORDIAN KNOT OF THE 21ST CENTURY

Meeting the needs of the rapidly growing urban population in India remains a critical challenge. These challenges can be broadly divided into kinds – environmental & infrastructure, and social-economic challenges.

ENVIRONMENTAL AND INFRASTRUCTURAL

Cities face many environmental and infrastructural problems that affect how people live and work. Issues like air pollution, unreliable electricity, poor public transport, and unplanned city growth make life difficult. Pollution from vehicles and burning fossil fuels harms health and lowers productivity. Frequent power cuts disrupt daily activities, showing the need for cleaner and more dependable energy sources.

Basic infrastructure like water supply, electricity, and transportation often fails to meet people's needs. These problems, along with a worsening urban environment, lead to poor health, lower productivity, and a reduced quality of life. This highlights the urgent need for better urban planning and management.

India's cities also struggle with challenges in housing, planning, and delivering services. Other environmental challenges which hinder sustainable urban development and adoption of renewable energy include resource competition wherein specifically in context with



⁷ Renewable energy statistics 2023-24. (n.d.).

<https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2024/10/20241029512325464.pdf>

solar energy, there is a large water demand to maintain solar panels which conflicts with local water demand particularly in urban regions such as Bangalore where there was even a recent water crisis.⁸

SOCIAL AND ECONOMIC

Social and economic challenges in urban areas create significant barriers to sustainable development. Overcrowding and unemployment as other urban challenges that strangle the growth and development of society. Many people migrate to urban areas in search of better job opportunities and healthcare, leading to overpopulated cities like Delhi, Mumbai, and Bangalore. As cities become densely populated, job availability declines, leaving many people without a livelihood. Urban unemployment in India is estimated at 15 to 25 per cent of the labour force and a big percentage of youth who are unemployed belong to well-raised and educated families. According to the National Statistical Office (NSO), India's unemployment rate is 9.3% in urban areas in 2021⁹.

Inappropriate urban planning has resulted in prohibitively high housing and office space costs, placing some Indian cities among the most expensive in the world. As population density rises in metropolitan cities, house rents skyrocket, leaving people unable to afford decent living spaces. This has led to a visible socio-economic disparity, with opulent housing projects like DLF's "The Dahlias" in Gurugram crossing the ₹100 crore price mark, while a significant proportion of the urban population lacks shelter.



⁸ Mogul, R. (2024, March 15). India's "Silicon Valley" is running dry as residents urged to take fewer showers and use disposable cutlery. CNN.

<https://edition.cnn.com/2024/03/14/india/india-bangalore-water-crisis-impact-intl-hnk-dst/index.html>

⁹ GeeksforGeeks. (2023a, September 10). Issues related to urbanization in India.

<https://www.geeksforgeeks.org/issues-related-to-urbanization-in-india/>

Policy and regulatory deficiencies combined with space constraints due to incorrect urban planning often result in the rapid increase of slums and squatter settlements. According to the World Bank, the population living in slums in India was reported to be 35.2 % of the total urban population in 2018.¹⁰ These areas become breeding grounds for diseases, crime, social tensions, and demoralization. The weak financial capacity of urban local bodies and service providers further hampers their ability to expand essential infrastructure for housing development.

Additionally, poor access to microfinance and mortgage finance limits marginalized populations from owning or improving homes and adopting clean energy solutions, hindering sustainable urban development. Local governments also struggle to fund renewable energy projects due to limited budgets and reliance on government assistance. Misconceptions about the cost and reliability of renewable energy further discourage its adoption. Tackling these challenges is essential to ensure cities grow in a way that benefits everyone and supports sustainable development.¹¹

GOVERNMENT IMPLEMENTATION & POLICIES

Governments across the world are taking initiatives to convert their cities into sustainable havens which encompass a wide range of urban planning techniques, from energy-efficient building designs to integrated public transport systems to switching to alternative forms of energy. Here is a brief overview of a few national and international policies and initiatives, which are paving the way forward for sustainable urban development.

¹⁰ GeeksforGeeks. (2023, September 10). *Issues related to urbanization in India*. <https://www.geeksforgeeks.org/issues-related-to-urbanization-in-india/>

¹¹ Person. (2012, June 5). *India's urban challenges*. World Bank. <https://www.worldbank.org/en/news/feature/2011/07/04/indias-urban-challenges>

PIONEERING INDIAN PROJECTS TRANSFORMING URBAN LANDSCAPES

India has embarked on an ambitious journey toward urban sustainability through numerous transformative initiatives and policy frameworks. The government has launched several flagship programs. Some of these are:-

Smart Cities Mission

Smart Cities Mission was launched on June 25, 2015, with the aim to provide citizens with essential infrastructure, a clean environment, and enhanced quality of life through implementing “smart solutions”. It focuses on social, economic, physical, and institutional foundations of urban development. The mission seeks to create replicable models that serve as examples for other aspiring cities. Through the initiative, 100 of India's 4,000 cities were chosen to become smart cities. To choose these cities, a two-phase competition was conducted in which each city had to propose innovative ideas and plans for sustainable growth. The cities were assessed based on the feasibility of their proposed projects, their potential impact on citizens, and their sustainability. Numerous projects, many of which are original and being carried out for the first time, have been developed in each of the 100 cities. These projects have brought in several important changes at a local level and around 8000 multi-sectoral projects worth over ₹1.6 lakh crore are being spent to create inclusive, and sustainable cities.¹²

Atal Mission for Rejuvenation and Urban Transformation

The AMRUT mission was announced on June 25, 2015, and five hundred cities and towns nationwide were chosen under this initiative wherein the focus was on the development of basic infrastructure in the sectors of water supply: sewerage and septage management; storm water drainage, green spaces, and non-motorised urban transport. Its primary goals are- ensuring every home has clean water and a toilet, fixing drainage systems to prevent floods, improving public transport and integrating green spaces like parks and gardens to lower temperature levels.

According to a 2022 press release,out of the 5,873 projects totalling 82,222 crores that the States and Union Territories were undertaken so far, 4,676 projects totalling 32,793 crores had been finished, while 1,197 projects totalling 49,430 crores have been grounded and are in various phases of implementation. In contrast to the targeted 139 lakh water connections and 145 lakh sewer connections, respectively, AMRUT & convergence had so far given 137 lakh water tap connections and 105 lakh sewer connections (including houses covered by

¹² Smart cities mission extended till March 2025. Press Information Bureau. (n.d.).
<https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2030491>

Faecal Sludge and Septage Management, or FSSM).¹³ According to another 2022 press release, 6,340 million litres per day (MLD) of sewage treatment capacity were being built through AMRUT projects. Among them, 2,840 MLD of capacity had been established for sewage treatment, and 1,437 MLD had been developed for recycling and reuse. AMRUT resulted in the development of 2299 green park projects, leading to an addition of 4,480 acres of green space. Additionally, 951 acres of green space was to be added as a result of park developments and 666 stormwater drainage projects had been completed under this initiative. Consequently, 2,434 water logging points had been eliminated, and 1,307 were being eliminated.¹⁴ AMRUT 2.0 was also launched on October 2021, with a planned budget of ₹2,99,000 crore including total Central assistance of ₹76,760 crore for five years to further make cities more water secure¹⁵¹⁶

National Urban Transport Policy (NUTP)

The National Urban Transportation Policy (NUTP), which was introduced in 2006, focuses on human mobility rather than car mobility in an effort to improve mobility and sustainability. The policy envisions an urban mobility framework that is contextual and appropriate for cities' and residents' geographic, social, and economic needs.¹⁷ It promotes metro trains and fast bus services, safe footpaths and roads to walk and bike, reducing traffic by planning cities better and using cleaner vehicles like EVs and bicycles to cut pollution..

PM Surya Ghar – Muft Bijli Yojna

The initiative was approved on February 29, 2024 with the aim of 10 million solar installations by 2026-2027. Under the scheme, a subsidy of 60% is provided for

¹³ Amruth scheme. Press Information Bureau. (n.d.-a). <https://pib.gov.in/PressReleasePage.aspx?PRID=1885837>

¹⁴ Status of amruth. (n.d.).

<https://pib.gov.in/Pressreleaseshare.aspx?PRID=1881751#:~:text=Total%20Sewage%20treatment%20capacity%20of%206%2C340%20MLD%20is,2%2C299%20green%20parks%20adding%204%2C480-acre%20of%20green%20space>

¹⁵ Atal Mission for Rejuvenation and Urban Transformation (amruth)| National Portal of India. (n.d.-b). <https://www.india.gov.in/atal-mission-rejuvenation-and-urban-transformation-amruth>

¹⁶ Status of projects under Amruth 2.0. Press Information Bureau. (n.d.-c).

<https://pib.gov.in/PressReleasePage.aspx?PRID=2079792#:~:text=Atal%20Mission%20for%20Rejuvenation%20and%20Urban%20Transformation%20%28AMRUT%29,the%20cities%20to%20become%20%27self-reliant%27%20and%20%27water%20secure%27>

¹⁷ Author Sunita Sanghi. (n.d.-a). Sustainable urban transport is the way forward. Niti Aayog. <https://www.niti.gov.in/sustainable-urban-transport-way-forward>

solar unit costs for systems upto 2KW capacity. It provides a 40% subsidy for additional systems cost with a capacity between 2 and 3 KW.¹⁸

These initiatives demonstrate India's commitment to building smart green urban settlements which strike a balance between environmental responsibility and rapid development.

INTERNATIONAL INITIATIVE ON SUSTAINABLE URBAN DEVELOPMENT

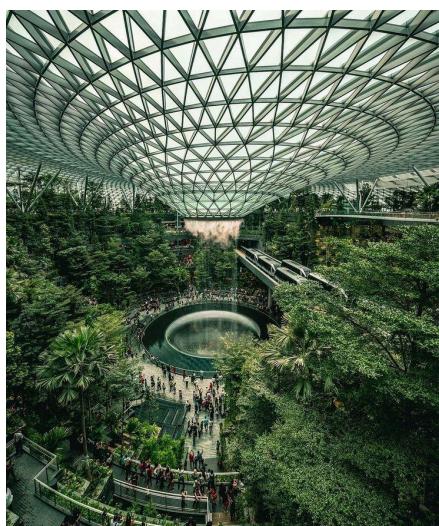
India's initiatives are part of a broader global movement toward sustainable urbanization. Cities worldwide are implementing innovative solutions to address environmental challenges while enhancing quality of life. Here are some examples:

Sustainable Green Plan 2030 (Singapore)

Launched in 2021, the Singapore Green Plan 2030 is a whole nation movement to advance Singapore's national agenda on sustainable development. It focuses on five key areas: City in Nature, Energy Reset, Sustainable Living, Green Economy, and Resilient Future. Under Energy Reset Singapore aims to use cleaner energy sources across



all sectors. In terms of producing power, solar energy continues to be Singapore's most promising renewable energy source.



Singapore is currently among the world's most solar-dense cities. At Tengeh Reservoir, they even have an inland floating solar PV system with a peak power of 60 megawatts, which is roughly the area of 45 football fields. The goal is to keep installing as many solar panels as possible, especially on reservoirs, rooftops, and other open areas, and to deploy 2 GW of solar energy by 2030 to supply 350000 families' electricity demands.

Additionally, Singapore is investigating new low-carbon options like hydrogen,

¹⁸ PM Surya Ghar - Muft Bijli yojana| National Portal of India. (n.d.-e).
<https://www.india.gov.in/spotlight/pm-surya-ghar-muft-bijli-yojana>

geothermal and carbon capture, utilisation and storage. Singapore launched Singapore's National Hydrogen Strategy to promote hydrogen as a significant decarbonization pathway in October 2022. They also introduced the Mandatory Energy Improvement (MEI) regime for existing buildings with poor energy performance to undergo energy audits and implement energy efficiency improvement measures.

Apart from these, considering the importance of managing the transportation system's environmental impact as its capacity and usage increase, by 2040, all automobiles are expected to be powered by cleaner energy. By promoting the use of public transportation, active mobility, and a shift to a population of cleaner-energy vehicles, they intend to keep lowering the sector's emissions.¹⁹

Energiewende (Energy Transition) in Germany

Germany has a big plan to switch to clean energy which is the initiative Energiewende. It is the country's planned transition to a low-carbon, nuclear-free economy by 2045 which focuses on using solar, wind, and water power instead of coal, thus transitioning towards renewable resources; Upgrading old buildings to use less energy and Promoting electric cars and green public transport to reduce carbon footprint and fossil fuel emissions.

This plan has helped Germany reduce pollution while creating jobs in green industries. Germany aims to have a negative emission balance from 2045, which means they will use natural sinks such as trees or soil to remove more greenhouse gases than they emit. The success of Germany's Energiewende depends on strong public support and participation with over half of renewable energy installations owned by citizens and farmers, highlighting community engagement in the energy transition.²⁰

California Solar Mandate

In 2018, the California Energy Commission introduced energy efficiency standards mandating the inclusion of solar photovoltaic (PV) systems in all new residential

¹⁹ Energy reset. Singapore Green Plan 2030. (n.d.).

<https://www.greenplan.gov.sg/key-focus-areas/energy-reset/>

²⁰ What is the German energiewende?. Agora Energiewende. (n.d.).

<https://www.agora-energiewende.org/about-us/the-german-energiewende/q1-what-is-the-german-energiewende>

buildings. Referred to as the California Solar Mandate, this regulation aims to reduce pollution, decrease dependence on natural gas, and encourage the use of renewable energy which also aligns with California's goal to produce 50% of its electricity from renewable sources by 2030.

The California Solar Mandate officially came into effect on January 1, 2020, requiring solar PV systems in all new residential constructions, including single-family homes, condominiums, and apartment buildings under three stories. The size of the solar panel system must be adequate to cover the building's annual electricity needs. Since estimating electricity usage for newly constructed properties can be challenging, builders rely on projections based on the property's floor area and the climate zone in which it is situated.²¹

Low Carbon Cities Act (Japan)

The Low Carbon City Act is designed to promote cross-sectoral emission reductions within communities by fostering low-carbon urban development. This legislation mandates local governments to create Low-Carbon Development Plans and implement measures that integrate various urban functions. These include encouraging public transportation, improving energy use efficiency, preserving urban green spaces, and advancing urban greening initiatives.²² Additionally, the Act provides tax incentives for buildings that are certified as energy-efficient (exceeding an energy efficiency standard, with other, low-carbon measures, water-saving measures, and use of sustainable building materials). Japan's plan focuses on reducing pollution in cities. It does this by creating districts that are completely carbon-neutral. They also focus on using energy-saving technology in homes and factories. Planting trees and adding green areas to absorb pollution is another strategy that not only increases the beauty of the place but also regulates temperatures. Japan's efforts show how cities can fight climate change while staying safe and beautiful.²³

²¹ Underwood, T. (2024a, May 17). *What homeowners need to know about the california solar mandate. #1 Stone-Coated Steel Metal Roofing*.

<https://www.decra.com/blog/how-the-california-solar-mandate-affects-your-roof-what-homeowners-need-to-know#:~:text=Known%20as%20the%20California%20Solar,renewable%20energy%20sources%20by%202030>

²² Iea. (n.d.). *Low carbon city act (eco-city act) – policies*. IEA.
<https://www.iea.org/policies/15-low-carbon-city-act-eco-city-act>

²³ 都市計画:3. major actions for low carbon city development - 国土交通省. (n.d.).
https://www.mlit.go.jp/toshi/city_plan/eco-city-3.html

PLANNING & IMPLEMENTATION

Adoption of renewable energy in order to create smart green urban cities requires substantial planning because rapid urbanization can lead to unplanned and informal settlements, like building in vulnerable locations which can leave people without access to basic public services. These factors increase the cities' and urban populations' vulnerability to the adverse impact of disasters and extreme climate events.

There is also a substantial untapped potential for the rational use of energy consumption in cities. Therefore, it is critical to: develop market and economic tools for the assessment and implementation of energy-efficient settlement principles; set criteria for the use of energy-efficient principles in urban plans; and establish standards for evaluating various scenarios and programs for energy-efficient buildings and residential areas. Success for the same requires coordination between urban planners, energy utilities, and building developers to ensure infrastructure compatibility and optimal resource utilization. The transition to urban renewable energy rests on two fundamental pillars: public engagement and policy framework, which are essential to ensure the successful planning and implementation of renewable energy projects which can absolutely transform urban landscapes.

Regulatory Framework:

Since the majority of the global economy still runs on fossil fuels, government policies serve as the backbone of renewable energy adoption. These policies are essential to provide the support needed for widespread implementation.

These policies must be carefully crafted with incentive programs, including tax benefits, subsidies, and renewable energy credits which way governments can make sustainable energy solutions more accessible and economically viable for both businesses and residents. Policy reforms that establish clear renewable energy targets create a roadmap for urban development while sending strong signals to the market about long-term commitments to sustainability.

In context to sustainable urban development these plans should include techniques and tools to improve energy efficiency. These should consider the city's size and location, street layout, building heights, position of parks and water areas, industrial locations and pollution levels. Also collaboration between the

public and private sectors, supported by these policies, encourages innovation and speeds up the use of sustainable technologies.

Private companies are also more likely to invest in research, development and implementation of renewable energy solutions when governments establish such supportive policies. This cooperative approach would create a positive feedback loop wherein lawmakers can implement even bigger sustainability targets as public support for renewable energy systems increases since more successful projects show feasibility due to intervention and support of private organisations.

Furthermore, one essential difficulty to be addressed by appropriate regulations is the space constraints in urban locations. Policymakers must create more focused solutions to maximise the impact of renewable energy initiatives by taking into account regional circumstances and obstacles. An example for the same is Mumbai which is not only one of the most dense urban landscapes in India but also worldwide has approximately 73,000 people living per square kilometre, with over 9 million people living in slums, hence it is crucial for regulatory frameworks to take into consideration addressing these space constraints, so that large scale renewable energy projects can be more efficiently planned and deployed.²⁴

Community Engagement

For sustainable urban settlements to become a reality one important factor is for citizens to understand the environmental, economic and health benefits of adopting renewable energy. It is essential for individuals to actively participate in these initiatives instead of just being observers.



This participation must extend beyond just basic understanding but also include practical knowledge regarding implementation, costs, and long-term advantages so that they can make more informed decisions at an individual as well as community level, and this participation begins when people are aware of which public awareness campaigns are essential. These campaigns not only help explain to citizens the benefits of renewable energy but also address concerns and clear up misunderstandings making it easier for people to accept and adopt renewable energy solutions.

²⁴ Mumbai, India population 2024. (n.d.). <https://worldpopulationreview.com/cities/india/mumbai>

A great example of a city where the transition has been greatly successful due to active community engagement is Copenhagen which is also referred to as one of the “coolest” cities to visit in the world recently and was also termed as the “Most Livable City” by Monocle. The residents have been engaged in renewable energy efforts through campaigns promoting solar energy installations and infrastructure for sustainable transportation, such as biking, which align with the city's renewable energy goals. The city has more cycles than any other automobiles. Not only this over 98% of households in the city are connected to a centralised heating system which is a result of decades of collaboration between the lawmakers and the residents.²⁵ Not only this, the city is planned to be the world's first carbon neutral capital by 2025 to show how growth, development, improved quality of life and reduction of emissions can all go hand in hand.²⁶

CASE STUDIES

DIU SMART CITY:

Diu Smart City has become India's first city to run on 100% renewable energy during the daytime. It previously imported 73% of its power from Gujarat. Diu currently generates power from a 9MW solar park which is spread over 50 hectares of rocky and barren land, and also from solar panels installed on the rooftops of 79 government buildings which collectively generate around 1.3MW of energy per year. Residents are incentivized with subsidies of around ₹10,000 to ₹50,000 for installing 1-5KW rooftop solar panels.

This initiative saves 13,000 tonnes of Carbon emissions every year and due to low-cost solar energy, power tariffs have been cut in the residential category by 10-15%.²⁷ These tariff reductions provide financial relief to residents while also showcasing the economic feasibility of renewable energy. Diu's success in achieving 100% daytime renewable energy sets a benchmark for other cities in India, offering a replicable model for sustainable urban development.

²⁵ Contributor), C. M. (Guest. (2024, February 23). *How Copenhagen is leading the world in sustainability - the Urbanist. The Urbanist - Examining urban policy to improve cities and quality of life.* <https://www.theurbanist.org/2024/02/23/how-copenhagen-is-leading-the-world-in-sustainability/>

²⁶ Copenhagen: Solutions for sustainable cities. (n.d.-c). https://international.kk.dk/sites/default/files/2021-09/Copenhagen_Solutions_for_Sustainable_cities.pdf

²⁷ Diu Smart City becomes first to run on 100% renewable energy during daytime. (n.d.). <https://pib.gov.in/newsite/PrintRelease.aspx?relid=178853>

DHOLERA SMART CITY:

Dholera Smart City is an ambitious initiative taken by the Government in Gujarat, India aimed at establishing a cutting-edge urban centre. Strategically located 100 kilometres from Ahmedabad, with the upcoming Dholera International Airport enhancing connectivity, the city is divided into residential, commercial, and industrial zones.²⁸ The sustainability initiatives of Dholera Smart City reflect a comprehensive and eco-conscious approach to urban development.

The city emphasizes water and wastewater management by achieving zero waste discharge through the treatment of 100% of the generated wastewater to tertiary standards, making it suitable for non-potable and industrial uses, with smart metering and SCA systems in place to reduce losses. Solid waste management strategies ensure the complete collection and recycling of biodegradable waste, which is processed for compost production and energy generation. Stormwater management and rainwater harvesting systems are implemented through open earthen canals to capture runoff, recharge aquifers, and reuse water for irrigation purposes. In terms of power management, the city offers uninterrupted 24/7 electricity through smart grids, metering, and monitoring systems to minimize energy losses while promoting the use of renewable energy.²⁹ These integrated systems highlight Dholera's commitment to creating a sustainable and resilient urban ecosystem, making it a benchmark in smart city planning.

BHUBANESWAR SMART CITY:

The Bhubaneswar Smart City plan is to develop the city into an integrated, sustainable and intelligent city which will enhance its resident's quality of life and advance the cause of sustainable development. The city is being managed by Bhubaneswar Municipal Corporation in collaboration with the IBI Group and JLL India and the two major focus areas are the Intelligent City Operations and Management Center (ICOMC) which integrates traffic management, transit operations, utilities, and energy response and the other is the Bhubaneswar Town Center District (BTCD). ICOMC also encourages sustainable behaviour change

²⁸ Home | dholera. (n.d.-b). <https://dholera.gujarat.gov.in/>

²⁹ Advantage Dholera | Dholera. (n.d.-a). https://dholera.gujarat.gov.in/advantage_dholera

through its initiatives, such as the "I Support My City" program which encourages positive behaviours including the use of public transport and sorting waste.³⁰

The Bhubaneswar Town Center District Plan targets the development of 985 acres around the transit station to develop a 24/7 functional urban core thus enhancing the economic and social activities. In 2017, an initiative called 'City Connect' was launched within the BTCD, it was a collaboration between Bhubaneswar Smart City Limited (BSCL) and a multilateral organisation. It focused on empowering young people from slums to drive positive change in their communities. The project showcased replicability, scalability, and sustainability in improving social aspects within the smart city context. The Bhubaneswar Smart City Plan is a good mix of the use of technology, stakeholder participation and equity, which provides a blueprint for sustainable urban development.³¹

MASDAR CITY:

Masdar City in Abu Dhabi is a global model for sustainable urban development equipped with integrated leading-edge technology, eco-friendly design and innovative governance which is built by Masdar a subsidiary of Mubadala Investment Company. The city focuses on low-carbon living and resource efficiency. It is partially powered by a 10MW solar plant which was the first ever grid-connected renewable energy project in the UAE and the largest of its kind at its inauguration in 2009.

The project offsets 15,000 tons of carbon emissions annually and generates roughly 17,500 megawatt-hours of renewable electricity. Water consumption, waste recycling, and energy use are all managed by advanced systems that contribute greatly to reducing footprint. The city will be an innovation hub, as the Masdar Institute nurtures renewable energy and sustainable technology research in cooperation with MIT. It supports businesses and startups in green industries to drive economic growth while advancing its sustainability goals³². Masdar City is a smart city that uses smart technologies to efficiently manage resources and run cities.

³⁰ Best practice: NFS. Best Practice | NFS. (n.d.). <https://nitiforstates.gov.in/best-practice-detail?id=100850>

³¹ Best practice: NFS. Best Practice | NFS. (n.d.). <https://nitiforstates.gov.in/best-practice-detail?id=100850>

³² Masdar City Solar Photovoltaic Plant. Masdar. (n.d.).
<https://masdar.ae/en/renewables/our-projects/masdar-city-solar-photovoltaic-plant>

CONCLUSION

The idea of green urban settlements is a more achievable feat with rapidly improving technology and increasing focus on sustainability. With world leaders taking aspirational steps to create these green urban settlements, the future seems bright.

A great example of the same is the NEOM. NEOM is a socio-economic region being built in Saudi Arabia which is spread over 26,500 square kilometers. It is being designed to become a community powered by talent and diversity in over 14 different sectors. This megacity is designed to be a centre for innovation, commerce, technology, and culture. It will have different zones, such as busy industrial areas using advanced manufacturing and quieter tourist spots with luxury resorts. One of the key parts of the project is its focus on sustainability and environmental responsibility.



The city aims to set new benchmarks in ecological preservation and resource management with plans such as advanced water conservation systems which not only reduce consumption but also recycle and purify it, green spaces throughout the city including vertical gardens, green roofs and enough plant life to cool the city and improve the air quality. The plan also includes implementing a zero-waste policy which focuses on reducing, reusing, and recycling waste. Facilities are specifically being built to handle waste in an eco-friendly manner and to convert it into reusable products.

The city is committed to preserving its natural areas and wildlife, ensuring that development does not harm habitats. Ecological monitoring will regularly monitor the ecosystem and help maintain the health of local ecosystems. Not only this transportation in NEOM is also planned to support its sustainability goals, with plans for electric vehicles, bike paths, and pedestrian areas to minimise emissions. Simultaneously public transport is planned to be as efficient and environmentally friendly as possible, making it easy for residents to get around the megaproject.

The project represents an ambitious vision of future urban development wherein technological advancements and environmental responsibility, both go hand in

hand. Once built the city is going to set a precedent on how the cities of tomorrow must be and its success could be a milestone in our journey to create innovative, and sustainable cities³³.

³³ Frank Da Silva. (2024, May 2). Neom: Pioneering the future of sustainable megacities. <https://fdas.co/megaprojects/neom-pioneering-the-future-of-sustainable-megacities>