# Emerging Technologies for Urban Cleaning

An overview of emerging technologies that can improve urban sanitation and cleaning.

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# Introduction

### Welcome remarks

Welcome and introduction

### City Challenges and urban cleaning

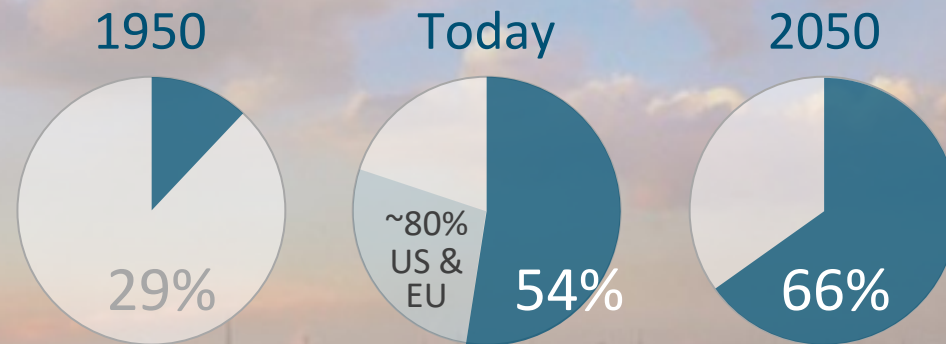Currency City Challenges and the Importance of urban leaning in cities

### Emerging Technologies

The role of Technology and its examples applied to Urban Cleaning and Smart Cities

# Rapid Urbanization

- Shifting economics
- Changing social demographics
- Environmental challenges
- Resource constraint

1950    Today    2050

29%    ~80% US & EU    54%    66%

2.5 Billion New Urban Residents by 2050 !

# City Sustainability Challenges

**There's a need for Cities to transform**

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# DIGITAL

- **Attracting companies and the best brains**
- **Safety and Security**
- **Budget constraints**
- **Infrastructure renewal (roads, water, etc.)**
- Housing
- **Education**
- **Healthcare**
- **Aging Demographics**
- **Environment & Energy**
- **Inclusion and Citizen Services**

Internet of Things**: People, Process, Data & Things**

Global Trends Changing the Urban Landscape

Shifting Economics

Changing Social Demographics

Rapid Urbanization

Environmental Challenges and Resource Constraint

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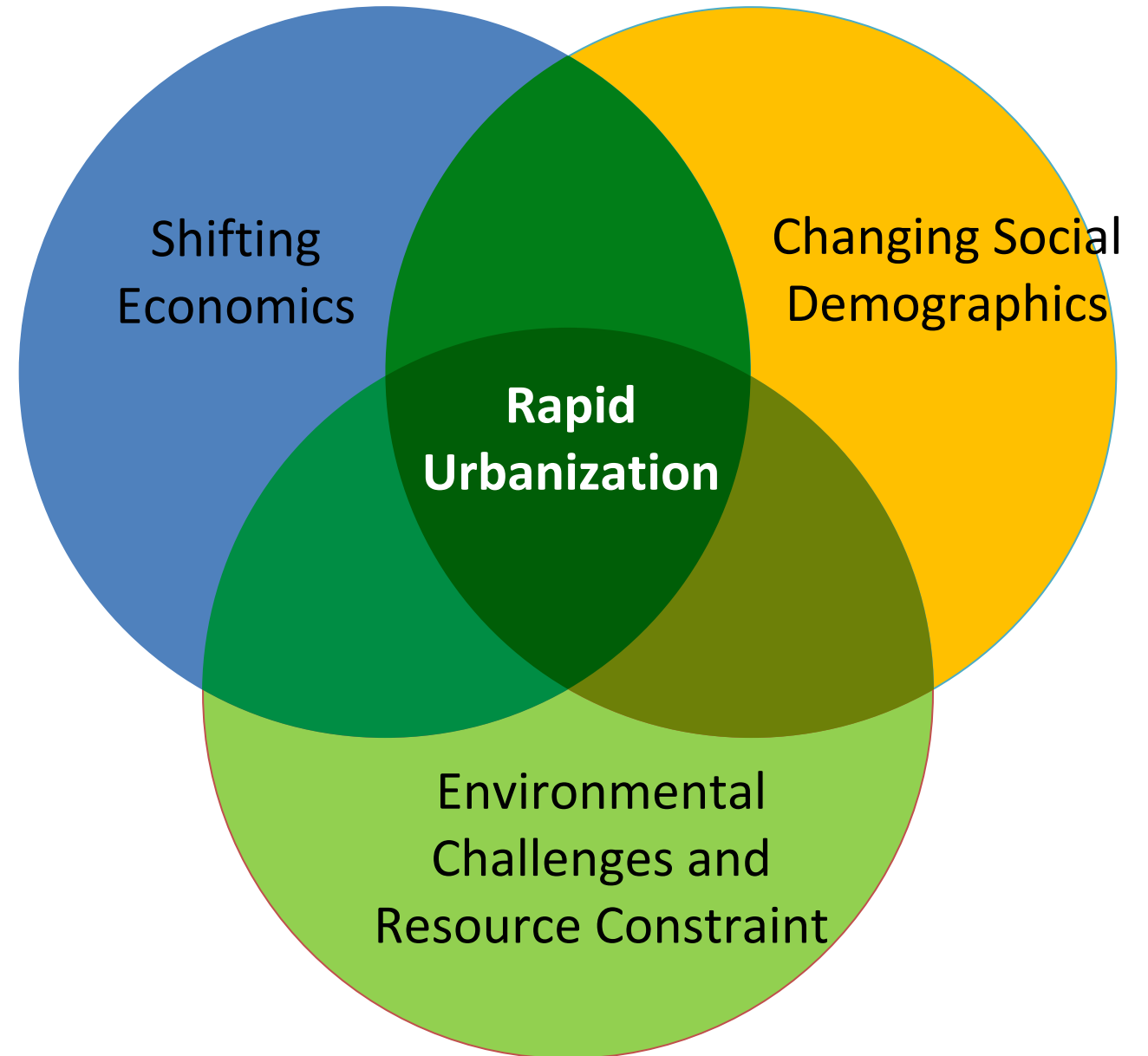
# Urban Cleaning Challenges

## Air Pollution

Vehicle emissions, industrial activities, and burning waste contribute to poor urban air quality.

## Water Pollution

Untreated sewage, industrial waste, litter, and oil spills pollute urban water sources.

## Soil Contamination

Heavy metals, chemicals, and waste contaminate urban soils.

## Noise Pollution

Traffic, construction, industry, and other urban activities generate excessive noise.

## Visual Pollution

Litter, graffiti, abandoned buildings and vehicles contribute to unattractive urban environments.

## Waste Management

Inefficient waste collection and disposal strains urban infrastructure and harms the environment.

# Citizen Challenges in Smart Cities

### Citizen Participation
How do we align and educate citizens about Urban Cleaning and how can they have an active role

### Data privacy and security
The large amount of data collected raises concerns over privacy and security

### Technology and Adoption
Integrating and aligning many heterogeneous systems is challenging and having adoption is key

While smart cities provide many benefits, overcoming the challenges requires careful planning and design.

# Emerging Technologies

# Internet of Things

## Smart Waste Management

### IoT-enabled bins
Bins have sensors to monitor fill levels and notify collectors when nearing capacity

### Route optimization
Collection routes optimized based on bin fill data to reduce miles driven

### Compaction technology
Trash compactors built into bins to significantly increase storage capacity

Emerging technologies such as IoT sensors, route optimization, and compaction can enable smart waste management in cities.

# Data Analytics

### Predictive analytics
Use machine learning models to forecast daily waste generation peaks

### GIS mapping
Map waste distribution patterns across the city using geographic information system tools

Leveraging data and analytics can help improve operational efficiency and long-term planning for waste management programs.

# Data and Inclusion

### Open Data
Enabling coders and city officials to create new applications based on currently available inputs (Chicago Open Data Portal)

### Participative Democracy
Enabling citizens to voice their opinions and connect them to city officials (Decidim)

Open data sharing together with citizen participation opens up the creation of new applications and models that have not yet been thought of

# Automation and AI

### AI video capabilities

Robots can clean streets autonomously without human intervention (Cortexia)

### Automation

Process automation as a way to optimize data capture and handling (Smart Contracts and Blockchain)

Automation and AI through video and processes can improve efficiency and coverage of urban sanitation and cleaning efforts

# Blockchain



Blockchain technology allows for transparent tracking of waste as it moves from the source to final disposal. All parties can view the movement history in a tamper-proof ledger, enabling accountability.

Blockchain and other distributed ledger technologies are transforming how cities manage services and infrastructure. By enabling secure data sharing between parties, blockchain can increase transparency and automation in areas like waste management.

E.g. Sensors on trash cans could log pickups on a blockchain, reducing fraud and optimizing routes.
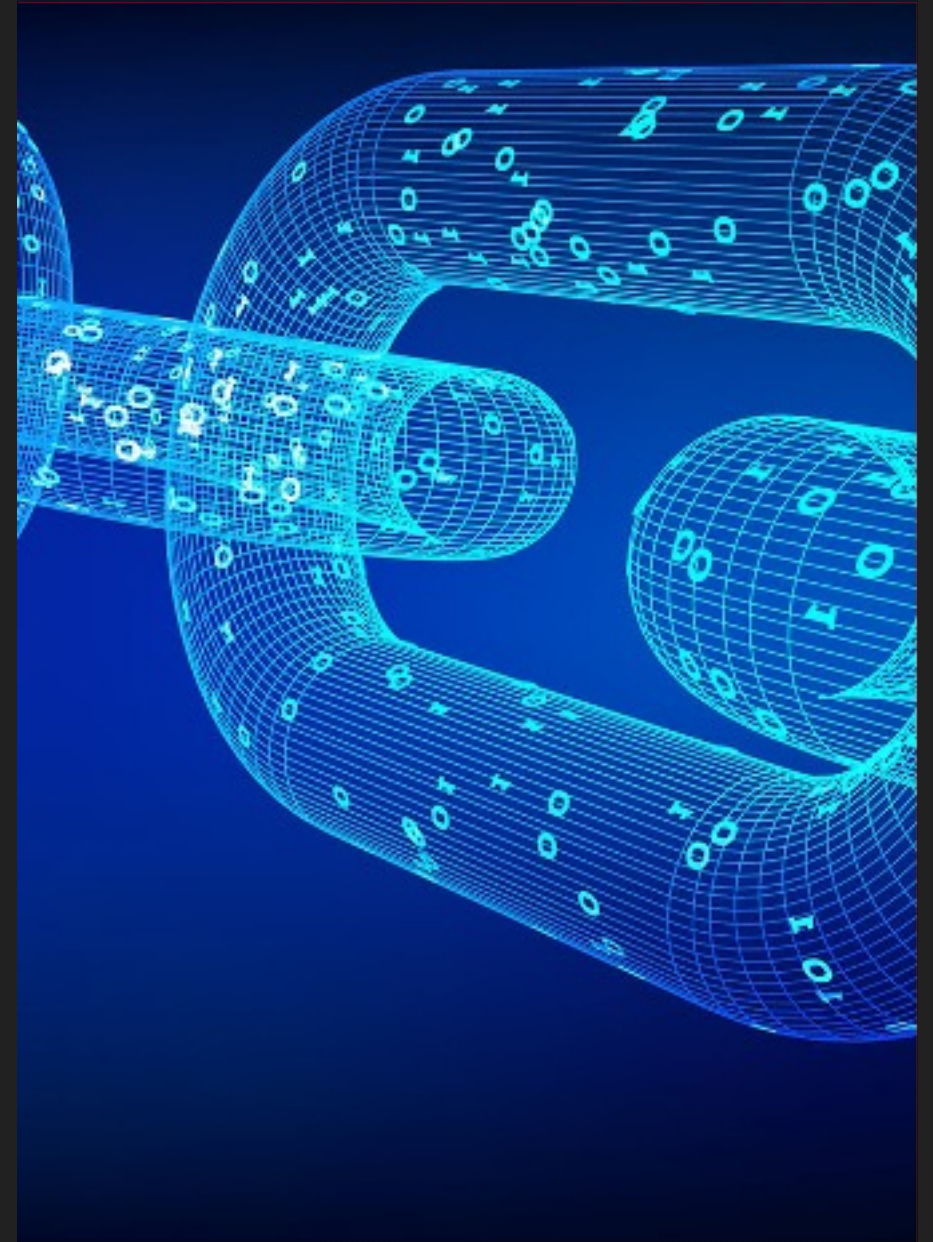
# Blockchain Basics

## What is Blockchain Technology?

Blockchain is a distributed ledger technology that allows transactions to be recorded in a decentralized, transparent, and secure manner through a peer-to-peer network.

## Decentralization

Blockchain does not rely on a central authority to approve transactions. The network is maintained by anonymous participants across the globe.

## Transparency

All transactions on a blockchain are visible to every participant in the network. This allows for complete transparency.

## Security

Blockchain uses cryptography and consensus mechanisms to make the ledger immutable and prevent fraudulent transactions.

# Blockchain in Urban Cleaning

Tokenization of Waste collection

Increased transparency in waste disposal

Waste Separation Gamification

Decreased fraud in waste management billing

# Use Cases for Blockchain in Urban Cleaning

Transparent Waste Tracking

Decentralized Waste Management

Recycling Supply Chain Tracking

Waste Collection Route Optimization