

Envisioning the Future of Cities, Regions & Communities



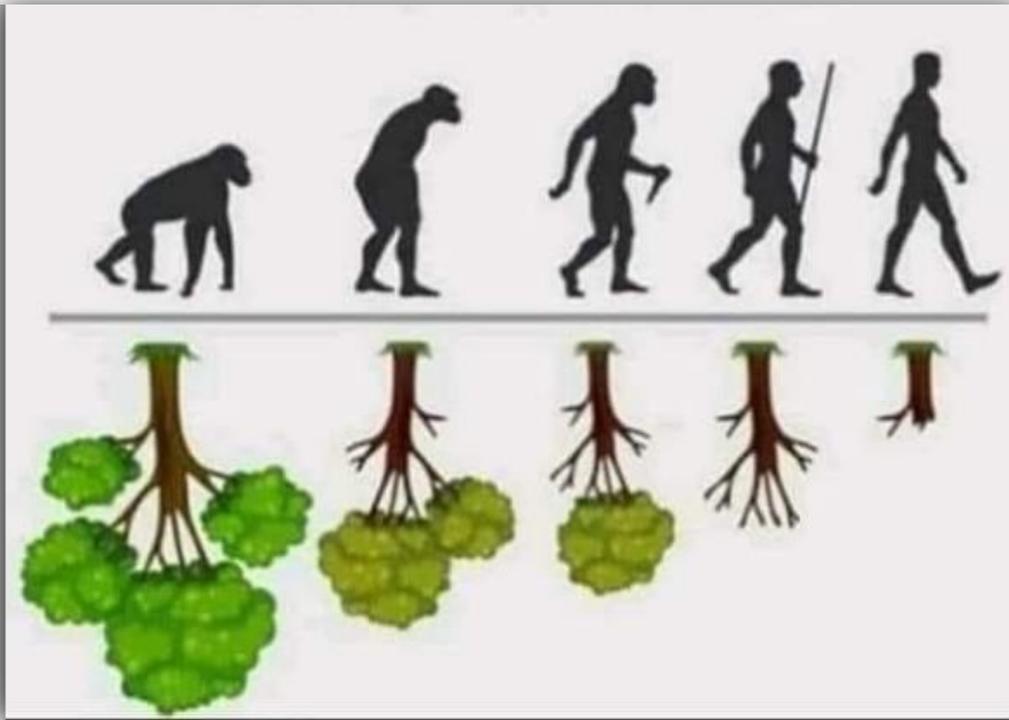
Architectural & Systems Approach
Imperatives for Smart & Sustainable
Mobility Systems in Cities



The World We Live In



The EVOLUTION we NEVER EXPECTED



It's a small world. It's also an increasingly hot, crowded, and contentious one.

The combined effect of climate change and society's impact on the earth is intensifying struggles over natural resources while also threatening our infrastructure, food systems and quality of life.

“Nature no longer runs the Earth, we do”

Climate is not politically strong enough to fight Carbon by itself.



DESIGNING A SUSTAINABLE & RESILIENT FUTURE





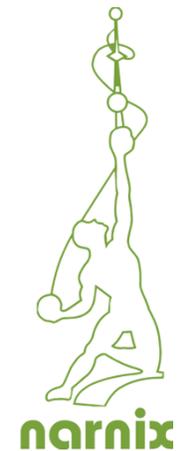
Where are we (globally)?...Struggling to do enough



“Someone’s gotta do something!” (someone else, ideally!)

Analogy: I want to lose weight... But don't want to exercise or change my diet**

(* ** there's no Ozempic or magic pill for climate change)





Myth: We're all in this together

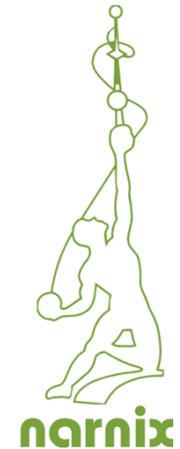


Climate Change Misconception:

“We’re all facing the same storm”

Climate Change Reality:

Same storm, but different boats





The fundamental problem:



We are trying to fix a **stock** problem (accumulation of carbon) with **future flow** instruments

Think of a bathtub about to overflow...the last cup may tip it over, but the problem wasn't that cup



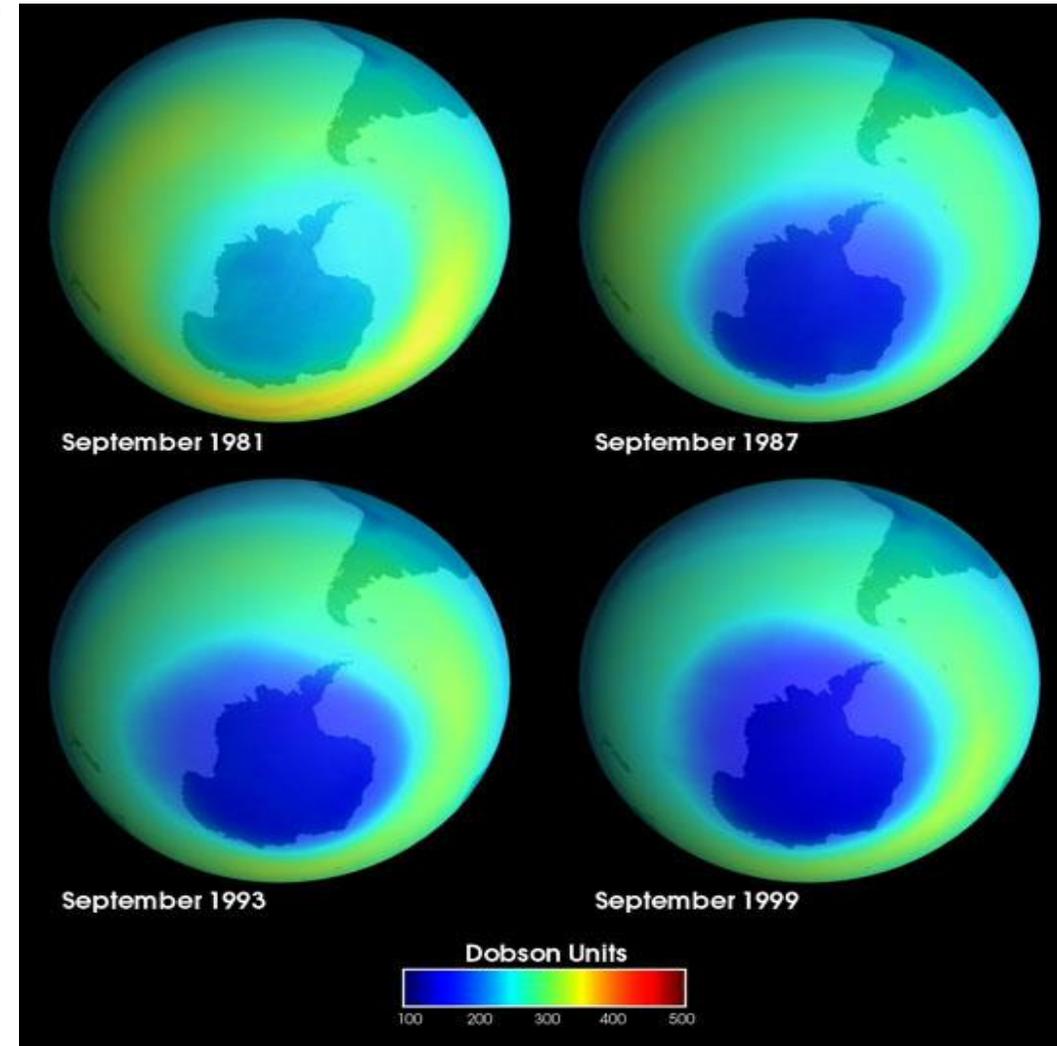


Learn from our past mistakes – History always repeats itself...



Past failures to consider environmental consequences early have been costly:

- Semiconductor Industry (Metals, Solvents)
- Synthetic Chemicals (PCB, DDT, Freon)
- Applications of Natural Compounds (Chlorine, Asbestos)
- Transportation, Energy (Air Pollution, Global Warming, Nuclear Wastes)



narnix





Future of Life... on EARTH...



It has been observed that the technologies developed by human beings in the last 2-3 centuries have had a major impact on the earth's climate and our nature's equilibrium

Some believe that we have reached a point of no return. This can have a huge impact on *life on earth*, especially on the *human species*.

However, while technology has been responsible for most of it, technology also seems to have a solution for it.

It's increasingly clear that today's environmental conditions are not sustainable. Over the past few decades, we have made huge progress fighting disease, poverty, and illiteracy.

Now we must apply that same ingenuity to the problem of global warming and other consequences of human activity.

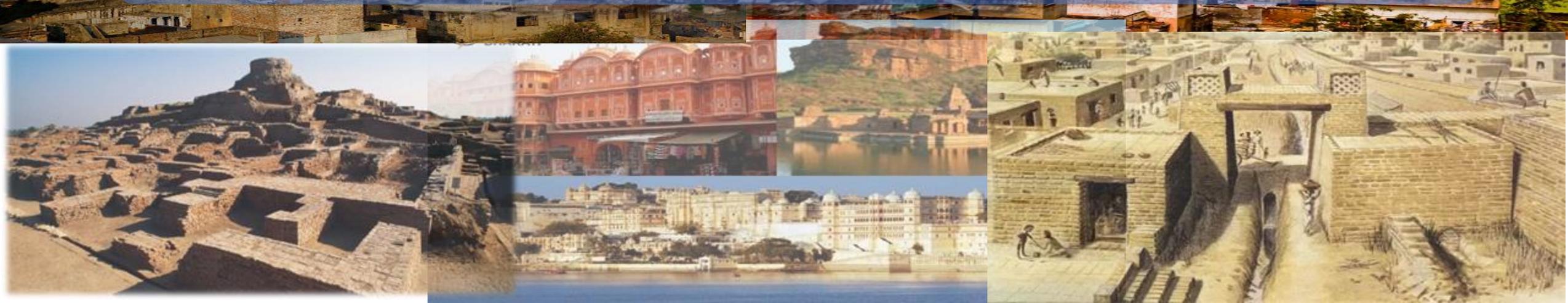


A collage of futuristic cityscapes and digital icons. The top left shows a modern city with green spaces and a tall tower. The top center features a blue background with various digital icons like a house, car, and cloud. The top right shows a city at night with glowing lines and icons. A green banner with white text is overlaid on the top half.

The Cities We Live In

An aerial view of a dense, colorful city with many small buildings and a mix of colors like blue, red, and yellow. A blue banner with white text is overlaid on the middle section.

cities of the present offer their inhabitants the whole planet in microcosm





‘What is the city but the people?’

William Shakespeare, Coriolanus, Act III, Scene I



- 🌿 The future of the world is decidedly urban - over six billion people are projected to live in cities worldwide by 2050.
- 🌿 Cities are economic powerhouses — they contribute over 80% of gross national product worldwide — while being locales of miraculous possibilities.

Darker dimensions to the glittering city

- 🌿 Cities consume two-thirds of the world’s energy and generate 75% of global carbon emissions despite housing 55% of the global population and occupying less than 3% of the global land area.
- 🌿 With an unsustainable use of fossil fuels for transport, industry, and buildings, with deforestation, concretisation and pollution, cities are causing intense global warming.
- 🌿 Over 80% people in urban areas face unsafe air quality — while worsening climate change which is now impacting cities through extreme rain events, rising sea levels, water scarcity and heat stress.

The effects are being felt by cities themselves through the phenomenon of

- 🌿 urban warming, metropolitan areas growing ten degrees Celsius hotter than surrounding rural regions, urban heat pushing up the demand for cooling, causing more emissions, thus entering a vicious warming cycle.

Cities are where problems and solutions meet...

DESIGNING A SUSTAINABLE & RESILIENT FUTURE





Smart Cities – Addressing 3 Core issues



DATA

DESIGNING A SUSTAINABLE & RESILIENT FUTURE



UNDERSTANDING THE FORCES OF CHANGE





By Looking into the Future -
Crystal Ball Gazing...

Linear Economy





Threatening Signs from the LINEAR ECONOMY



🌍 A city's built-environment in the linear economy can contain "over 300 tons of building materials per capita, [...] and the environmental impact of adding this material in the construction supply chain "accounts for 6 to 20% of global greenhouse gas emissions".

🌿 On a global basis, humans consume 1.7 times the amount of resources the earth can produce, and "the current rate of resource consumption is unsustainable".

🌿 The average consumer uses tons of materials each year; only an estimated 40% is recycled or reused; and recycling and recovery captures only about 5% of the original value.





FOOD AND WATER

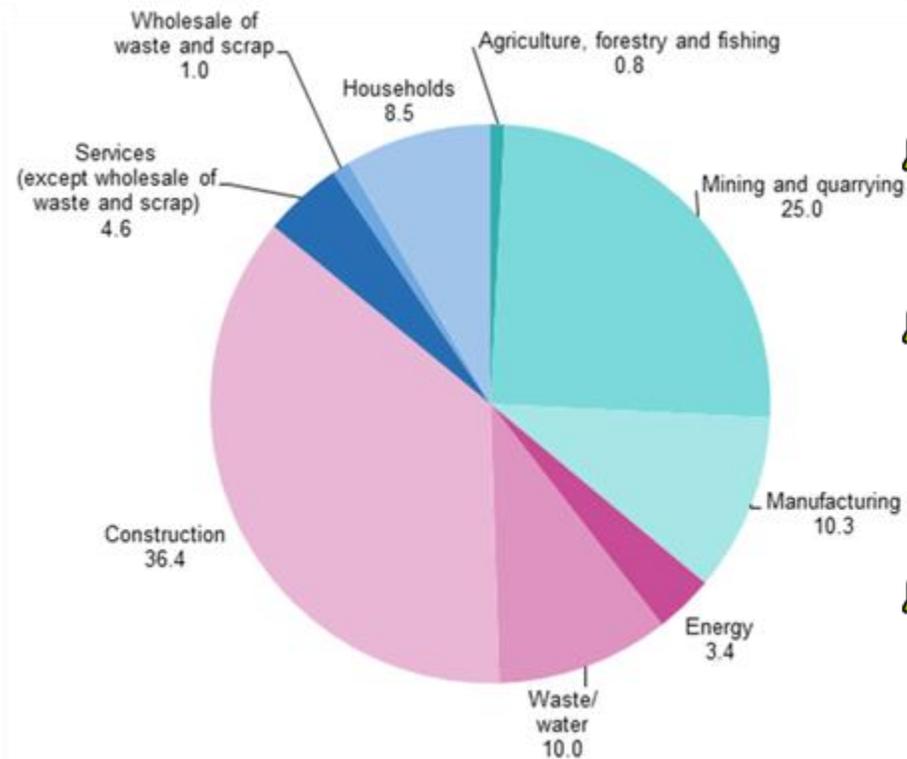


- ✦ Although food security has improved in many parts of the world, "declining soil fertility and threats to the biodiversity of our planet" are still major issues.
- ✦ "The linear food system is ripe for disruption. For every dollar spent on food, society pays two dollars in health, environmental, and economic costs."
- ✦ Many of the world's water systems are already impaired. Rivers, lakes and aquifers are drying up or becoming polluted; more than 50% of the world's wetlands have disappeared; and climate change is causing water shortages, droughts and floods.
- ✦ "By 2025, two-thirds of the world's population may face [water shortage](#)."





TRASH AND WASTE



🌿 In the global linear economy, humans "generate about [1.3 billion tons of trash per year](#), far more than we can properly process or recycle".

🌿 "This leads to environmental tragedies like ocean plastic pollution and geopolitical tensions as Western countries search for new places to stash their trash."

🌿 [90% of all plastic waste](#) ever generated has never been recycled. To address "we need to create a [market for recycled plastic](#) and to reduce the huge amount of plastic waste going to incineration and landfill. [...] This is dangerous for the environment and makes no sense from a circular economy point of view."

🌿 In 2016, Europe generated an estimated [5 tons of waste per inhabitant](#) with about 45% going into landfills. Construction activities account for an estimated 36% of waste in EU countries, stressing the need for circular innovation in the built environment.

🌿 Electronics and electrical waste (e-waste) is a hazardous problem affecting cities and landfills. "The world produces as much as [50 million tons of e-waste per year](#), weighing more than all the commercial airliners ever made. Only 20% of this is formally recycled."

WASTE GENERATION BY ECONOMIC ACTIVITY & HOUSEHOLDS, EU-28, 2016 (%)




Greenhouse Gas (GHG) Emissions

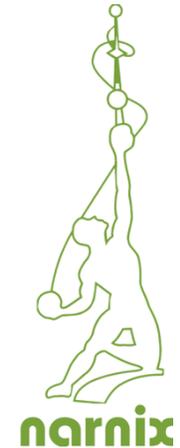




Greenhouse Gas (GHG) Emissions



- 🌿 Greenhouse gases, like carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), occur naturally in the atmosphere and help regulate Earth's temperature by trapping heat.
- 🌿 However, human activities have significantly increased the concentration of these gases, intensifying the greenhouse effect and causing global warming.
- 🌿 Greenhouse gas (GHG) emissions are a major problem because they trap heat in the atmosphere, leading to global warming and climate change.
- 🌿 This warming is causing significant shifts in weather patterns, rising sea levels, and more frequent and intense extreme weather events.
- 🌿 Human activities, particularly the burning of fossil fuels, are the primary driver of increased GHG emissions.





Sources of GHG emissions:



-  **Fossil fuel combustion:** Burning coal, oil, and natural gas for energy (electricity, transportation, industry) releases large amounts of CO₂.
-  **Agriculture:** Livestock farming, particularly cattle, is a major source of methane emissions.
-  **Deforestation:** Trees absorb CO₂, so deforestation reduces the planet's ability to naturally remove greenhouse gases from the atmosphere.
-  **Industrial processes:** Certain industrial activities release significant amounts of greenhouse gases, including methane and fluorinated gases.
-  **Waste management:** Landfills release methane as organic waste decomposes.

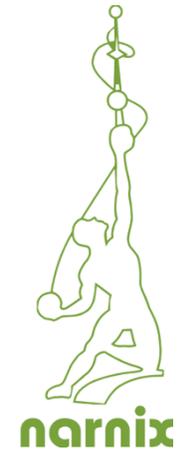




Consequences of increased GHG emissions:



-  **Climate change:** Warming temperatures cause shifts in weather patterns, including more frequent and intense heatwaves, droughts, floods, and storms.
-  **Sea level rise:** Melting glaciers and ice sheets, along with thermal expansion of water, contribute to rising sea levels, threatening coastal communities.
-  **Ecosystem disruptions:** Changes in temperature and rainfall patterns can disrupt ecosystems, impacting plant and animal life.
-  **Impact on human health:** Air pollution from GHG emissions can negatively affect respiratory health, and extreme weather events can lead to injuries and displacement.
-  **Economic impacts:** Climate change can disrupt agriculture, infrastructure, and other sectors, leading to economic losses.



CLIMATE CHANGE IS HERE, AND WE'RE FEELING REAL EFFECTS

Climate Crisis





Climate Crisis



- 🌿 A situation characterized by the threat of highly dangerous, irreversible changes to the global climate.
- 🌿 Climate change has caused a worldwide climate crisis. The record-breaking heat, floods, storms, drought, and wildfires devastating communities around the world underscore the grave risks we already face.
- 🌿 The consequences of the climate crisis are already being felt globally and are projected to intensify significantly in the coming years.
- 🌿 it's mainly human activity that causes climate change and that the resulting crisis poses a real threat to the planet and human life.
- 🌿 The climate crisis is a complex and urgent global issue driven by human activities, primarily the release of greenhouse gases into the atmosphere. These gases trap heat and cause global warming, leading to a cascade of environmental, social, and economic disruptions.





Causes of the climate crisis



-  **Burning fossil fuels:** Burning coal, oil, and gas for electricity, heat, transportation, manufacturing, and other purposes accounts for over 75% of global greenhouse gas emissions and nearly 90% of all carbon dioxide emissions.
-  **Deforestation:** Forests absorb carbon dioxide from the atmosphere. When forests are cleared for agriculture, development, or other reasons, stored carbon is released, and the ability to absorb future emissions is diminished.
-  **Industrial processes:** Manufacturing goods, producing materials like cement and steel, and various industrial activities contribute significantly to greenhouse gas emissions.
-  **Agriculture:** Agricultural practices, including livestock farming (which releases methane) and the use of nitrogen-containing fertilizers (which emit nitrous oxide), also contribute to the increase of greenhouse gases in the atmosphere.
-  **Consumption patterns:** Consumption habits, including the things people buy, how people travel, what people eat, and how much waste is produced, all contribute to greenhouse gas emissions.





Effects of the climate crisis



-  **Rising global temperatures:** The average global temperature is now approximately 1.2°C warmer than it was in the late 1800s. This leads to more frequent and intense heatwaves, which poses risks to human health, increases the risk of wildfires, and impacts agricultural yields.
-  **Changes in precipitation patterns:** Some regions are experiencing more severe droughts, which impacts water availability, agriculture, and ecosystems. Other regions are facing increased heavy rainfall events and flooding.
-  **Melting glaciers and ice sheets:** Melting ice contributes to rising sea levels, which threatens coastal communities and ecosystems.
-  **Ocean changes:** Oceans are absorbing more heat and carbon dioxide, which leads to ocean warming and acidification, which endangers marine life and coral reefs.



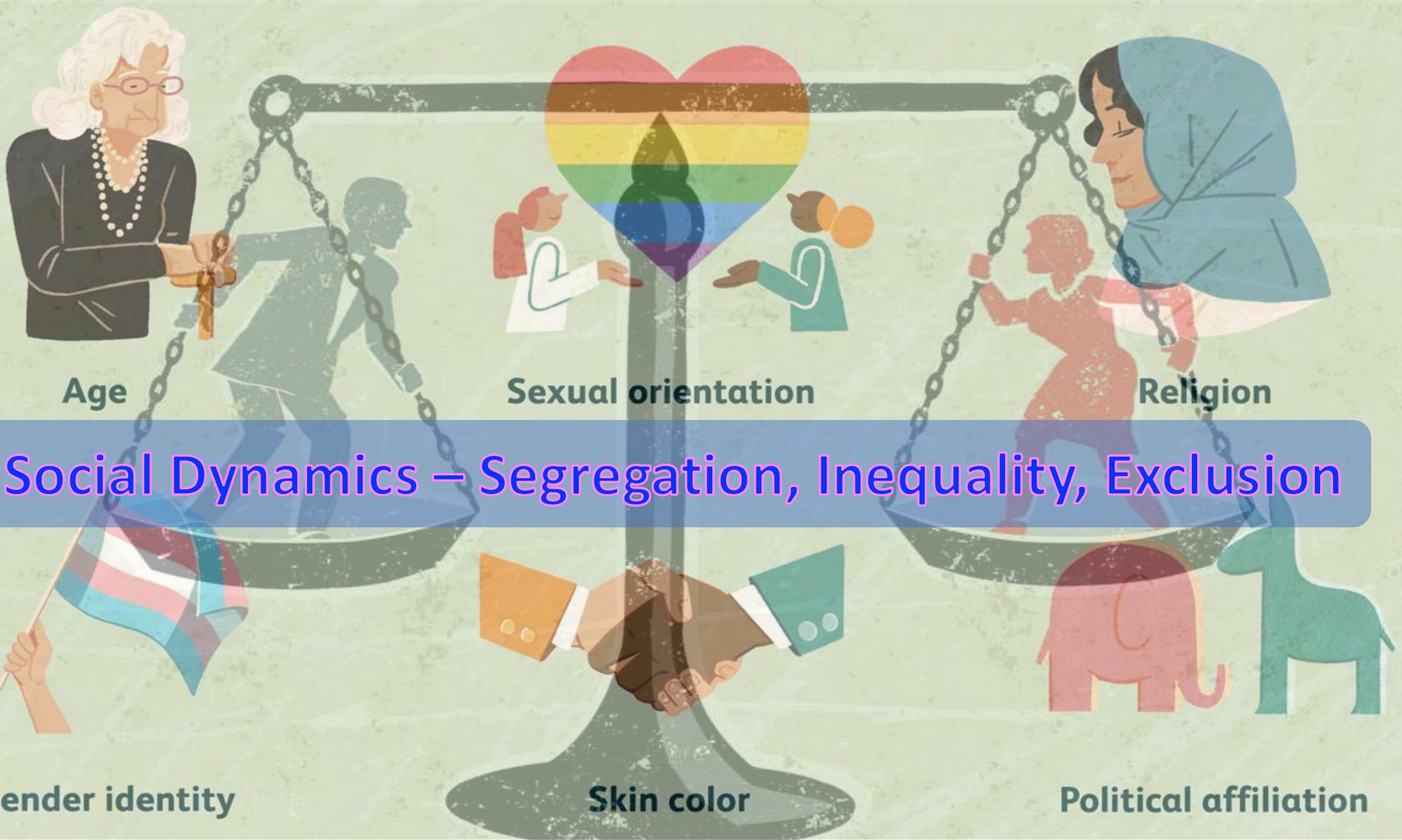


Effects of the climate crisis



-  **Loss of biodiversity:** Climate change, combined with other factors like habitat loss, is accelerating species extinction rates.
-  **Threats to food and water security:** Changes in temperature and precipitation, along with ocean acidification, impact agriculture, fisheries, and access to clean water, which leads to food and water insecurity.
-  **Health impacts:** Climate change is a significant health threat, impacting respiratory and cardiovascular systems, contributing to mental health issues, and increasing the spread of vector-borne diseases.
-  **Poverty and displacement:** Extreme weather events can displace communities and push people into poverty, particularly in vulnerable areas with limited resources.





Age

Sexual orientation

Religion

Social Dynamics – Segregation, Inequality, Exclusion

Gender identity

Skin color

Political affiliation



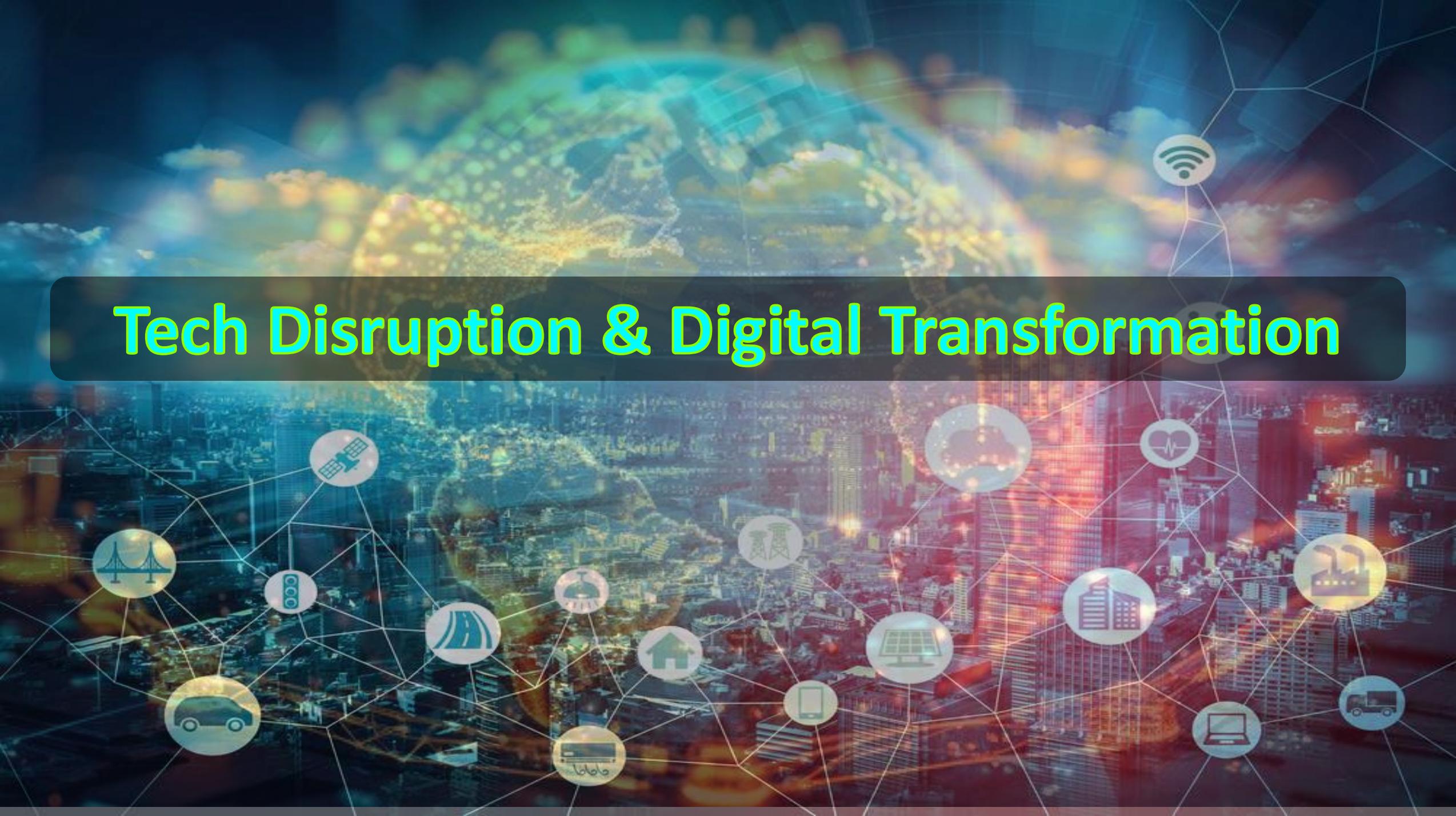
Social Dynamics – Segregation, Inequality, Exclusion



- 🌿 Vibrancy of social fabric of the society is getting adversely impacted by the climate change, industrialization and digitalization.
- 🌿 These mega forces are disrupting the diversity, equality & inclusion by creating barriers for certain groups while favouring others. A culture where certain groups or individuals feel unwelcome, unheard, or not valued. They are systematically marginalized and denied access to resources, opportunities, or social participation.
- 🌿 This means that certain groups are systematically disadvantaged and lack the same opportunities or resources as others. This can result in unequal outcomes, even if everyone is given the same opportunities.
- 🌿 It can lead to a lack of belonging and a negative impact on well-being and productivity
- 🌿 While urbanization is moving the global economy forward, rising inequality and exclusion within cities can derail development progress. Today, one out of three urban residents in the developing world still lives in slums with inadequate services.
- 🌿 The global population is growing older, and the world is getting more urban, which will require cities and towns to meet changing needs.



Tech Disruption & Digital Transformation





Disruption: The New Normal



- 🌿 Disruption is everywhere and the future is uncertain — no one knows what the world will look like even a decade from now. As we head into future, we are surrounded by disruptive innovation.
- 🌿 Whether it's artificial intelligence, driverless cars, space exploration or quantum computing, it can be hard for even the most enthusiastic technophiles to stay up to date with all the rapid advances taking place and coming down the line.
- 🌿 As we look to the years & decades ahead, tech-disruption will be driven as much by the methods and systems as it is by the devices, we associate with tech disruption.
- 🌿 The pace of innovation is incredibly fast, with new things getting discovered daily.
- 🌿 The future trends in technology are very diverse, very intertwined, and very promising.
- 🌿 There are several developments that have and will continue to shape business strategies.
- 🌿 From automation to sustainability, organizations are adapting to a whole new wave of consumer preferences.

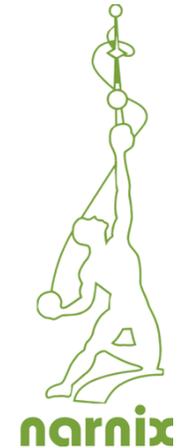




The Disruptive & Most Profound Technologies...



- 🌿 Disruptive technology is the bearer of tremendous opportunity and equally, a harbinger of obsolescence.
- 🌿 Technology's impact on society and business is substantial, if not underestimated.
- 🌿 Though product cycle times are accelerating, the underlying technologies unfold over many years.
- 🌿 Within each trend there are multiple enabling technologies, all at various stages of maturity and adoption.
- 🌿 *The most profound technologies are those that disappear...*
- 🌿 *They weave themselves into the fabric of everyday life until they are indistinguishable from it...*





ARTIFICIAL INTELLIGENCE



The current wave of progress and enthusiasm for AI began around 2010, driven by three factors that built upon each other:

 The availability of *big data* from many sources;

 Dramatically *improved machine learning approaches and algorithms*; and

 The capabilities of *more powerful computers*.





The Three Mega Trends



AI Everywhere

Deep Learning
Deep Reinforcement Learning
Artificial General Intelligence
Autonomous Vehicles
Cognitive Computing
Commercial UAVs (Drones)

Conversational User Interfaces
Enterprise Taxonomy
Ontology Management
Machine Learning
Smart Dust
Smart Robots
Smart Workspace



Transparently Immersive Experiences

4D Printing
Augmented Reality
Brain-Computer
Interface
Connected Home

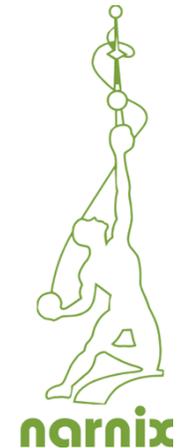
Human Augmentation
Nanotube Electronics
Virtual Reality
Volumetric Displays



Digital Platforms

5G
Digital Twin
Edge Computing
Blockchain
IoT Platform

Neuromorphic Hardware
Quantum Computing
Serverless PaaS
Software-Defined Security





Disruptive Technology Trends



🌿 Robots Become Coworkers

🌿 From Wearables to Implantable

🌿 Bots Usurp Apps

🌿 Genetically Modified Life forms

🌿 3D Printing Gets Industrial

🌿 AI Replaces White Collar Expertise

🌿 Quantum Computing Gets Practical

🌿 Self Driving Vehicles On the High Street

🌿 Blockchain Disrupts More than Banks

🌿 Virtual Reality as a Commercial Reality

🌿 From Augmented Reality to Mixed Reality

🌿 Robots Teaching Themselves

🌿 Cyber Security Wars

🌿 The Things Are Taking Over the Internet

🌿 Renewables and Clean Energy

Diversify

DESIGNING A SUSTAINABLE & RESILIENT FUTURE

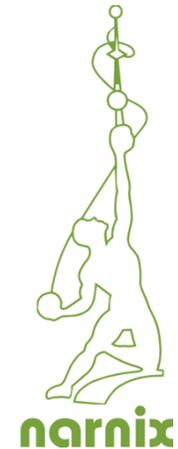




The current landscape & imperatives...



-  **Climate Change** - Net Zero Goals and Going Carbon Neutral imperatives and initiatives
-  **Energy Security** – Example - Current challenges that Europe is facing due to geo-political issues...
-  **Clean/Green Energy** - Coal, gas and oil still meet three-quarters of global heat demand, making it heavily fossil-fuel dependent.
-  **Energy Efficiency** - It is rightly considered as the 5th Fuel and a Source of Clean Energy rather than a strategy...
-  **Electricity Access** - 90.5% in 2020. An estimated 660 million people would still lack access in 2030, most of them in Sub-Saharan Africa.
-  **Global Digital Population** - Internet Users 5.0 Billion++; Social Media Users 4.65 Billion++
-  **Disruptive Technologies** - Their impact on different aspects of society, industry & business including but not limited to ethical and sustainability aspects.
-  **Digital Transformation** - Intertwining of IT, OT, NT, IoT & AI... DT is NOT about Technology, it is domain & context specific evolution leveraging Disruptive Technologies
-  **AI a Double Edge Sword** – The pervasiveness of AI comes with plenty of adverse implications including but NOT limited to exponentially multiplying Carbon Footprint and other Ethical concerns...
-  **Growing Carbon Footprint of Digital Infrastructure** – Impact of growing digitalization
-  **Cyberthreat Landscape** - Securing the critical/civic infrastructures, Industrial, Business and Financial enterprises from Cyber-attacks,
-  **A meaningful Safe Digital Life** - a fair, more liveable digital future for our fast-evolving and technology-driven world
-  **Industry 4.0 to Industry 5.0** – Shifting perspectives: Man-Machine Collaboration & Sustainability on the forefront.
-  **Sustainability & Resilience** – Whether Electrified, Connected and/or Digital, Society has to be Sustainable and Resilient to say the least...
-  **Green Washing** - Need to control it comprehensively...





Disruptive Technologies – Concerns...



🌿 The diverse Disruptive Digital Technologies including but NOT limited to : Internet of Things, Edge Computing, Big Data, Cloud, Data Centers, Block Chain, Artificial Intelligence, Machine Learning, 5G/6G, AR/VR, Web 3.0, Digital Twin, Metaverse, Robotics & Drones etc. come with their respective and collective adverse environmental impact including but NOT limited to the following concerns:

- 🌿 Carbon Footprint
- 🌿 Water Footprint
- 🌿 Energy Intensity
- 🌿 GHG Emissions
- 🌿 E-Waste Generation
- 🌿 Raw Material & rare Earth Minerals





Technology as a double Edge Sword...



- There is no doubt that AI is transforming how we work, play, and think in revolutionary ways. Recent developments in AI-focused areas herald its full-fledged arrival via autonomous automobiles, cognitive computing, and collaborative robotics.
- The exponential growth of disruptive digital technologies and innovations therein have undoubtedly helped the mankind survive, grow, prosper, and lead a good quality of life, even in the face of unprecedented calamities. However, all these technologies also come with plethora of moral, ethical, societal, and environmental concerns, including climate change, resource depletion, pollution, and e-waste generation, but also presents opportunities for sustainable solutions.
- Like any disruptive innovation, AI presents a number of complex public policy challenges in terms of our moral values and ethical principles that require extensive knowledge of science and technology for effective decision-making.
- These issues span a diverse spectrum of applications including agriculture, communications, energy, the environment, health care, and transportation.
- However, Sustainability, Safety, Security, Privacy take the lead in needing the attention of all stakeholders be it SDOs, Governments, Policy Makers & Regulators, System Developers & Business Organizations, Academia & Researchers or Intergovernmental & NGOs.





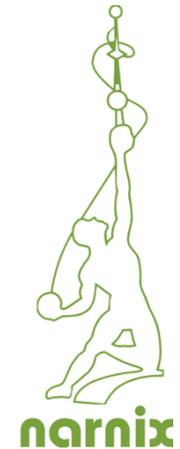
The Digital Transformation



The society, the business, the infrastructure, the services and all other aspects of the civilization on the planet Earth are going through a paradigm shift in the wake of technological advancements, especially in the field of ICT

All the ecosystems, be it Smart Cities, Smart Grid, Smart Buildings or Smart Factories now find themselves making three classes of transformations:

- 🌿 **Improvement of Infrastructure** – to make it resilient & sustainable...
- 🌿 **Addition of the Digital Layer**- which is the essence of the *smart paradigm*; and
- 🌿 **Business Process Transformation** - necessary to capitalize on the investments in smart technology.

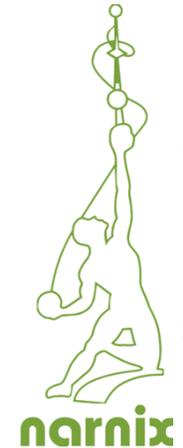
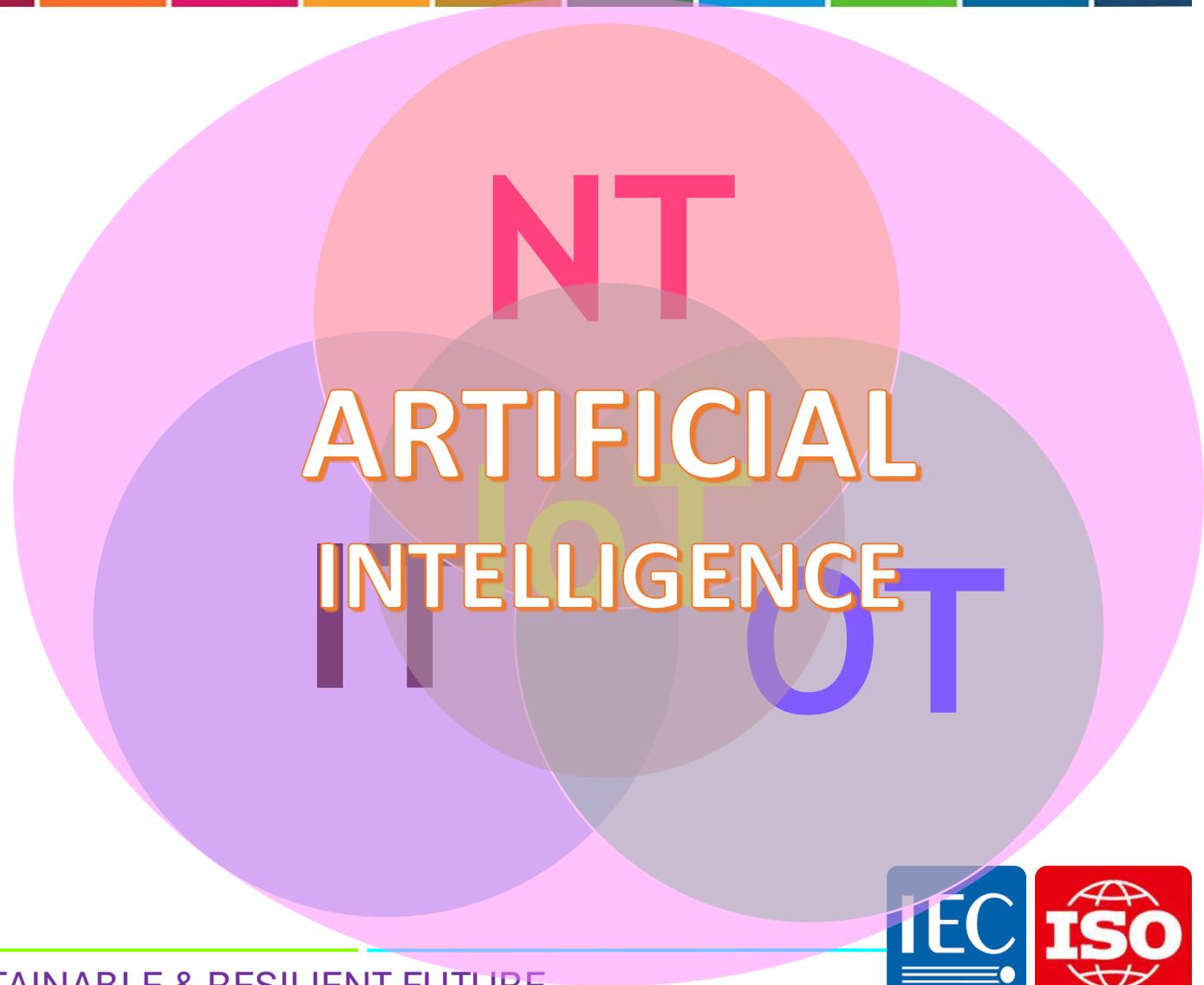




Digital Transformation Constituents



- ⚙ Information Technologies
- ⚙ Operational Technologies
- ⚙ Network Technologies
- ⚙ IoT Technologies
- ⚙ Artificial Intelligence
- ⚙ **SUSTAINABILITY ???**





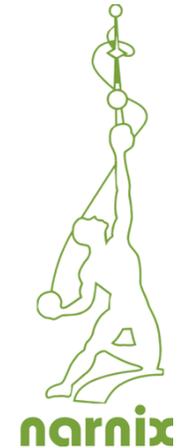
The genesis of Digital Transformation



In digital transformation in any paradigm, domain or ecosystem

- 🌿 ‘Sustainability is the *True* Destination’
- 🌿 ‘Resilience is the *Core* Characteristic’
- 🌿 ‘Smart is *merely* the Accelerator’

Standards are the Chromosomes of Digital Infrastructure





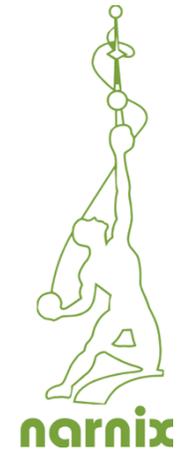
Digital Transformation



is not a technology,
it's a complex paradigm
with domain-specific implications

We are living in an ephemeral world

DESIGNING A SUSTAINABLE & RESILIENT FUTURE





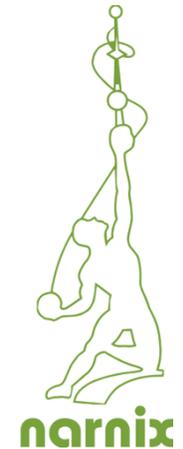
Tech Disruption & Transformation



 Digital transformation refers to the integration of digital technologies into all aspects of an organization or society, fundamentally changing how it operates and delivers value to its stakeholders.

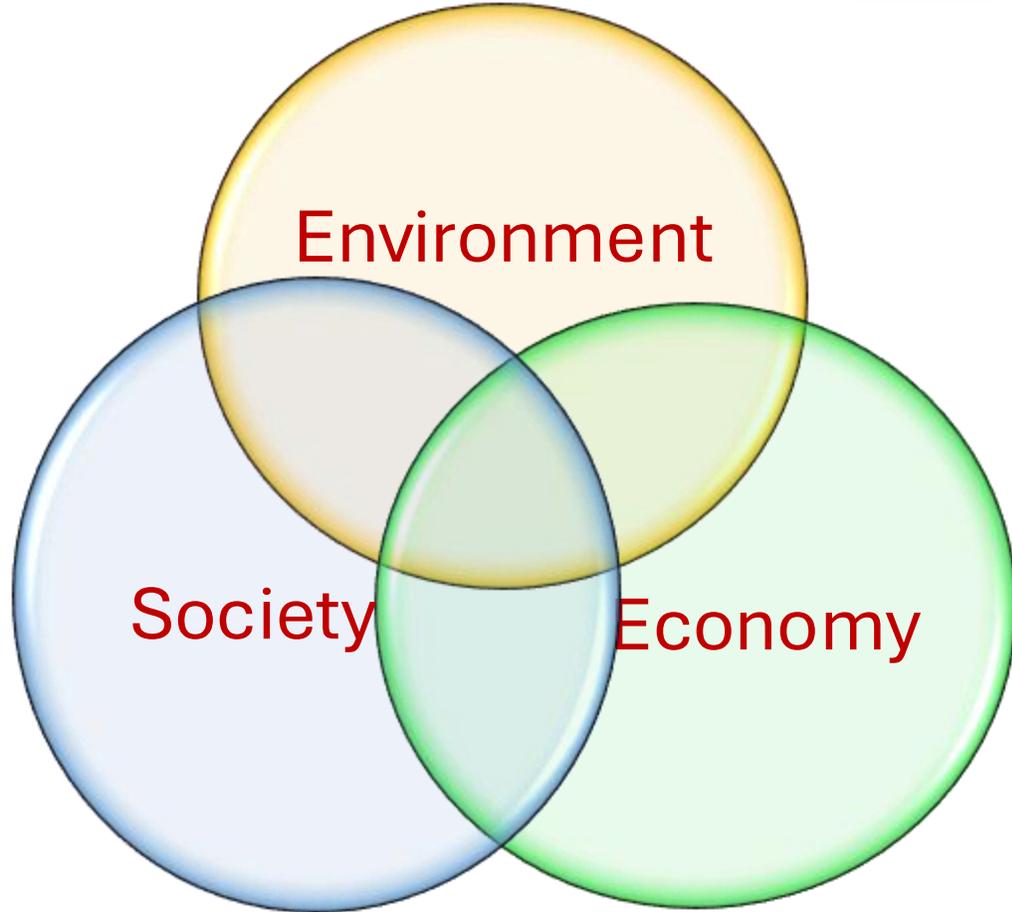
 This question is at the intersection of environmental sustainability, digital transformation and diverse disruptive digital technologies.

 Digital Transformation can be both a solution and a challenge for sustainability in Disruptive Digital Technologies. By adopting eco-friendly practices, optimizing energy usage, and considering the full life cycle, we can harness the digital technologies' potential while minimizing its environmental impact.

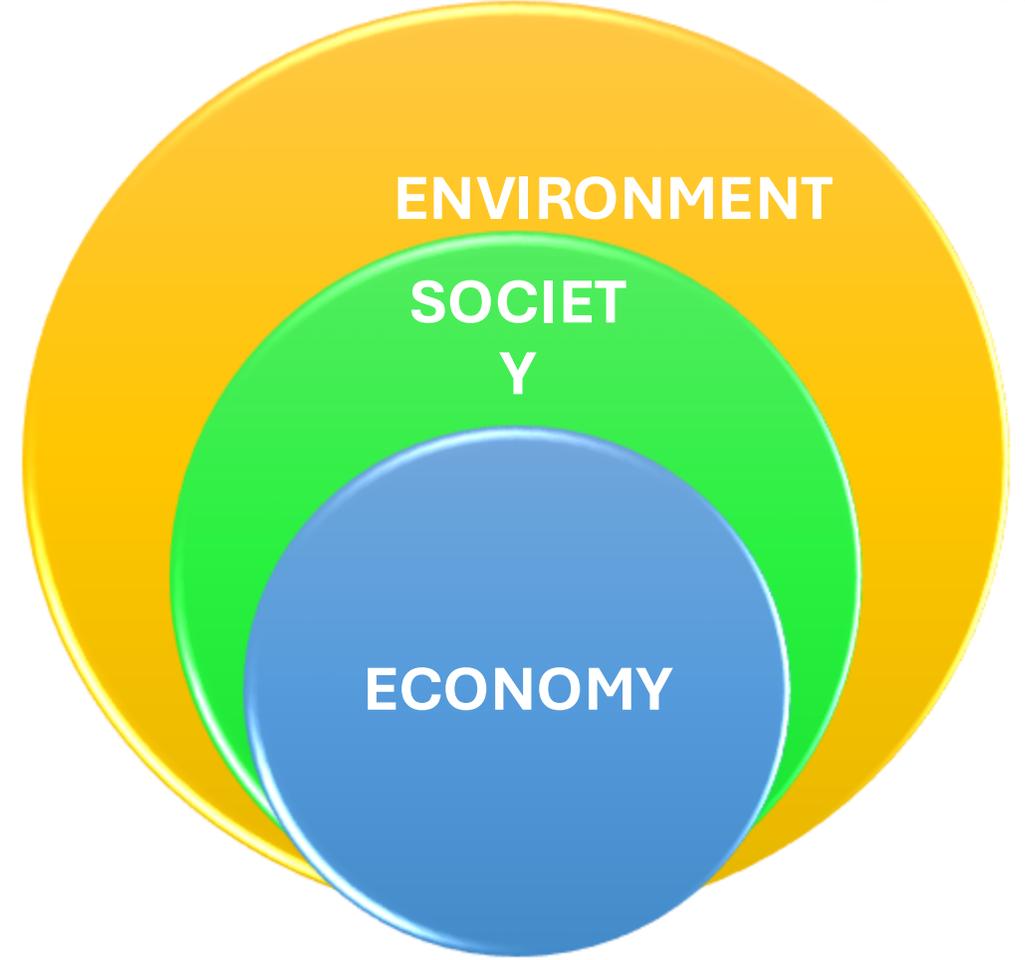




Changing the Way, We Look at the Environment



Overlapping Circles Model



Nested Dependencies Model





The 3 Nested Dependencies Model



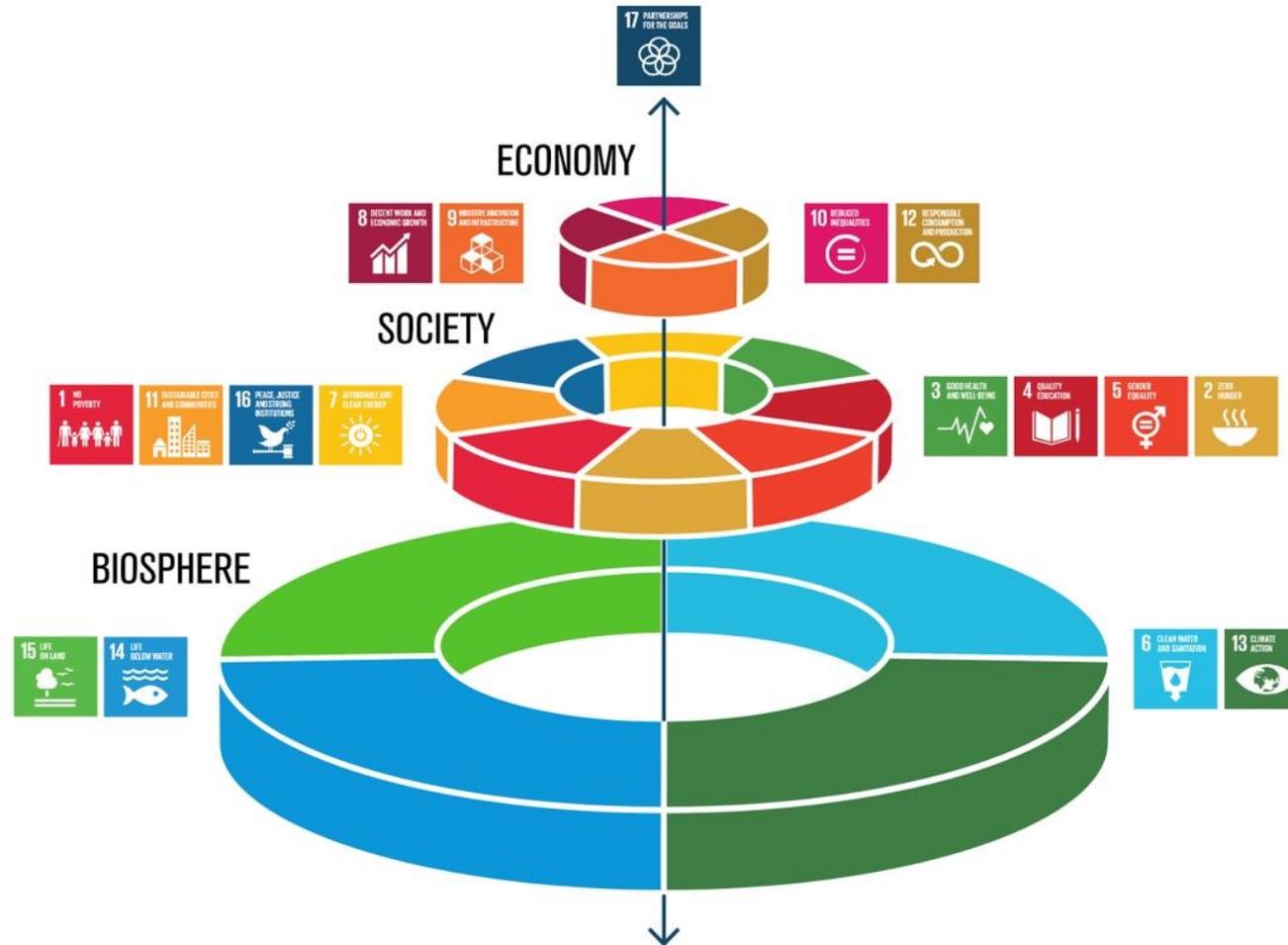
- There are three key differences between the 3 Nested Dependencies Model and the 3 Overlapping Circles Model.
- In the 3 Nested Dependencies Model the three sectors are co-dependent: while the 3 Overlapping Circles imply the economy can exist without the environment, the 3 Nested Dependencies recognise the economy is a wholly-owned subsidiary of the society which in turn is a wholly-owned subsidiary of the environment. They not only co-exist but interact.
- The 3 Nested Dependencies Model reminds us that there is no planet B: Without the environment, the society and the economy cannot exist. The 3 Nested Dependencies remind us that we must live within our means or face the very real threat of ecological (and subsequently societal and economic) collapse.

In short, the 3 Nested Dependencies approach is eco-centric as it acknowledges the inherent value of the environment and prioritises the health of our planet over economic gains. Rather than the three sectors competing with each other, as might be the case in the 3 Overlapping Circles model, the 3 Nested Dependencies remind us that without clean water, fresh air and healthy ecosystems the society and the economy cease to function.





Attaining the SDGs within the planetary boundaries



Graphics by Jerker Lökvantzi/Azote

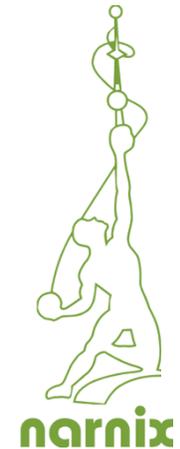
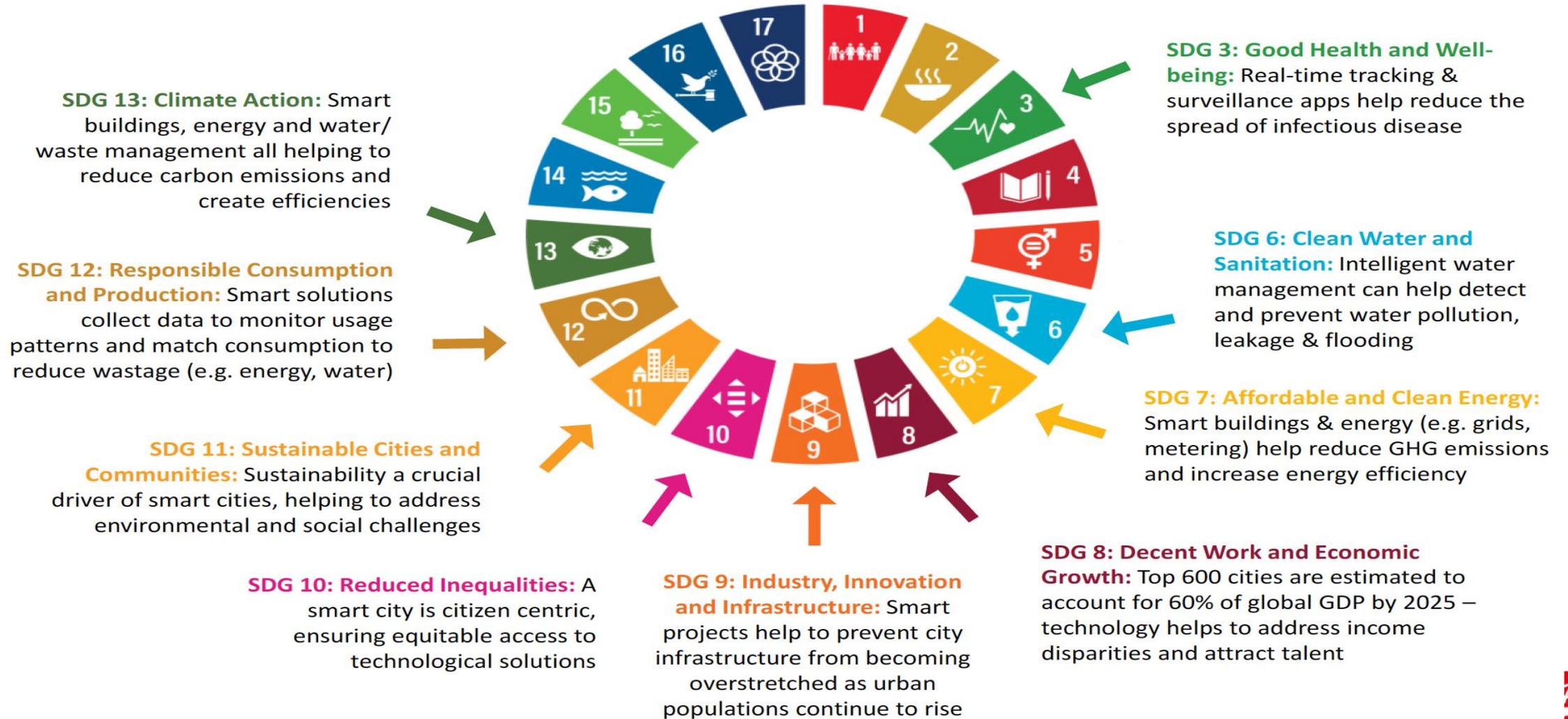


DESIGNING A SUSTAINABLE & RESILIENT FUTURE





Broad basing the SDGs & Cities Interplay...





Why Map all 17 SDGs to Cities/Smart Cities?



- 🌿 It has been observed that all the 17 SDGs have some interplay with different aspects of the Cities.
- 🌿 Cities are a confluence of the three core pillars of Sustainability – the Environment, the Society and the Economy.
- 🌿 Understanding the relationship of all the 17 SDGs individually with respective aspects of Cities shall go a long way in making our Cities comprehensively Smart, Sustainable, Resilient, Safe, Secure and Citizens' friendly.
- 🌿 Hence, a structured meta-analysis is the first step towards a 'Sustainable & Resilient Future' for our children and future generations.

We shape our cities, thereafter they shape us....

DESIGNING A SUSTAINABLE & RESILIENT FUTURE



Cities are where the climate change battle will be primarily won or lost



The Cities, we want to Live In



A meaningful Safe Digital Life



- 🌿 As of February 2025, **5.56 billion** individuals worldwide were **internet users**, which amounted to **67.9 percent** of the global population (**~8.2 billion**). Of this total, **5.24 billion**, or **63.9 percent** of the world's population, were **social media users**.
- 🌿 Data shows the average internet user now spends 6 hours and 42 minutes online each day, which equates to more than 100 days of connected time per internet user per year, or roughly 40 percent of our waking lives.
- 🌿 "It is clear that we live in a digital-first, work-from-home world, yet not one of the 17 Sustainable Goals addresses a fair, more liveable digital future for our fast-evolving and technology-driven world,"
- 🌿 We need a comprehensive **Governance Framework** that is globally adopted and enforced to ensure that there are ample safeguards to protect & enable us to lead **"A Meaningful Safe Digital Life"** and encourages companies **to use data for mutual benefit rather than for unwelcomed intrusion or manipulation?"**
- 🌿 It would need to be duly supported by **Comprehensively Cyber Secure & Trustworthy Digital Infrastructures** across the planet and beyond.





Inclusive Diverse & Vibrant City



An inclusive, diverse, and vibrant city is characterized by its ability to accommodate and celebrate differences among its residents while fostering a sense of community and belonging for everyone. Here are key elements that contribute to creating such a city:

 **Social Inclusivity**

 **Cultural Diversity**

 **Economic Opportunity**

 **Public Spaces and Recreation**

 **Education and Lifelong Learning**

 **Accessibility and Mobility**

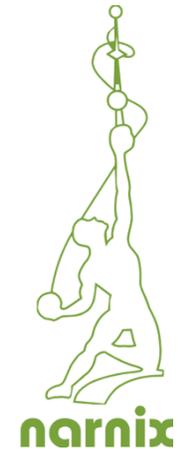
 **Safety and Well-being**

 **Environmental Sustainability**

 **Governance and Participation**

 **Celebration of Differences**

By prioritizing inclusivity, diversity, and vibrancy, cities can cultivate a sense of belonging and civic pride among residents while promoting social cohesion, economic prosperity, and sustainable development for all.





Cognitive Cities

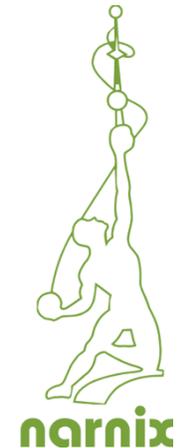


In our rapidly evolving urban landscape, the concept of cognitive cities has emerged as a powerful paradigm.

These cities go beyond the traditional notion of smart cities by incorporating cognition – the ability to learn, adapt, and respond intelligently to the needs of their inhabitants.

A cognitive city is not just a collection of smart infrastructure and connected devices. It is a dynamic ecosystem that learns from its past, adapts to changes, and continuously improves its efficiency, sustainability, and resilience. some defining characteristics:

-  **Advanced ICT Infrastructure:** Cognitive cities rely on advanced information and communications technologies (ICTs) to automate daily urban processes. These technologies enable seamless data exchange between citizens, businesses, and municipal systems.
-  **Learning Systems:** Unlike conventional cities, cognitive cities incorporate learning processes. They analyze data collected from citizens and interactions with the environment. This learning loop allows them to evolve and optimize their services continually.
-  **Collective Intelligence:** Cognitive cities harness collective intelligence within their communities. By involving citizens as active participants (think of them as sensors), they create a feedback loop that informs decision-making and policy formulation.





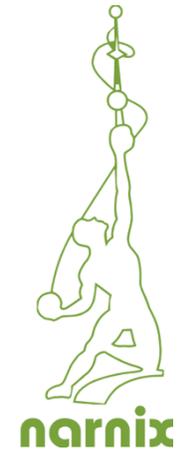
Circular Cities: Reimagining Urban Centres



Circular cities hold the key for transformational change, unlocking a new economic model that will transition away from fossil fuels, provide a reliable platform for waste to become a resource and advance more equitable, inclusive value chains for our communities.

”Cities can transform from black holes sucking in food, energy and other resources to engines of a [regenerative food system and bio-economy](#). The transition to a circular economy will see production which regenerates rather than harms the natural systems upon which it relies.”

Through circular economy strategies, [countries and cities can take actions](#) in "food waste, eco-design, organic fertilizers, guarantees for consumer goods, and innovation and investments. Circular economy principles have also need to be gradually integrated in industrial best practices, green public procurement, the use of cohesion policy funds, and through new initiatives in the construction and water sectors.”



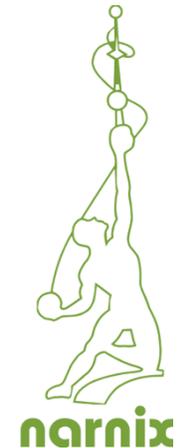


Circular Cities Principles...



Circular city encourages the use of systems thinking to provide economic, social and environmental benefits for its citizens, while also looking to improve the quality of life. Cities can follow seven principles in their transition towards a circular economy. These principles can be extended to define a vision and an action roadmap on circularity in cities:

- 🌿 **Closed-loop** – all materials enter into an infinite cycle (technical or biological).
- 🌿 **Reduced emissions** – all energy comes from renewable sources.
- 🌿 **Value generation** – resources are used to generate (financial or other) value.
- 🌿 **Modular design** – modular and flexible design of products and production chains increases the adaptability of systems.
- 🌿 **Innovative business models** – new business models for production, distribution and consumption enable the shift from the possession of goods to (use of) services.
- 🌿 **Region-oriented reverse logistics** – logistics systems shift to a more region-oriented service with reverse logistics capabilities.
- 🌿 **Natural systems upgrading** – human activities positively contribute to ecosystems, ecosystem services and the reconstruction of “natural capital”.





Circular City Strategies...



To facilitate the transition to a circular economy, smart city strategies may encompass:



- 🌿 Ecological public procurement policies
- 🌿 Local production, repair and reuse initiatives
- 🌿 Eco-design principles in the built environment
- 🌿 Bio-intensive urban farming
- 🌿 Energy generation from biomass
- 🌿 Innovation in water and waste management systems
- 🌿 Infrastructure solutions for e-mobility and low-energy districts



Net Zero Cities



Net Zero cities are urban areas that aim to achieve net zero carbon emissions, meaning they balance the amount of greenhouse gases emitted with an equivalent amount offset or removed from the atmosphere.

Here's how cities can work towards becoming Net Zero:

 Reducing Emissions

 Offsetting Emissions

 Energy Efficiency

 Renewable Energy

 Transportation

 Circular Economy

 Urban Planning and Design

 Community Engagement

 Policy and Governance

 Monitoring and Reporting

Net Zero cities represent a proactive approach to addressing climate change and promoting sustainable development. By integrating these strategies, cities can mitigate greenhouse gas emissions, enhance resilience to climate impacts, improve air quality, and create healthier and more liveable environments for residents now and in the future.





Cities as Hubs for Climate Action



Cities play a multifaceted & crucial role in climate change, acting as both significant contributors and vulnerable recipients of its impacts, while also emerging as vital hubs for innovative climate action and solutions.

-  **Concentrated Population and Emissions:** Cities are home to over half the global population and are responsible for a large share of greenhouse gas (GHG) emissions, primarily from transportation, buildings, and energy consumption. This concentration means that interventions at the city level can have a significant impact on global emissions reductions.
-  **Vulnerability to Climate Impacts:** Urban areas are particularly vulnerable to climate change impacts such as extreme weather events, heatwaves (exacerbated by the urban heat island effect), and sea level rise. Coastal cities, in particular, face threats to infrastructure and livelihoods from rising sea levels and coastal flooding.
-  **Innovation and Solutions:** Cities are centers of innovation and can implement adaptation and mitigation programs tailored to their specific needs like: Sustainable Building and Construction, Decarbonizing Transportation, Waste Management, Greening the Cities.
-  **Capacity for Swift Action:** Municipal governments often have greater agility than national governments in implementing climate policies and can act as testbeds for innovative solutions.
-  **Economic and Social Co-Benefits:** Climate actions in cities can deliver numerous co-benefits, including job creation, improved public health, and enhanced quality of life for residents.





Cities as Hubs for Climate Action



Challenges and needs: Despite the potential for urban climate action, several challenges remain:

-  **Financing Gap:** Cities, particularly in developing countries, struggle to access sufficient funding and investment for climate-resilient projects.
-  **Governance and Institutional Capacity:** Integrating climate action into urban planning and ensuring effective coordination across different levels of government and stakeholders remain crucial.
-  **Vulnerability of Informal Settlements:** Informal settlements, where a significant portion of urban populations live, are particularly vulnerable to climate impacts and require targeted support and inclusive planning approaches.

Moving forward: Addressing these challenges requires a concerted effort involving:

-  **Strengthening Local Governance and Capacity:** Empowering cities with greater fiscal autonomy and supporting their capacity to develop and implement climate action plans is essential.
-  **Innovative Financing Mechanisms:** Exploring and leveraging diverse financing sources, including public, private, and blended finance models, is crucial to bridge the investment gap.
-  **Promoting Integrated Planning and Collaboration:** Fostering collaboration among different city departments, stakeholders, and levels of government ensures that climate action is integrated into all key urban decisions and delivers multiple benefits.
-  **Sharing Knowledge and Best Practices:** Creating platforms for cities to exchange experiences, learn from successful case studies, and access technical assistance can accelerate climate action globally.



The background features a lush, green futuristic cityscape with tall, tree-like structures. In the foreground, a large, metallic robot with a human-like head is visible. Overlaid on the scene is a network of blue circular icons connected by lines, representing various aspects of technology and industry. The icons include a laptop, a group of people, a factory, robotic arms, a ship, and a Wi-Fi symbol.

**TO REBUILD OUR FUTURE –
CITIES NEED TO NURTURE THE NATURE**

Envisioning the Future Cities



Empowered Citizens



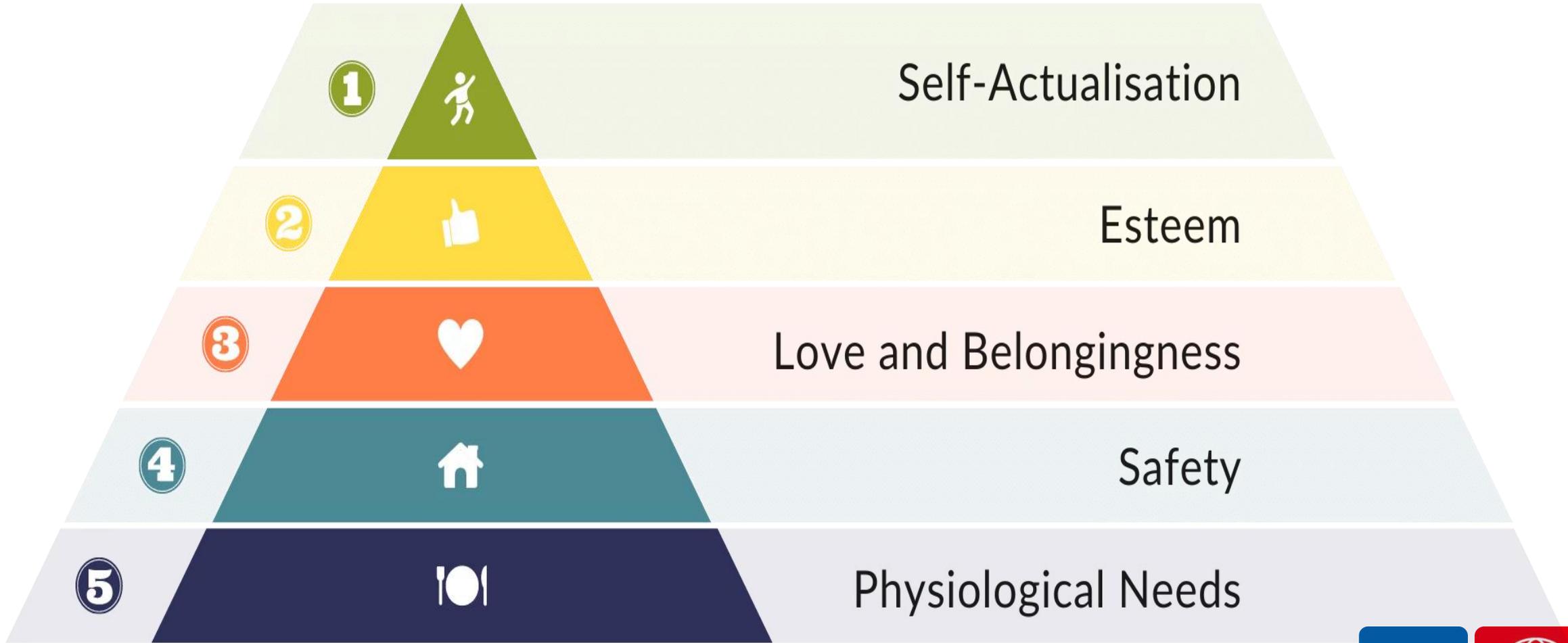
Citizens are the core of any city. Empowering the citizen is about ensuring that each citizen finds the city, its infrastructure, its governance, and its lived environment conducive to fulfil all his/her needs in accordance with the “Manfred Max-Neef's Fundamental human needs Model” and the “Maslow Model”.

Empowered citizens play a crucial role in democratic societies by contributing to social cohesion, promoting inclusive governance, and driving positive change for the collective well-being of their communities and beyond.





Maslow Model





Applying the Maslow Model to Living City



The order of need implies how living city can improve or adapt to changing conditions

DESIGNING A SUSTAINABLE & RESILIENT FUTURE





Beyond Sustainability: Designing Regenerative Cultures



HUMANITY IN HARMONY WITH NATURE - A TIME TO TRANSFORM

Living Systems Design

Pays attention to quality & quantity
Effectiveness doing things right
Informed by a Systems View of Life
Thinking in patterns and principles

The SDGs as a bridge towards regeneration?



Regenerative Development

Depletion fossil energy stocks

Degenerative Development

Using renewable energy flows

Design of Technical Systems

Values only the quantifiable
Efficient - doing things right
Informed by Mechanism & Technology
Siloed & fragmented thinking

Conventional
(staying within the law)

Green
(a little less negative impact)

Sustainable
(adding no additional harm)

Restorative
(humans doing things to nature)

Regenerative
(humans doing things as nature)

Degenerative Cultures

Regenerative Cultures

Based on Reed, 2006 & Roland, 2018

DESIGNING A SUSTAINABLE & RESILIENT FUTURE





Sustainable Multi-Modal Urban Mobility



Sustainable multi-modal urban mobility refers to the integration of various transportation modes within cities in a way that prioritizes environmental sustainability, social equity, economic efficiency, and user convenience.

- 🌿 Diverse Transportation Options
- 🌿 Infrastructure for Active Transportation
- 🌿 Public Transit Expansion and Integration
- 🌿 Promotion of Shared Mobility Services
- 🌿 Electrification and Sustainable Fuels
- 🌿 Smart Mobility Solutions
- 🌿 Transit-Oriented Development (TOD)
- 🌿 Accessibility and Equity
- 🌿 Environmental Sustainability
- 🌿 Policy and Governance Frameworks

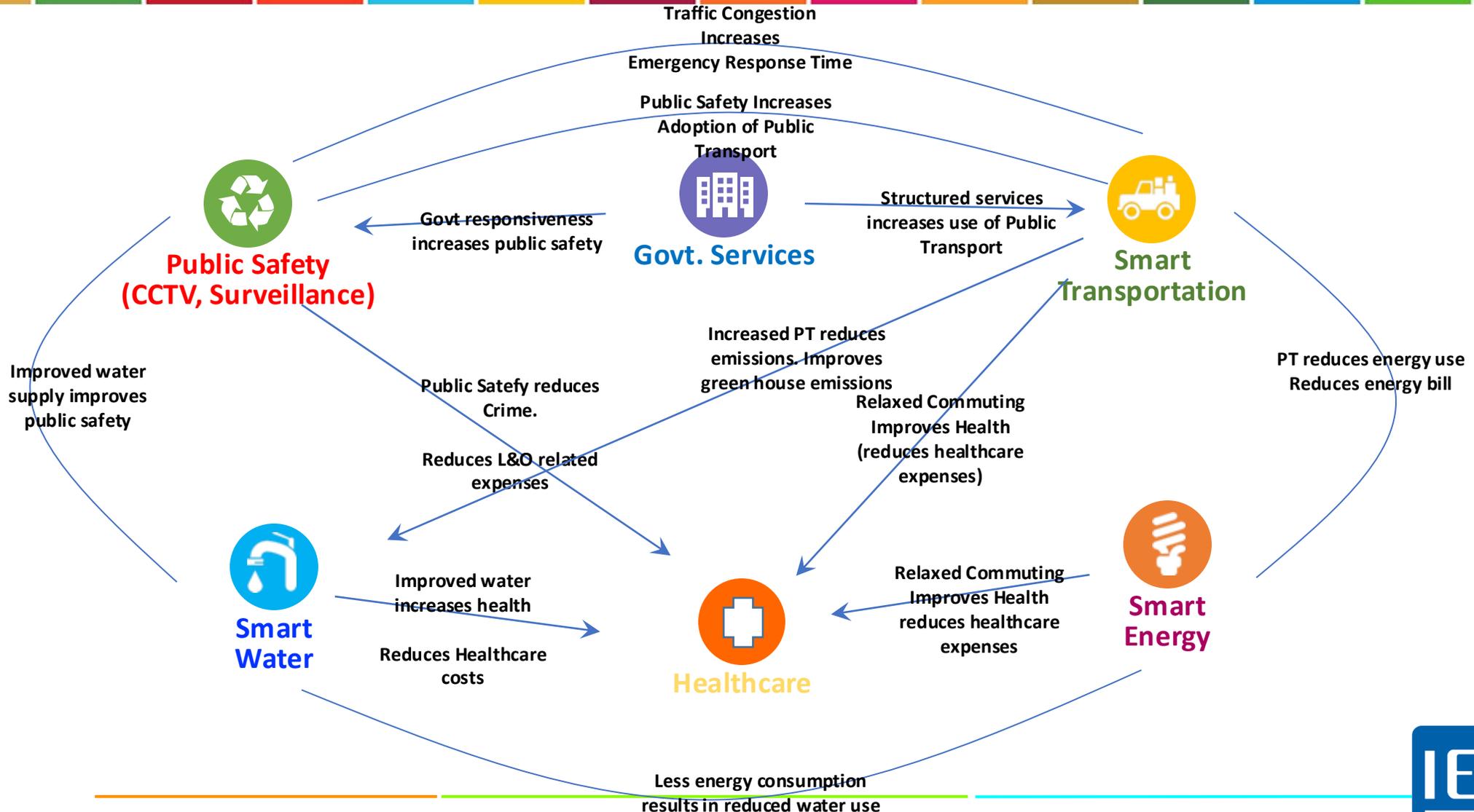
By integrating these strategies, cities can create a comprehensive and sustainable multi-modal urban mobility system that enhances mobility choices, reduces environmental impact, improves public health, and fosters inclusive economic development. Sustainable urban mobility is essential for building resilient, liveable cities that meet the needs of present and future generations.





Integrated Infrastructure

Interdependencies of Services and Solutions





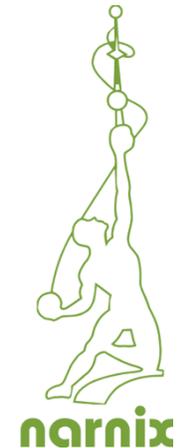
Integrated Infrastructure



Integrated infrastructure refers to the coordinated planning, design, and management of various physical networks and systems within urban or regional contexts. It aims to optimize efficiency, improve resilience, and enhance sustainability by integrating traditionally separate infrastructure sectors.

- 🌿 Multi-Sector Coordination
- 🌿 Efficiency and Cost Savings
- 🌿 Improved Service Delivery
- 🌿 Resilience to Disruptions
- 🌿 Sustainability and Environmental Benefits
- 🌿 Technological Integration
- 🌿 Community and Social Benefits
- 🌿 Policy and Institutional Frameworks
- 🌿 Long-Term Planning and Adaptation
- 🌿 Public and Private Sector Collaboration

Integrated infrastructure is essential for creating sustainable, resilient, and liveable cities and regions. By adopting a comprehensive and interconnected approach to infrastructure development and management, cities can address complex challenges, enhance urban functionality, and improve overall quality of life for residents.

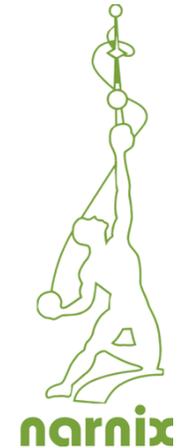




Unified Digital Infrastructure



- Smart projects are often connected to other aspects of infrastructure and should be thought of as large systems of systems, the success of which relies on the optimization of all the sub-systems that support it.
- All sectors in the infrastructure framework are influenced by the unified ICT backbone paradigm. However, a common infrastructure pool enables the creation of a interconnected and truly homogenous system with seamless communication between Services. Coordination, collaboration and harmonization can be better implemented by the effective use of standards based open, common and shareable, information and communication technologies.
- As the Smart city is a complex system of systems, involving many different domains and infrastructures and organisations and activities, it is imperative that all of these need to be integrated and work together effectively for that city to become smart in the real sense. There is a need to focus on the creation of a secure, standardized and open infrastructure model for the delivery of services.





Today data is very often organized in silos

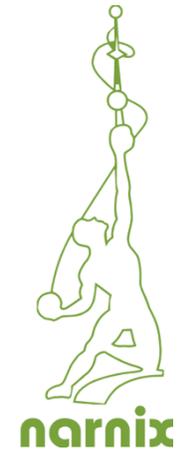
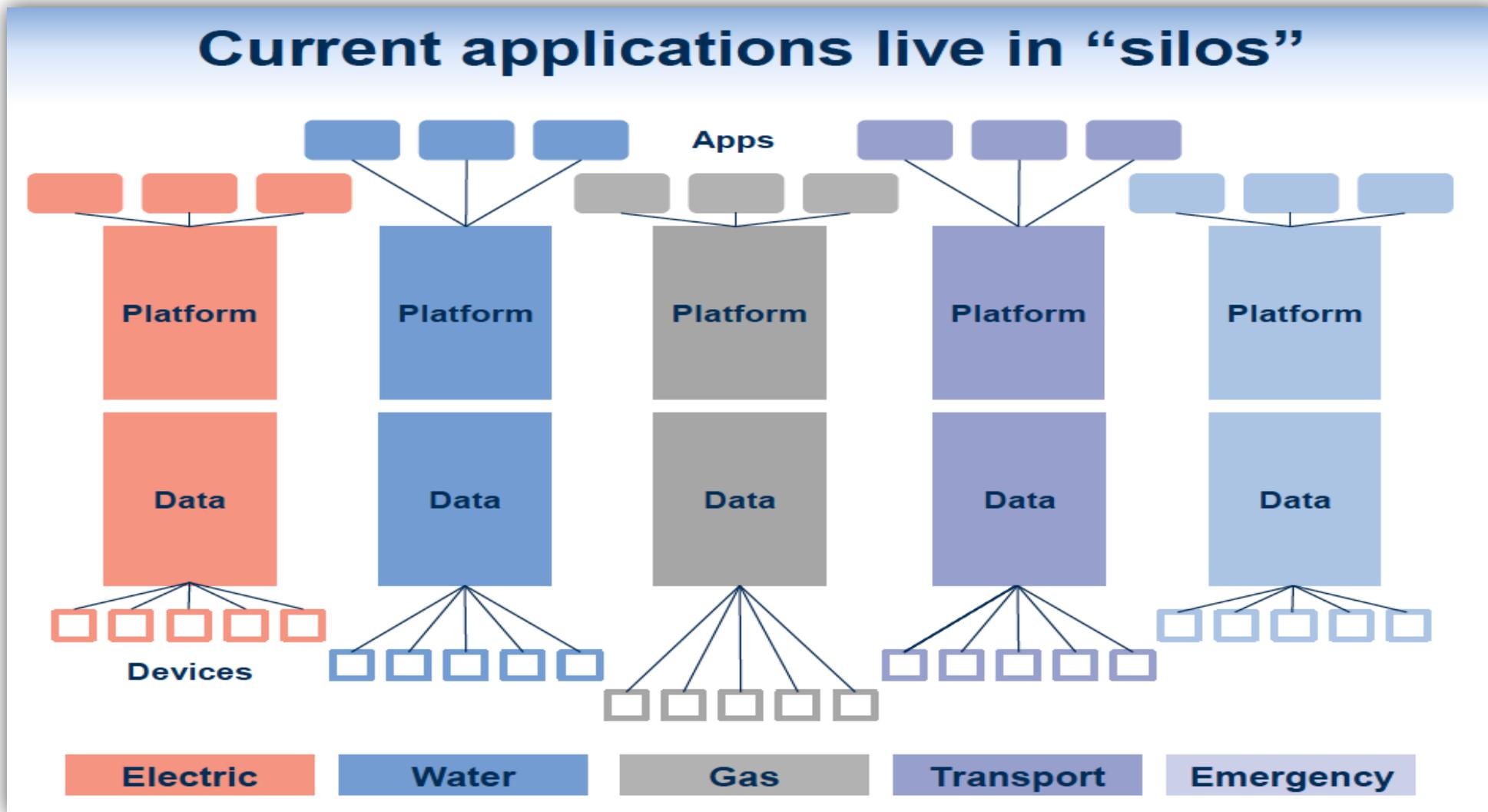


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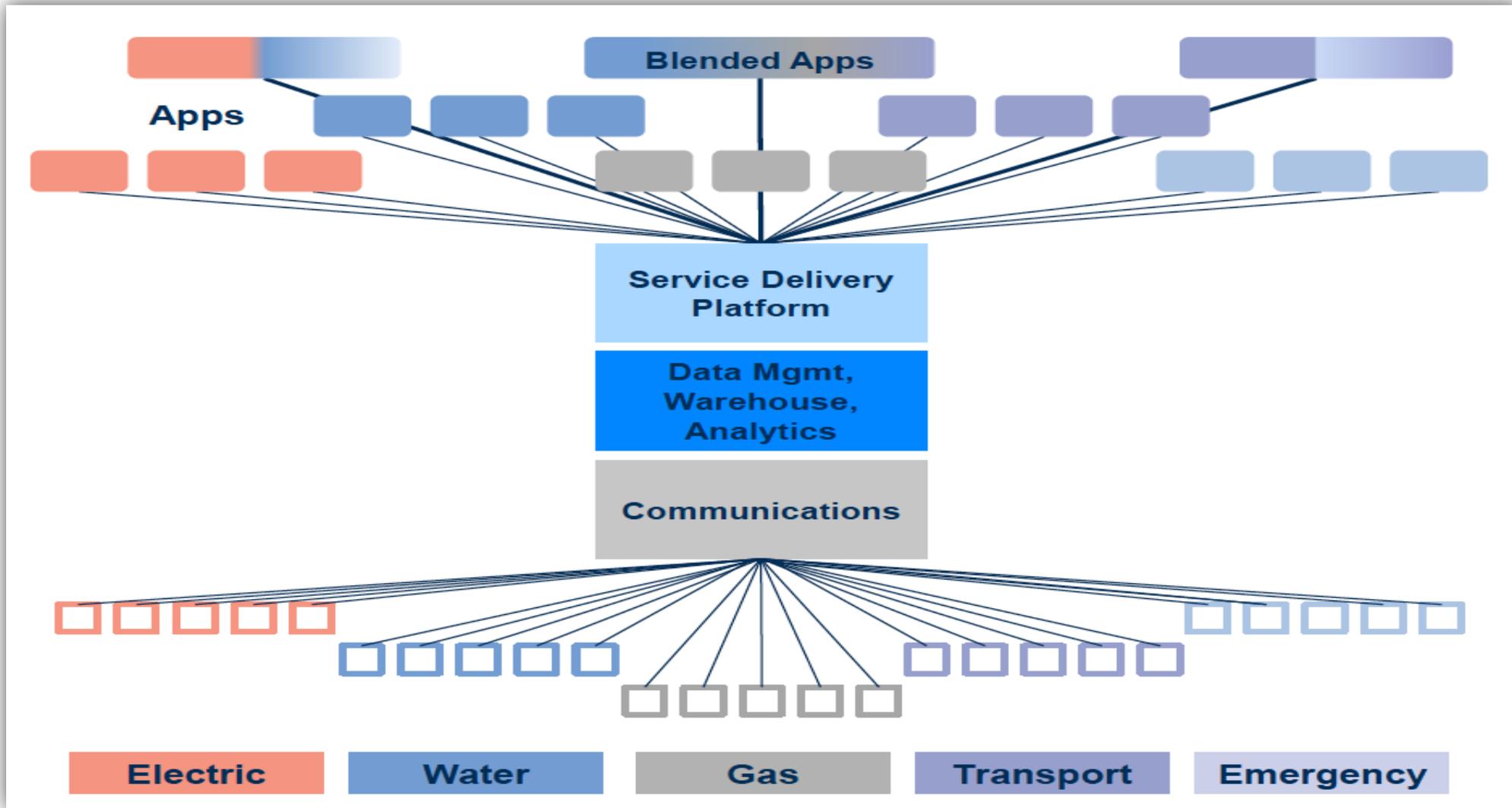


Current Applications live in silos





The way forward: Unified Architecture



DESIGNING A SUSTAINABLE & RESILIENT FUTURE





Smart City ICT Architecture - Simplified View



City KPI (Vision, Mission, Liveability Index)

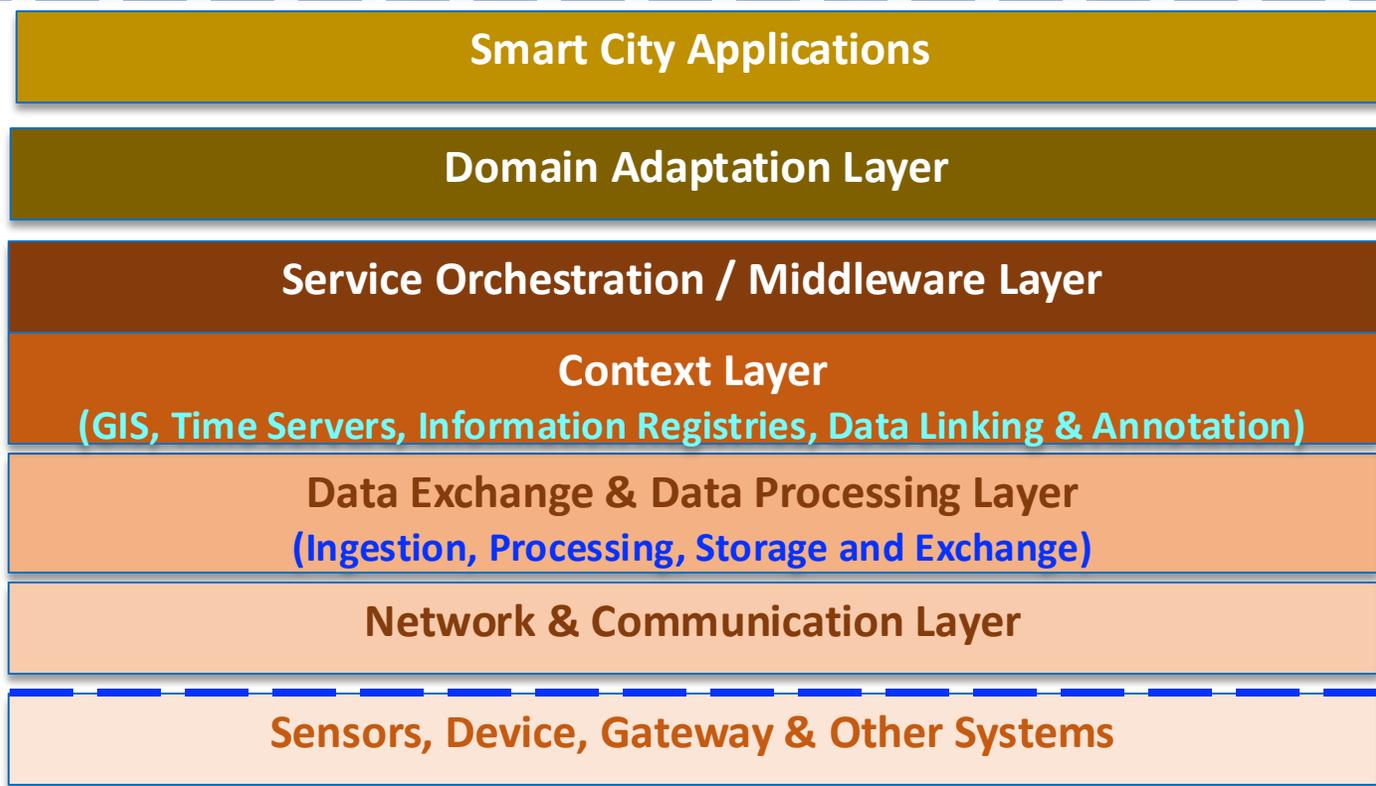
Citizens Administrator Service Provider

Smart City ICT Layers



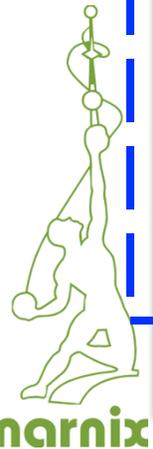
OPERATIONS

GOVERNANCE



SECURITY

INTEGRATION



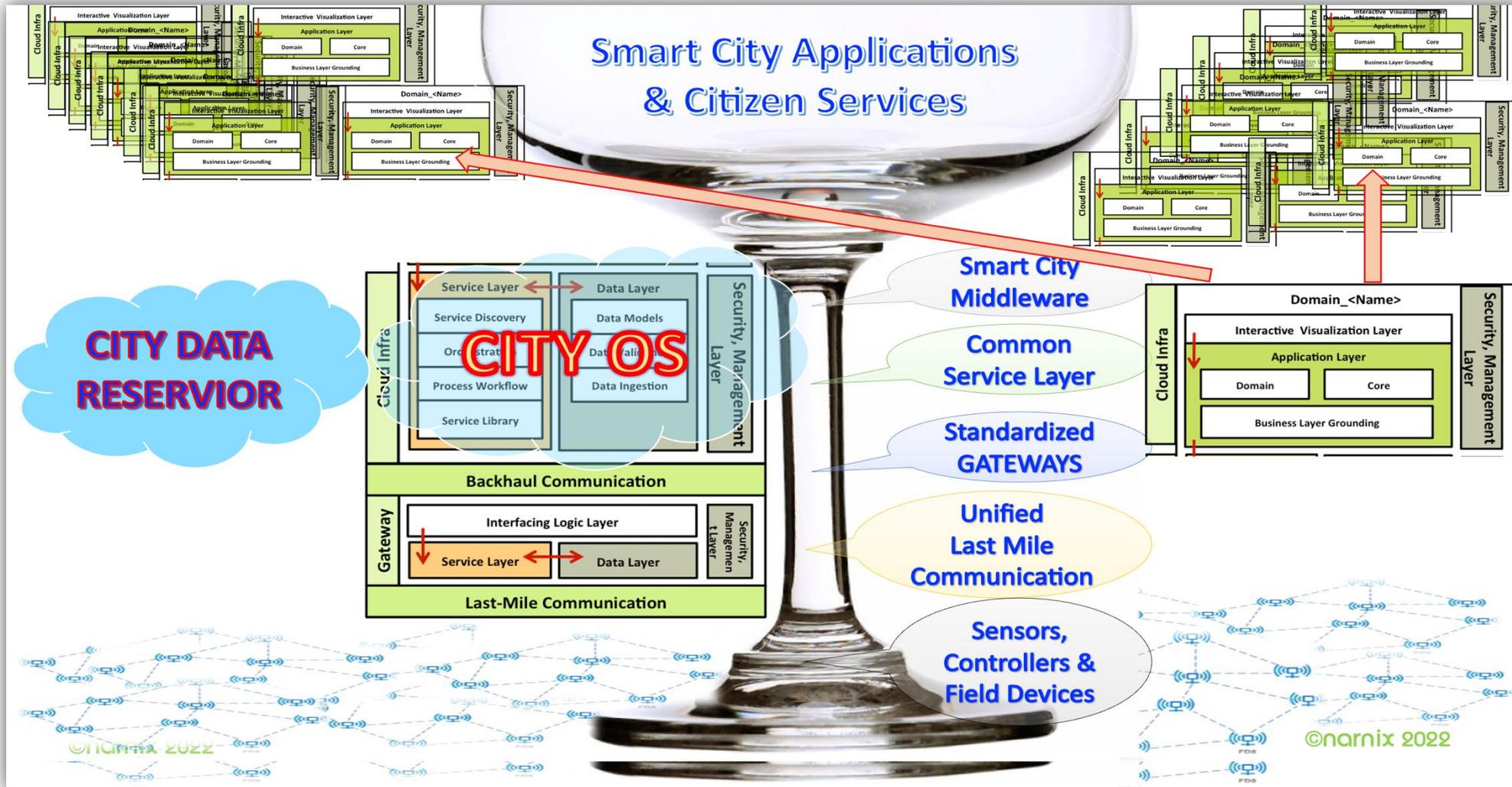
narnix

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Classic Saucer Champagne Glass Architecture Model:



narnix

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Unified Digital Infrastructure Architecture Model



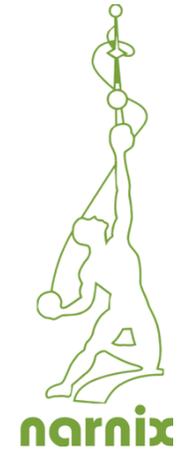
The evolved Comprehensively Unified ICT Architecture can be modelled as a “Classic Saucer Champagne Glass” with a wide Flat Bottom Base depicting the multitude of Field Devices & sensors etc. The Saucer Shaped Bowl on the Top depicting being filled with an ever-increasing spectrum City Applications and Citizens’ Services.

The Long Stem depicts all the Common Layers viz.: the Unified Last Mile Communication, Common Standardized Gateways (application or Vertical Agnostic), Common Service layer representing the Common Service Functions in the Gateways, as well as, in the Cloud... and the City Middleware & City Data Reservoir in the Cloud.

It is the “Long Stem” of the “Champagne Glass Model” instead of the Short & Narrow Neck in the “Hourglass Model” that brings the comprehensive harmonization, standardization & interoperability in the Architecture leading to optimization in operational efficiency & Life Cycle Cost of the ICT Infrastructure in any City.

This Architecture Model, beyond reducing significantly, the CAPEX, OPEX & Carbon Footprint of the Digital Infrastructure, enables a unified & well architected Infrastructure that can be easily designed to be comprehensively Resilient & Cyber Secure.





DESIGNING A SUSTAINABLE & RESILIENT FUTURE





Secure Digital Public Infrastructure

One earth, One family, One future

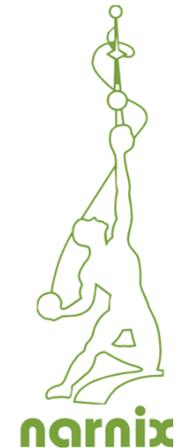


The Digital public infrastructure (DPI) is a shared means to many ends. It is a critical enabler of digital transformation and is helping to improve public service delivery at scale. Designed and implemented well, it can help cities and countries achieve their national priorities and accelerate the Sustainable Development Goals. Governments, donors, the private sector, and civil society alike have an opportunity to shape it.

- 🌿 DPI is an evolving concept, but there is growing consensus on it being a combination of:
 - 🌿 Networked open technology standards built for public interest,
 - 🌿 Enabling governance, and
 - 🌿 A community of innovative and competitive market players working to drive innovation, especially across public programmes.
- 🌿 From health to finance, digital transformation is reshaping public and private services with greater efficiency and effectiveness. Despite its numerous benefits, not all countries are equally benefiting. Today, a global vision for an inclusive and sustainable digital public infrastructure offers renewed hope.

Digital public infrastructure is a critical enabler of digital transformation and can help improve public and private service delivery at scale

DESIGNING A SUSTAINABLE & RESILIENT FUTURE





Sustainable & Resilient Built Environment

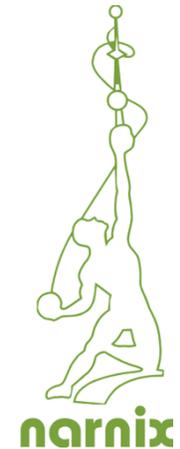
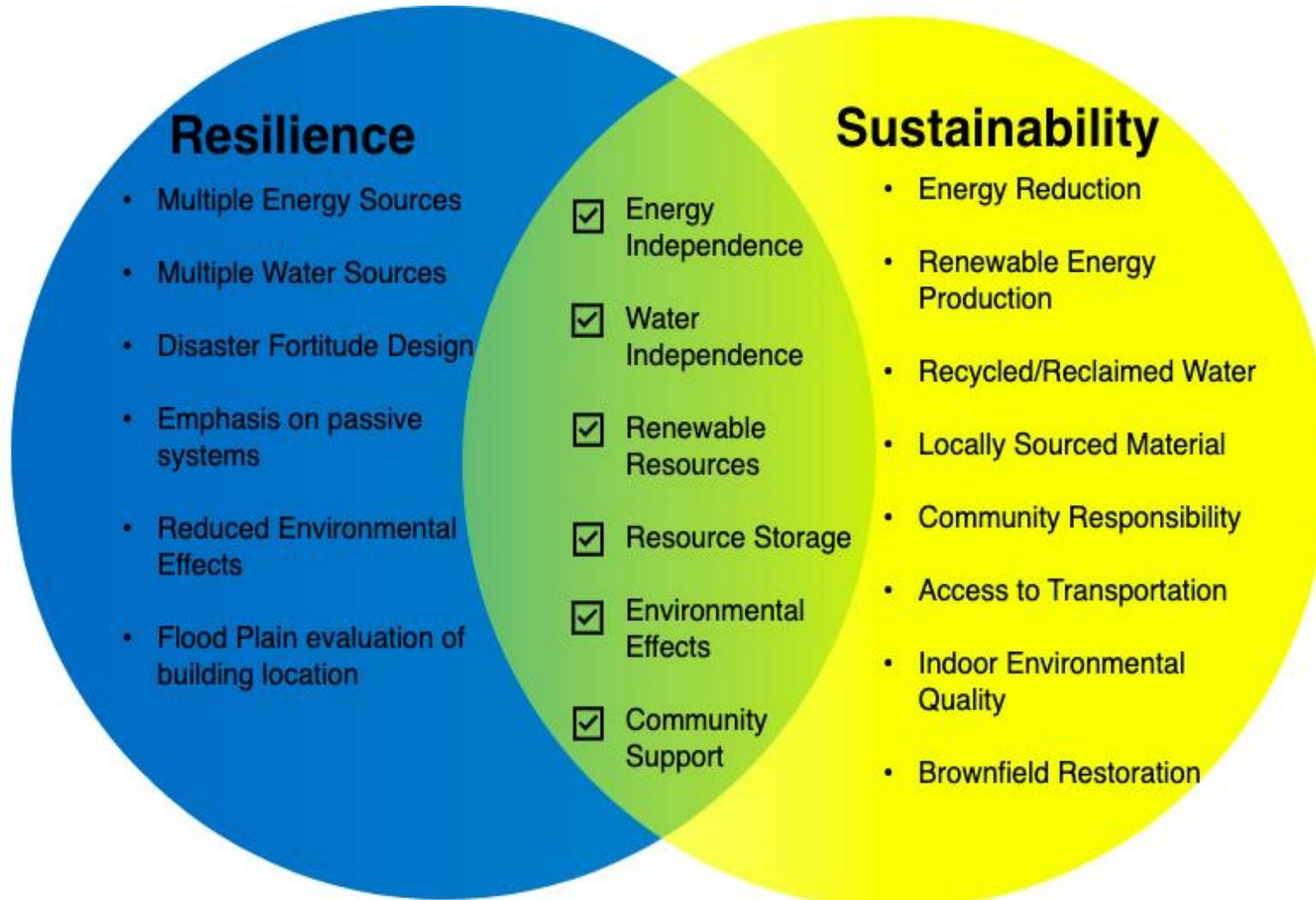


- 🌿 Sustainable & Climate Resilient Districts involve compact, energy-efficient urban landscapes with access to urban functions and ecosystem services that create attractive and liveable cities. In smart buildings, electric and thermal loads can be shifted and evened out using demand-response strategies, allowing for a more-efficient resource use and increased use of renewable resources.
- 🌿 Enabling cities to save lives, reduce losses, and unlock economic and social potential.
- 🌿 Climate change is acknowledged as the largest threat to our Societies.
- 🌿 The City Resilience Programs (CRP) need to be designed to work to build resilient cities with the capacity to plan for and mitigate adverse impacts of disasters and climate change, thus enabling them to save lives, reduce losses, and unlock economic and social potential.
- 🌿 Urban transformation should aim to build sustainable cities and communities through an urbanization process that is green, inclusive, competitive, and resilient, contributing to the comprehensive Sustainable Development as well as to end extreme poverty and boost shared prosperity.





Resilience & Sustainability Interplay...





Clean & Green Energy



-  In the context of cities, clean and green energy refers to the adoption of renewable and environmentally friendly energy sources and energy-efficient technologies to reduce reliance on fossil fuels, minimize pollution, and create a more sustainable urban environment.
-  This includes integrating solar panels, wind turbines, and other renewable energy solutions, as well as promoting green buildings, efficient waste management, and sustainable transportation.
-  Clean and green energy in cities focuses on sustainable energy solutions that reduce environmental impact and promote public health.
-  By embracing these strategies, cities can transition towards a more sustainable and resilient energy system, reducing their environmental footprint and improving the quality of life for their citizens.
-  Green and clean energy plays a vital role in creating sustainable, resilient, and liveable cities. By embracing renewable resources, investing in technological innovation, and promoting supportive policies, cities can overcome challenges and pave the way for a healthier and greener future.





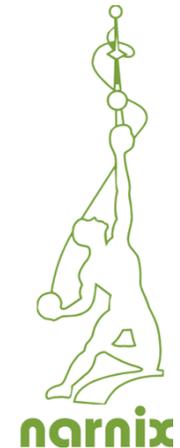
Cities & Regions Interplay...



The interplay between cities and regions refers to the dynamic relationship and interactions between urban centres and their surrounding areas or broader regions. This relationship is crucial for economic development, social cohesion, environmental sustainability, and overall regional prosperity.

- 🌿 Economic Integration
- 🌿 Spatial Planning and Development
- 🌿 Labor Market Dynamics
- 🌿 Infrastructure and Connectivity
- 🌿 Resource Management and Environmental Impact
- 🌿 Cultural and Social Exchange
- 🌿 Governance and Collaboration
- 🌿 Innovation and Knowledge Sharing
- 🌿 Resilience and Disaster Preparedness
- 🌿 Tourism and Regional Development

The interplay between cities and regions is characterized by mutual dependencies, collaborative opportunities, and shared challenges. By fostering integrated planning, infrastructure development, economic partnerships, and cultural exchange, cities and regions can harness their collective strengths to achieve sustainable development goals, improve quality of life, and promote inclusive growth across urban and rural landscapes.



Developing Future Proof Cities

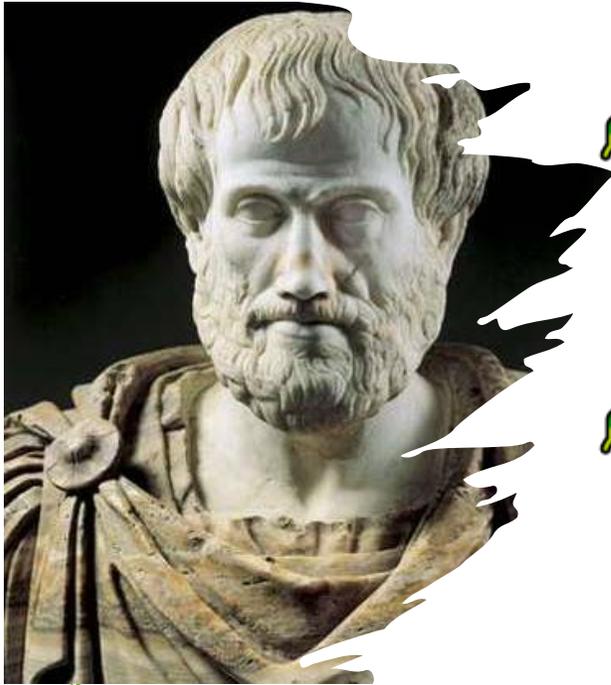
A vibrant, futuristic cityscape illustration. The scene is dominated by tall buildings with lush green vertical gardens. In the foreground, a white robotic arm stands on a green lawn. A sleek, modern train is stopped at a platform. A small drone flies in the sky. People are seen walking and interacting in the green spaces. The overall atmosphere is one of sustainable, high-tech urban development.



Systems Approach: Holism



Systems Approach Imperatives



Aristotle (300 B.C.)

**“The Whole is Greater
than the Sum of its
Parts”**

- 🌿 The multiplicity of technologies and their convergence in many new and emerging markets, however, particularly those involving large-scale infrastructure demand a top-down approach to standardization starting at the system or system-architecture rather than at the product level.
- 🌿 Therefore, the systemic approach in standardization work can define and strengthen the systems approach throughout the technical community to ensure that highly complex market sectors can be properly addressed and supported.
- 🌿 It promotes an increased co-operation with many other standards-developing organizations and relevant non-standards bodies needed on an international level.
- 🌿 Further, standardization needs to be inclusive, top down and bottom up; a new hybrid model with a comprehensive approach is needed.





The unique role of Cities in taking a Systems Approach



-  Cities are the place where 70% of greenhouse gas emissions are produced despite housing 55% of the global population and occupying less than 3% of the global land area.
-  The leadership of mayors and local governments is thus instrumental in devising innovative solutions and urgently scaling up action to put cities on a path of decarbonization and, at the same time, adapting to the impacts of climate change.
-  Creating healthy, productive urban spaces that avoid sprawl, reduce carbon emissions and improve residents' well-being is at the heart of a systems approach.
-  Adopting a systems approach to urban infrastructure delivery will help cities create more liveable spaces and curb climate change.
-  Cities need to take a systems approach if they are to develop urban infrastructure that will achieve net-zero carbon and climate-resilience goals.

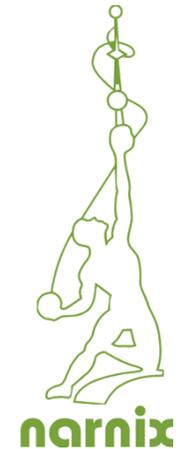




The unique role of Cities in taking a Systems Approach



- 🌿 Cities must engage residents, civil society and the private sector in creating policies to ensure that the technology behind municipal services is responsible, secure and universally accessible.
- 🌿 A system approach to infrastructure not only makes it easier to take cross-sectoral action and evaluate any impacts holistically, but it also aids climate resilience and helps reduce carbon emissions.
- 🌿 Modern infrastructure sectors (e.g. energy, buildings, transportation, water, solid waste and green and digital infrastructure) are interconnected and interdependent.
- 🌿 Multiple sectors form complex infrastructure networks that transcend city boundaries. Forward-looking land-use planning can create more compact cities, reducing the need to travel and lowering the cost of upgrades to electric systems. Circular economy strategy in water, waste and energy sectors also relies on systems approach.
- 🌿 Fostering integrated technological and engineering solutions is a powerful way for cities to directly address climate change challenges.





System Standards: Reference Architectures



Idealized Smart City Architecture



Common elements

Unique elements

Smart City A architecture



Common elements

Unique elements

Smart City B architecture



Common elements

Unique elements

Smart City T architecture



🌿 Reference Architecture - Architecture of an idealised system covering commonalities among a set of evolving systems; RA is a governing template

🌿 RA helps to achieve desired properties of those systems cheaper, faster, more ecologically and more sustainable than without RA

🌿 cooperation among all stakeholders involved

🌿 coordination among all stakeholders involved

🌿 Commercial off-the-shelf products based on standard RA

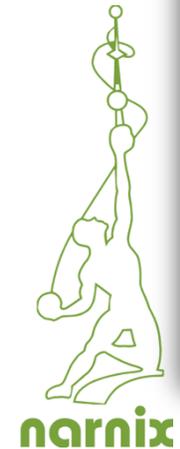
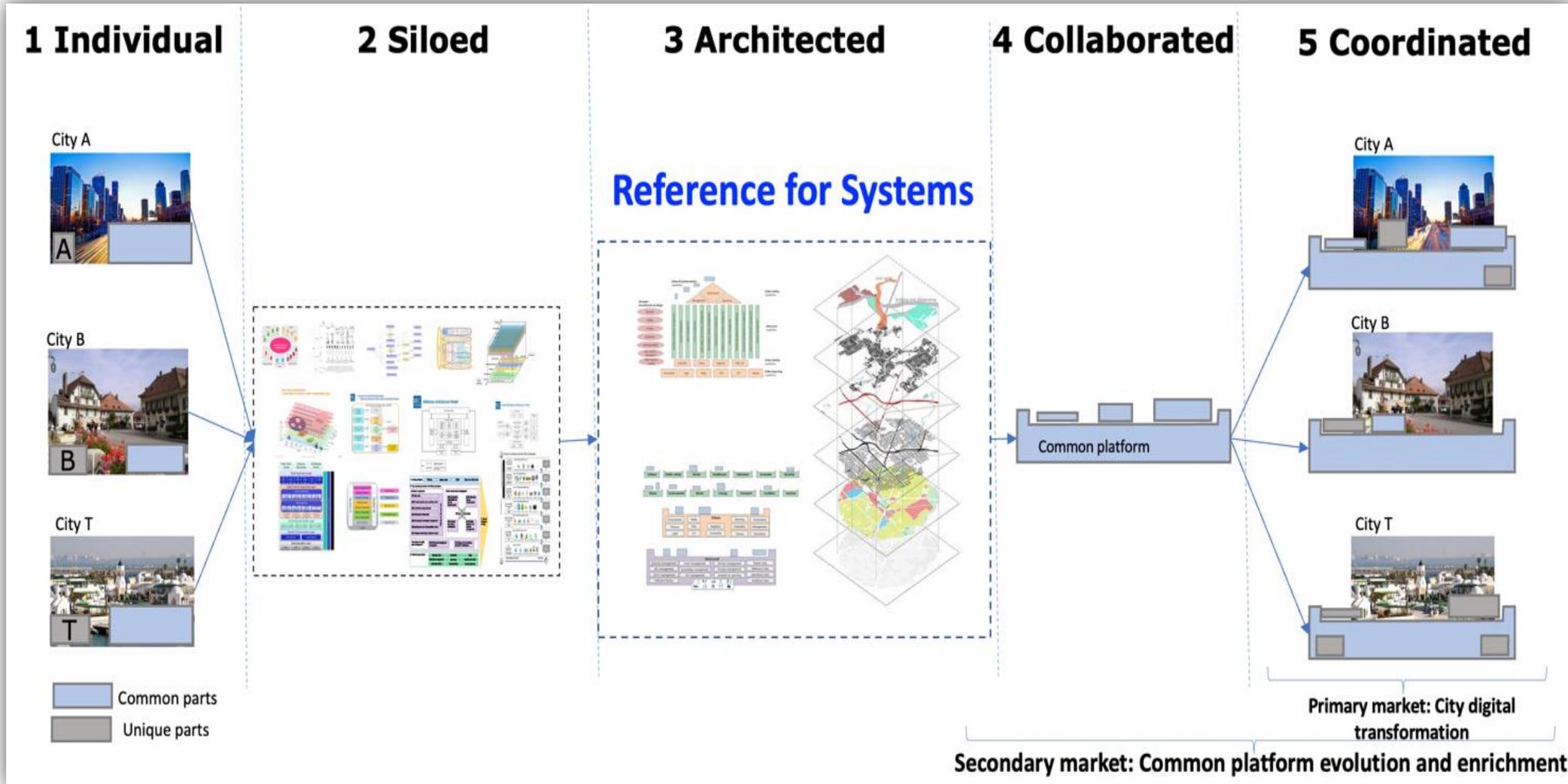
🌿 readiness for “unknown unknowns” in socio-technological systems

DESIGNING A SUSTAINABLE & RESILIENT FUTURE



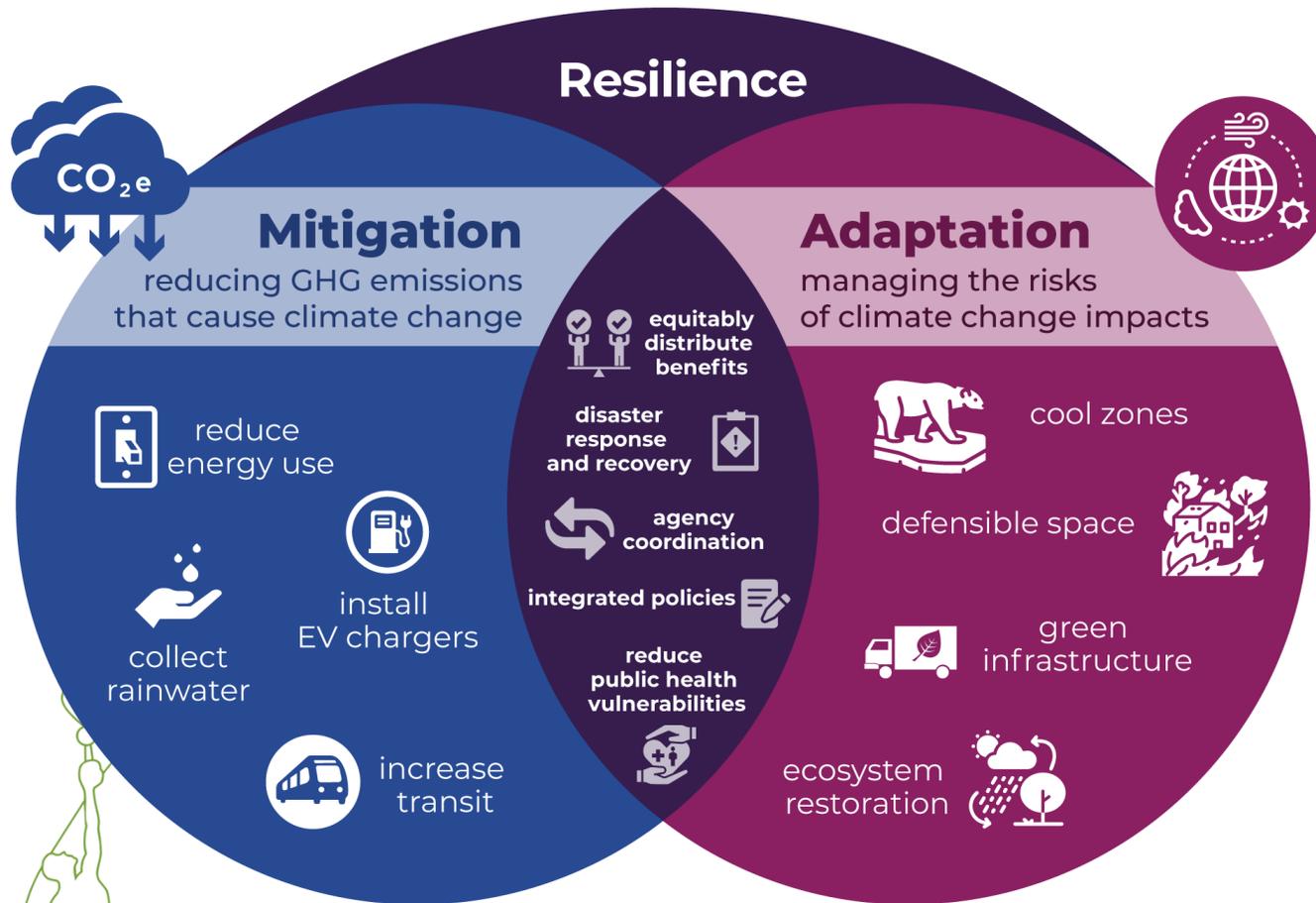


Levels of maturity of Digital Transformation for Smart Cities





Climate Adaptation & Resilience



- Climate change is already impacting communities and ecosystems worldwide, from extreme weather events to rising sea levels. To safeguard human well-being and ecosystems, it is crucial to embrace both climate adaptation and resilience.
- Climate resilience and adaptation are crucial strategies for managing the impacts of climate change.
- Building climate resilience and implementing adaptation strategies are essential for creating a more sustainable and secure future in the face of a changing climate
- These concepts are vital to reduce vulnerability to climate change impacts, build capacity to adapt and recover, maintain essential functions, safeguard infrastructure and natural systems, and promote long-term sustainability. They also help achieve global development goals and prioritize vulnerable communities.





Sustainable Digital Transformation



- 🌿 The sustainable digital transformation of urban landscapes involves leveraging digital technologies and innovative approaches to create cities that are environmentally friendly, socially inclusive, economically vibrant, and resilient to future challenges.
- 🌿 With the ongoing development of powerful technologies and disruptive innovations such as artificial intelligence and autonomous systems (AI/AS) comes the need for greater social responsibility and accountability from the technology community.
- 🌿 We have a unique opportunity to harness the ongoing Disruptive Technologies' Revolution, and the societal shifts it triggers, to help address environmental issues and redesign how we manage our shared global environment.
- 🌿 The disruption we are witnessing could, however, also exacerbate existing threats to environmental security or create entirely new risks that will need to be considered and managed.
- 🌿 Climate change/Sustainability are wicked problems. Dealing with them means we find solutions at the intersection of Social, Technological, Economic and Natural Systems...
- 🌿 But when we solve one problem using technology, we must not create new problems. That is why we are sustainable in everything we do - both environmentally, economically and socially.
- 🌿 If sustainability is part of the digital business case and reason for investing, it will be part of how targets are set, and value is measured.

**Sustainability must be at the centre of a digital strategy –
not a sideshow or an afterthought.**





Role of Standards...



Standards play a crucial role in designing future-proof cities by providing frameworks, guidelines, and benchmarks that ensure consistency, interoperability, and quality across various aspects of urban development.

- 🌿 Sustainability
- 🌿 Resilience
- 🌿 Smart Technologies
- 🌿 Accessibility and Inclusivity
- 🌿 Infrastructure and Construction
- 🌿 Health and Well-being
- 🌿 Data Security and Privacy
- 🌿 Building Codes and Regulations
- 🌿 Water and Waste Management
- 🌿 International Collaboration and Knowledge Sharing

Standards provide a framework for designing and developing future-proof cities that are sustainable, resilient, inclusive, and technologically advanced. By adhering to standards, cities can enhance their competitiveness, improve quality of life for residents, and ensure long-term environmental and economic sustainability.





Key Takeaways



Need to develop a Comprehensive approach to

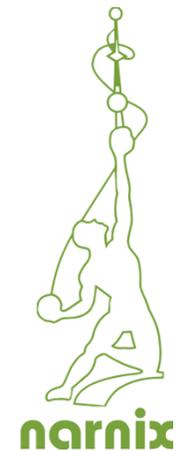
 Sustainability

 Security & Resilience

 Leveraging Disruptive Technologies

 Ethically Aligned Designs

And adopt Systems approach to Standardization in complex paradigms...





Conclusion

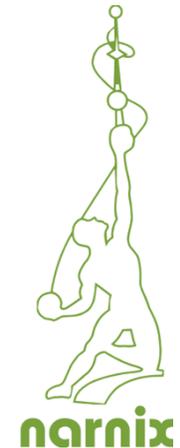


🌿 Developing future-proof cities involves strategic planning and implementation of sustainable practices across various dimensions. Here are key steps to achieve this goal:

- 🌿 Integrated Urban Planning
- 🌿 Sustainable Infrastructure
- 🌿 Smart Technologies
- 🌿 Green Spaces and Biodiversity
- 🌿 Resilience and Adaptation

- 🌿 Inclusive and Equitable Development
- 🌿 Circular Economy Practices
- 🌿 Public Participation and Governance
- 🌿 Promote Sustainable Mobility
- 🌿 Knowledge Sharing and Collaboration

By adopting these strategies, cities can proactively address current challenges while preparing for future uncertainties, ensuring resilience, sustainability, and quality of life for residents in the years to come.





Conclusion...



 Standards play a pivotal role in helping cities comply with the United Nations Sustainable Development Goals (UN SDGs) by providing guidelines, benchmarks, and frameworks that promote sustainable practices and measure progress towards achieving these goals.

 In conclusion, standards serve as essential tools for cities striving to comply with the UN SDGs by providing clear guidance, measurable targets, and quality assurance mechanisms that enable effective and sustainable urban development. By adopting standards-aligned approaches, cities can enhance their resilience, improve quality of life for residents, and contribute to global efforts towards a more sustainable and equitable future.





Good Practices



Based on the initial set of System Standards already published, cities are being encouraged to update their respective Deployment strategies by including these standards in the future Solutions' RFPs. The various Guidelines, Indices and Maturity & Assessment Frameworks are being recalibrated to ensure compliances to the standards.

The Technology Products, Systems & Solutions providers are aligning their respective offering to comply to the published standards. These standards have enabled the Sustainable Digital Transformation of the Urban Landscape by enabling optimization of the Digital Infrastructure in a Technology agnostic & Vendor Agnostic manner opening the floodgates of structured innovation by the Academia, Researchers, Start-ups, and industry at large.

The initiatives have created a healthy competitive environment for the industry with level-playing field for big and small enterprises leading to new synergies amongst innovators/start-ups and large organization to collaborate to develop new Standards based Technology Solutions for Smart Cities.

These Standards have been developed in accordance with principles laid out in the IEC SRD 63188 - Smart Cities Reference Architecture Methodology (SCRAM) & IEC 63205 – Smart Cities Reference Architecture (SCRA). These Standards are being developed under IEC Systems Committee Smart Cities.

DESIGNING A SUSTAINABLE & RESILIENT FUTURE





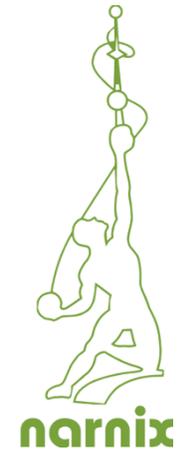
Lessons learned



These standards shall help bring the Lifecycle cost of the Digital Infrastructure down substantially because of standards based Interoperable system components available through multiple vendors along with making it Resilient and Cyber Secure & Trustworthy.

The 100 Smart cities acting as the living lab and Test Beds for innovation have provided a vast body of knowledge base and actionable insights to the City Planners, Administrators, Technology Solutions Providers & Deployers to bring a comprehensive homogeneity in the heterogenous & fragmented ecosystem.

However, it is still 'work in progress' and continuous new learnings are being imbibed to leverage in updating the National Standardization Strategy and Roadmap for the "Sustainable Digital Transformation of the Urban Landscape" in India.





Lessons learned...



- 🌍 The architectures and frameworks that we design for the different digital infrastructures provide only high-level guidelines to the stakeholders of different layers and components.
- 🌍 To achieve comprehensive interoperability, it is imperative to work on the finest granularity of each component and layer for standardization, as well as, harmonization, and ensuring the interoperability among various similar components addressing different applications at semantic, as well as syntactic levels.
- 🌍 Further the standards being adopted for the smart homes or smart buildings deployments must be harmonized with standards in all other relevant ecosystems like smart grids & smart cities and integrated digital infrastructure paradigms.



There is a need to create and suggest frameworks to achieve the Interoperability among all the devices & layers at every interface in the networks, be it a smart home network, a smart building network, a smart city/community network or the smart grid network that shall enable the stakeholders to prepare a set of detailed standards-based specifications to cater to specific/defined/fixed use cases followed by development of compliance testing frameworks.





Rethinking Smart Cities: Prioritising Infrastructure



- 🌿 The premise of a smart city has evolved from a technology-centric project to one that leverages technology to create a sustainable and citizen-centric environment.
- 🌿 It is no longer enough simply to deploy sensors – companies and governments need to demonstrate a meaningful impact on the population.
- 🌿 Keeping pace with the challenges presented by COVID-19, escalating sustainability commitments and ongoing population growth will require unprecedented urban investment and innovation.
- 🌿 We see digital infrastructure as pivotal to the Smart City evolution.





Anatomy of a “Zero Emissions” CAR



This is an Electric Vehicle battery

To manufacture it you need:

- 🌿 12 tons of rock for lithium
- 🌿 5 tons of cobalt minerals
- 🌿 3 tons of mineral for nickel
- 🌿 12 tons of copper ore

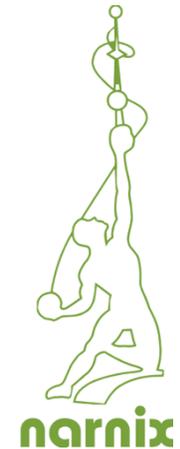
Move 250 tons of soil to obtain:

- 🌿 12 kg of lithium
- 🌿 13 kg of nickel
- 🌿 22 kg of manganese
- 🌿 7 kg of cobalt
- 🌿 100 Kg of rams
- 🌿 200 kg of aluminium, steel, and plastic.

Finally, you get a **ZERO EMISSIONS CAR**



The Caterpillar 994A used for earthmoving consumes 1000 Litres of Diesel in 12 hours, NOT to mention all of other Equipment...





CALL FOR ACTION



Cities shall be judged on their ability to deliver to citizens most of their human needs: food, shelter, education, a clean environment, a sense of community and a sense of purpose in life.



SDOs



Governments, Policy Makers & Regulators



System Developers & Business Organizations



Academia & Researchers



Intergovernmental & NGOs





Key takeaway from my Standardization Journey:



Since Standardization is a collective churning, deliberation & collaboration process, we need to moderate, as well as expand our individual thoughts on any subject to make it acceptable globally.



We humans need to radically change our relationship, not just with the planet, but with the objects with which we fill our lives.

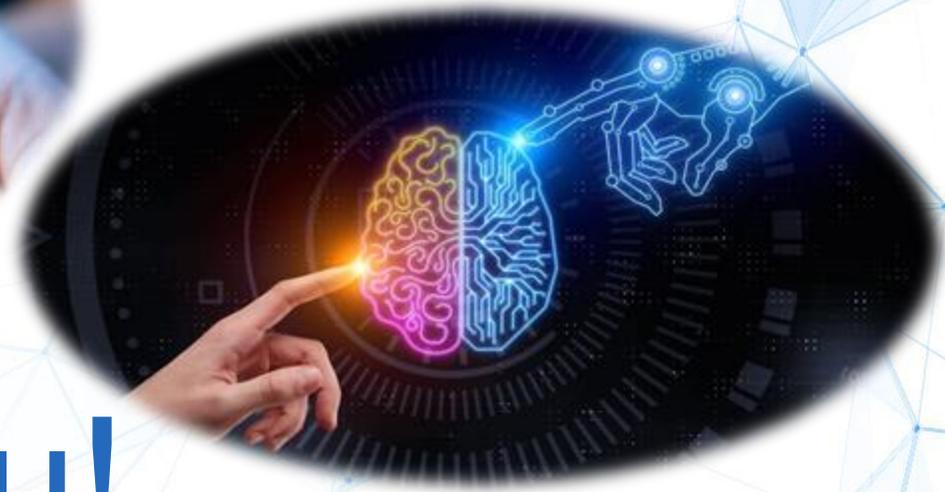
We need to change how we think about technology and innovation.

Rather than allowing technological advancement to steer our narratives, innovation and technology should help us build bridges between the worlds we inhabit now and the ones we imagine for tomorrow.



narnix





Thank you!

For a Sustainable & Resilient Future



narang n. kishor
+91 9810163990
kishor@narnix.com



About me... N. KISHOR NARANG



Technology Philanthropist, Ethicist, Innovation, Standardization & Sustainability Evangelist...

Technology Advisor, Mentor & Design Strategist & Architect in Electrical, Electronics & ICT; running an Independent Design House - NARNIX since 1981

- Over 47 years of professional experience in education, research, design and advisory .
- Over 37 years of hardcore Research and Design Development Experience in Solutions, Systems, Products - Hardware, Software & Firmware (Embedded Software) in fields of Industrial, Power, IT, Telecom, Medical, Automotive, Aerospace, Defense, Energy and Environment. Over 10 years of Strategic Advisory Experience to different segments of business & industry.
- Over 400 Research & Design Mentees in the Electronics & ICT Ecosystems.
- Mentoring many Deep Tech & Disruptive Tech Startups.**
- Leading & contributing to multiple National & Global Standardization Initiatives at BIS, Niti Aayog, TSDSI, IEC, ISO, ITU, IEEE etc....
- Member, IEEE SA Standards Board**
- For the last 15 years, been deeply involved in standardization in the electrical, electronics, communications, information technology, digital infrastructure and cyber security domains with a focus on identifying gaps in standards to bring harmonization through system standards and standardized interfaces to ensure end-to-end Interoperability.
- National Standards (INDIA) based on 10 years of Pre-Standardization Research Published Recently (December 2020) -
 - Unified Digital Infrastructure ICT Reference Architecture - IS 18000:2020.
 - Unified Last Mile Communication Protocol Stack Reference Architecture - IS 18010:2020.
- Founding Chairman of the Smart Infrastructure Sectional Committee LITD 28 in BIS (20 + standards on Unified Digital Infrastructure already published).
- Vice Chair-Strategy, and Project Leader of two international standards in IEC SyC Smart Cities - SCRAM: Smart Cities Reference Architecture Methodology IEC 63188 (published in September 2022) and SCRA: Smart Cities Reference Architecture IEC 63205 being developed jointly with ISO TC 268 & ITU-T SG 20.
- Chair, IEEE SA Working Group P2784 - Smart Cities Technology Framework.
- Vice Chair, IEEE SA Working Group P 2872 - Standard for Interoperable and Secure Wireless Local Area Network (WLAN) Infrastructure and Architecture
- Convenor, Communication Technologies Work Group in IEC SyC Communication Technologies & Architectures,
- Convenor, IEC SyC SET, ahG 1: Systems Architecture for Sustainable Electrified Transportation
- Convenor, IEC TC 13/JahG 17 - Identifying Synergy & Interplay between TC 13 & TC 69
- Member, IEC SMB/SG 12 -Digital Transformation and Systems Approach,
- Member, IEC SMB/SG 14- All Electrified & Connected Society
- Member, IEC SMB/ahG 96 - Governance of Artificial Intelligence
- Member, IEC MSB/SWG 14 - SMART Standards - A Market & Industry perspective.
- OCEANIS - Chair of Advancing Research Work Group & member Steering Committee.
- ITU-T SG 20, ITU-T SG 17 & ITU-R SG 5 - Proactive Contributor.
- ITU-T SG 17 - Editor - X.cs-ra - Cyber Security Reference Architecture; Co-editor, X.arch-design: Design principles and best practices for security architectures.
- Member UL STP 3600 - 'Measuring and Reporting Circular Economy Aspects of Products, Sites and Organizations'.
- ISO/IEC JTC1/WG11 - Co-Editor in Four Standards.
- IEEE IoT Magazine** - Standards Column Editor.