Toolkit:

Energy-efficient municipal planning

Municipal and Utility Services: Session 3

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Energy Efficiency Training Week: Municipal and Utility Services

1. **Where to start:** Energy use in municipalities
2. **Where to start:** Energy efficiency potential in municipalities
3. **Toolkit:** Energy efficient municipal planning
4. **Toolkit:** Energy efficient technologies

   Where do I get help? IEA's Technology Collaboration Programmes
5. **What are the steps:** Implementing energy efficiency programmes – target setting
6. **What are the steps :** Implementing energy efficiency programmes – implementation
7. **What are the steps:** Enable public energy efficiency investment
8. **What are the steps:** Enable private energy efficiency investment

   Special session: Multiple benefits of energy efficiency for Municipalities
9. **Did it work:** Evaluation and energy efficiency indicators

   Special session: International and regional initiatives that can help
10. **Energy Efficiency Quiz:** Understanding energy efficiency in municipal services & utilities

3. Toolkit: Energy-efficient municipal planning

Trainer(s): John Dulac

Purpose: To teach the fundamentals of how urban planning and policy can be used to reduce energy use in municipalities and in related municipal services.

Scenario: Your municipality is growing quickly and so is demand for municipal services.

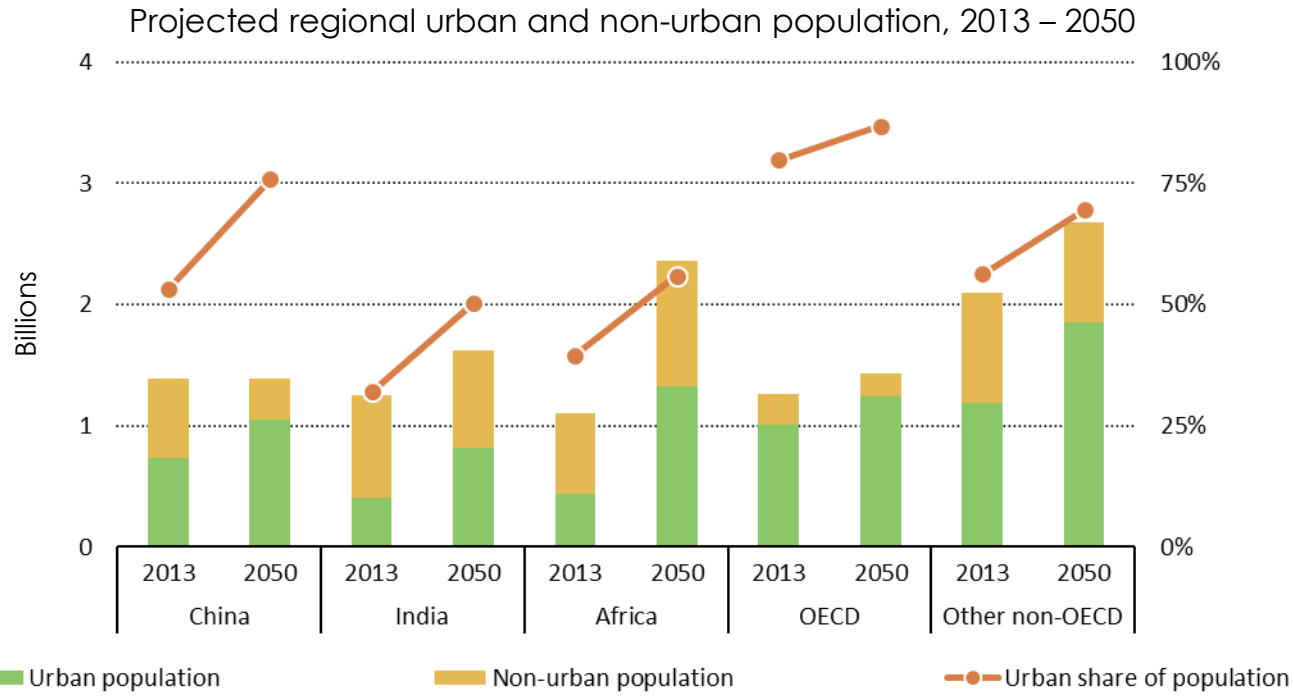
Question: How can we design a more energy-efficient municipality?

Energy-efficient municipal planning

Trends in urbanisation

An energy efficient urban system

Energy-efficient municipal planning: Trends in urbanisation



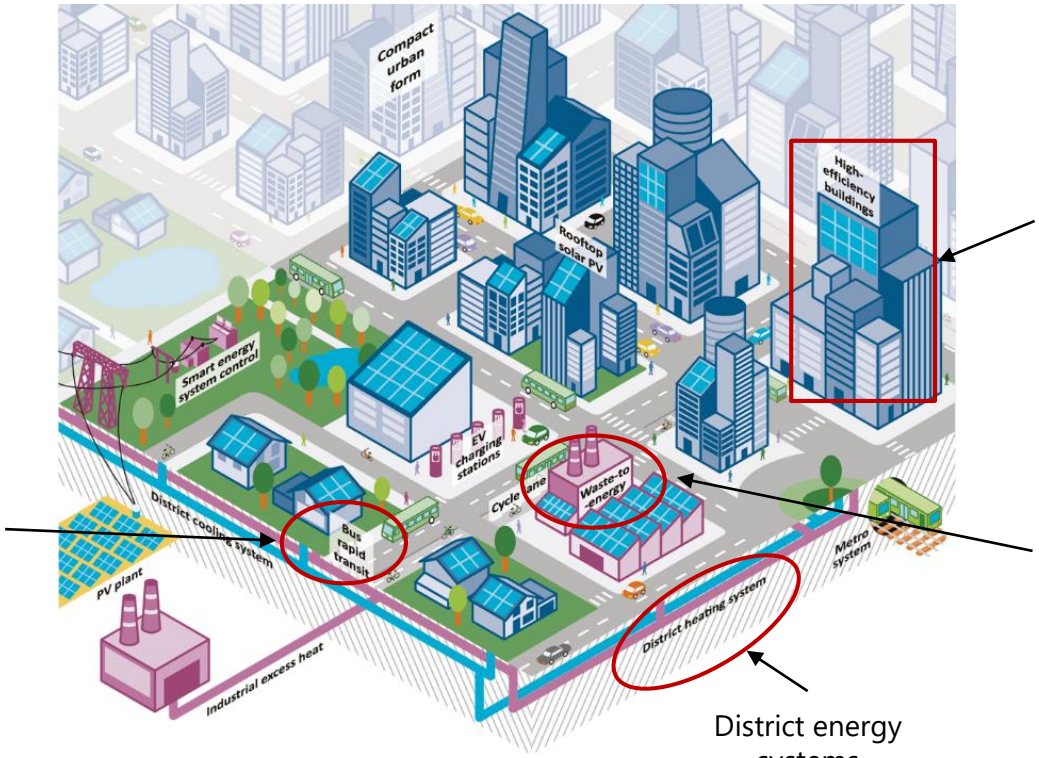
By 2050, two-thirds of the world's population will live in urban areas, with the greatest growth in China, India, Africa, and non-OECD economies in other regions

Source: ETP 2016

Energy-efficient municipal planning: an energy-efficient urban system

What is typically happening in cities with respect to energy consumption? What does an energy-efficient urban system look like?

Transport
- Sustainable streets
- Transit-oriented development
- Non-vehicle public transport options
- Efficient vehicles



Buildings:
- Mixed use planning
- High-density compact development
- Zero net energy buildings

Utilities:
- Waste-to-energy
- Technology improvements
- System integration

District energy systems

Source: ETP 2016

Municipal Buildings

Zoning and land-use

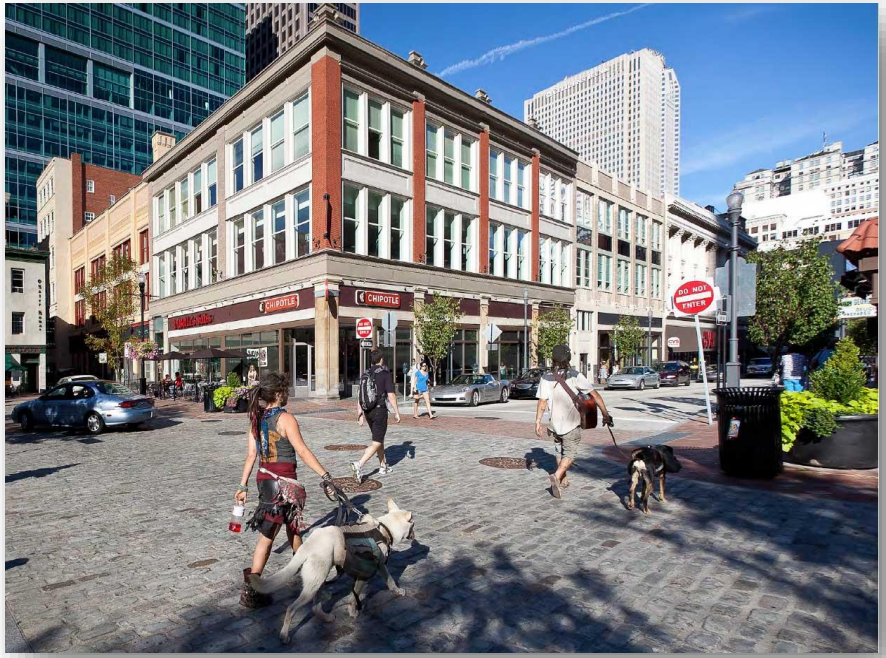
Building services

Towards net-zero energy buildings

Municipal buildings: zoning and land-use

Zoning can regulate the use of land in a particular area, and takes into consideration **mixed-use planning** and **high density compact urban development**

A mixed use development in a downtown neighbourhood in Pittsburgh, PA, USA



Source: https://www.cnu.org/publicsquare/2017/04/27/great-idea-mixed-use-urban-centers

Municipal buildings: zoning and land-use

Energy efficiency opportunities:

- **Non-vehicle transport** modes
- **Less frequent, long-distance travel**
- **Alternative technologies** for energy supply
  - e.g. district energy systems

Source: http://www.sicomindia.com/blog/105-smart-cities-to-accelerate-growth-in-india-efficient-sustainable-utopian

Municipal buildings: zoning and land-use

Urban policy options – zoning bylaws and development regulations for:

- **Smart growth** development patterns
- Preventing strip development
- Energy-related **site development standards**
- **Building energy standards**
- **Incentives** for renewable energy generation
- **Avoiding barriers to renewable energy facilities** that are subject to local zoning
- Development standards to address **transportation efficiency**

Source: Vermont Natural Resources Council - http://vnrc.org/resources/community-planning-toolbox/tools/energy-efficiency-standards-in-zoning-bylaws/

Municipal buildings: building services

- Municipalities generally have high control over their municipal buildings
- Building services include:
  - Light bulb replacement
  - Water pumps
  - Fixing dripping faucets and leakages (+ efficient taps)
  - Repairing windows and doors
  - Chiller and boiler maintenance
- This gives them a significant opportunity to improve energy efficiency and reduce carbon emissions.

Municipal buildings: building services

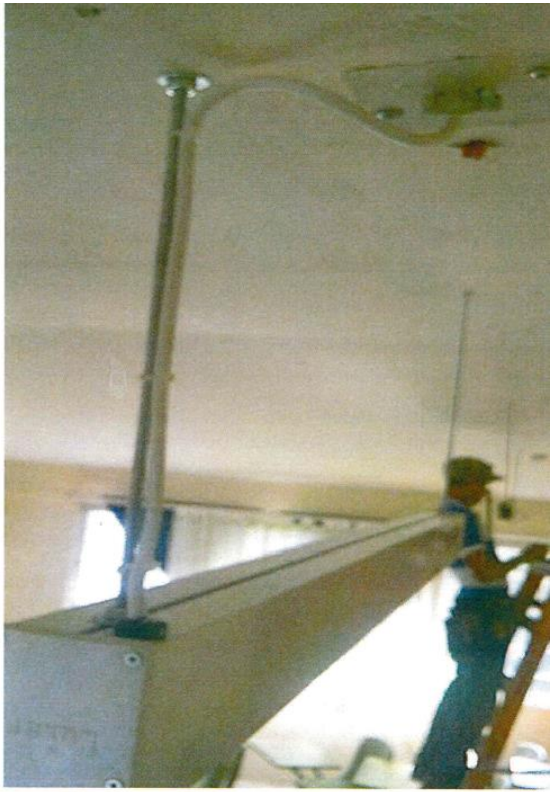
Energy efficiency opportunities:

Schools and hospitals	Retrofitting to **efficient lighting**
	EE improvement of building fabric
	Upgrades to efficient heating/hot water systems, water pumps & faucets, etc.
	EE best practices of facility equipment
Public housing	**EE upgrades** for existing public housing, e.g. compliant lamps
	EE features for new public homes: e.g. effective insulation

Source: https://www.carbontrust.com/media/39232/ctv019_schools.pdf ; https://aceee.org/blog/2018/05/affordable-housing-disappearing ; https://www.epa.gov/sites/production/files/2015-08/documents/affordable_housing.pdf

Municipal buildings: building services

Electrical installations in schools, before and after:



Source: Secretaría de Educatión Pública

Municipal buildings: building services

Lighting retrofits in schools, before and after:

Source: Secretaría de Educatión Pública

Municipal buildings: building services

"In emerging economies such as India, where 70-80% of the 2030 built environment has yet to be constructed, there is tremendous potential to implement best-in-class building practices in current new construction in order to avoid "locking in" decades of inefficiency and more costly renovations later"
– World Resources Institute [1]

Urban policies can enable:

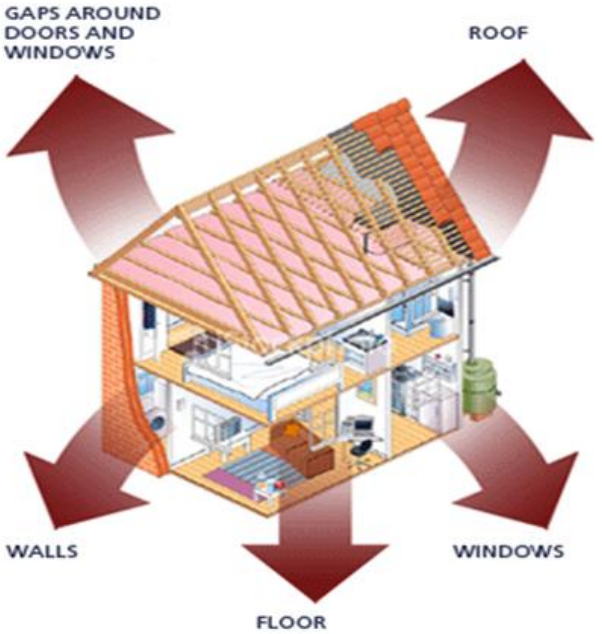
- Building efficiency **codes and standards**
- Efficiency improvement **targets**
- Performance **information and certifications**
- **Incentives and finance**

[1] **Source:** http://publications.wri.org/buildingefficiency/

Municipal buildings: towards net-zero energy buildings

Energy Saving Opportunities:

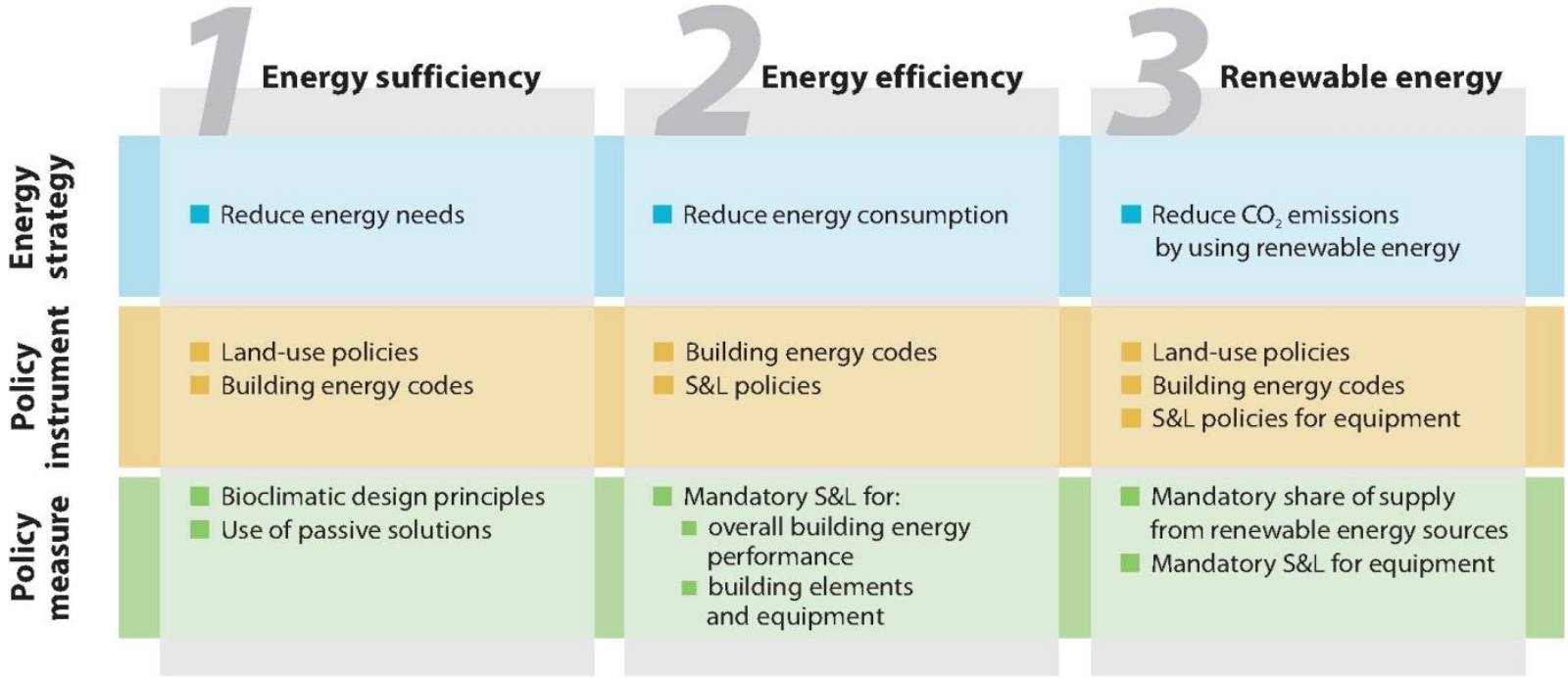
- Building envelope design
- Heat storage system
- Lighting design
- Efficient equipment



Source: CNU Public Square - https://www.cnu.org/publicsquare/2017/04/27/great-idea-mixed-use-urban-centers

Municipal buildings: towards net-zero energy buildings

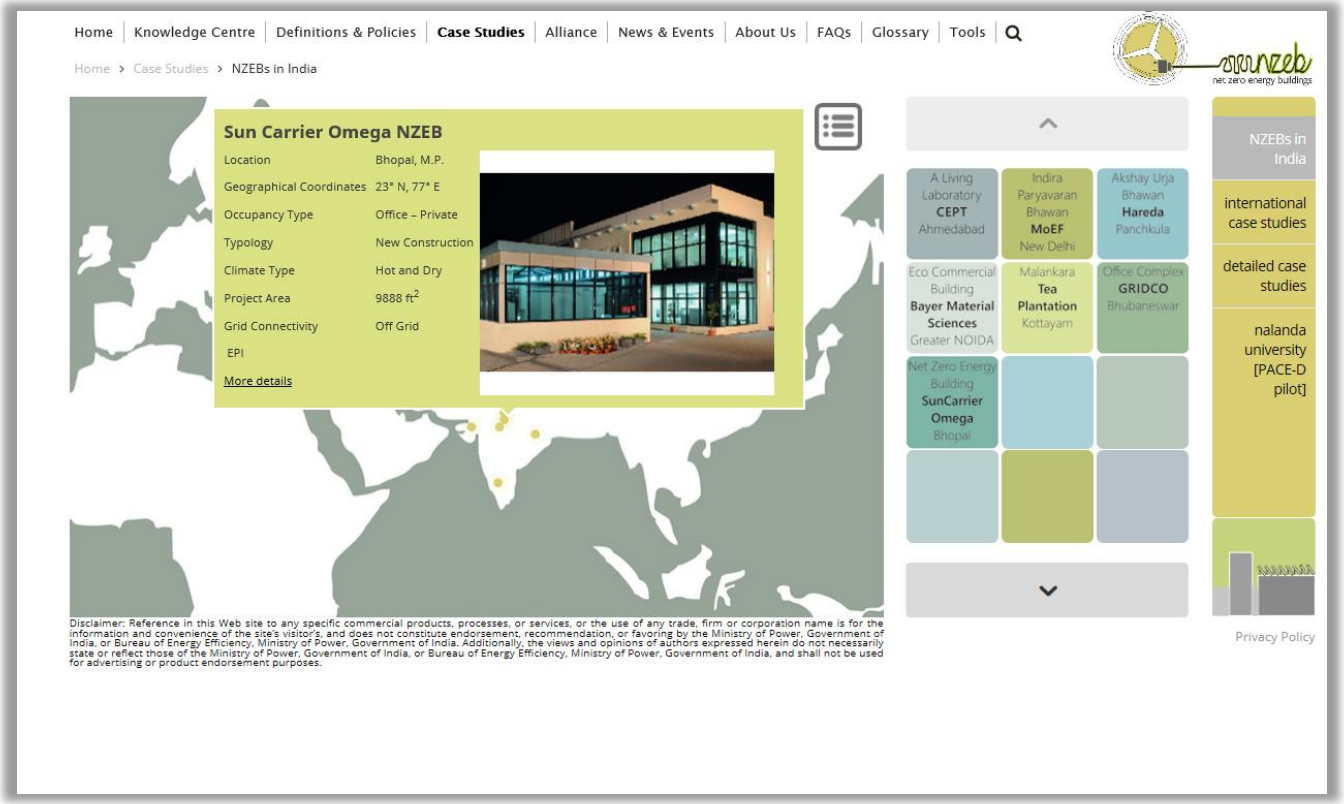
The path to net zero buildings:



Source: IEA Policy Pathways Series - https://www.iea.org/publications/policypathwaysseries/

Municipal buildings: towards net-zero energy buildings

Net zero buildings in India:



Source: NZEB Alliance - http://www.nzeb.in/case-studies/nzebs-in-india/

Transport

Land use and transit-oriented development

Sustainable Streets

Public transport services

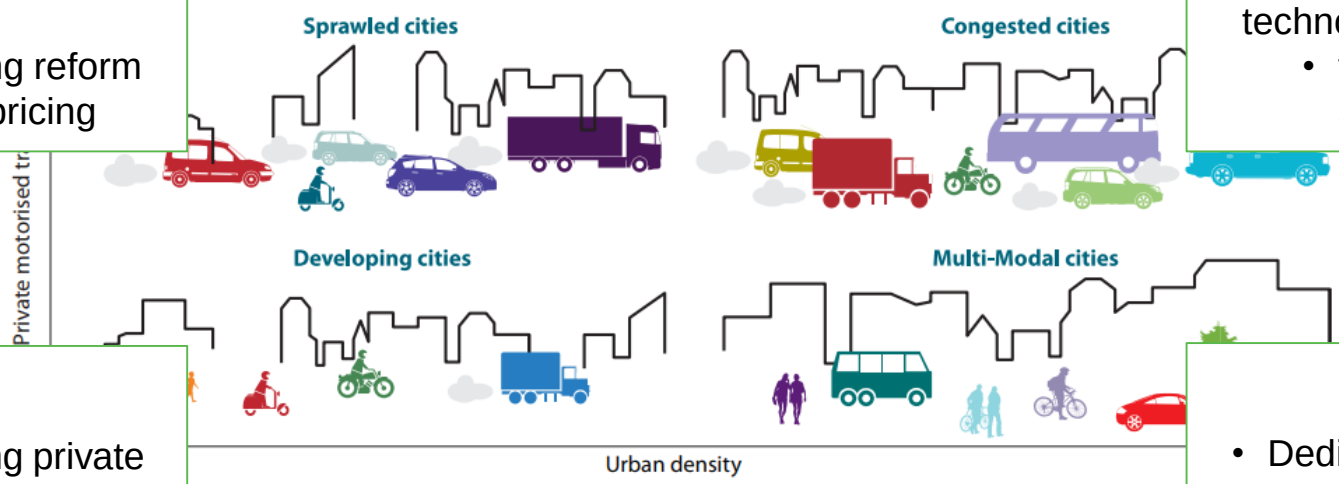
“Avoid-Shift-Improve” Framework

Strategies for action

Transport: land use and transit-oriented development

- Travel demand management programs
  - parking reform
  - road pricing

- Improved travel-managed technologies
  - traffic signalisation



Typology of common urban land-use transport contexts in cities

- Discouraging private motorised travel

- Dedicated facilities for bus/cycling lanes

Source: https://www.iea.org/publications/freepublications/publication/Renewed_Cities_WEB.pdf

Transport: sustainable streets

From this…

… to this

This features more elements of **non-vehicle oriented street design**, building compact and **well-connected urban areas** with **dense networks** of streets and paths

Source: IEA, Urban Transport Pathway Launch Presentation

Transport: sustainable streets

Energy efficiency opportunities:

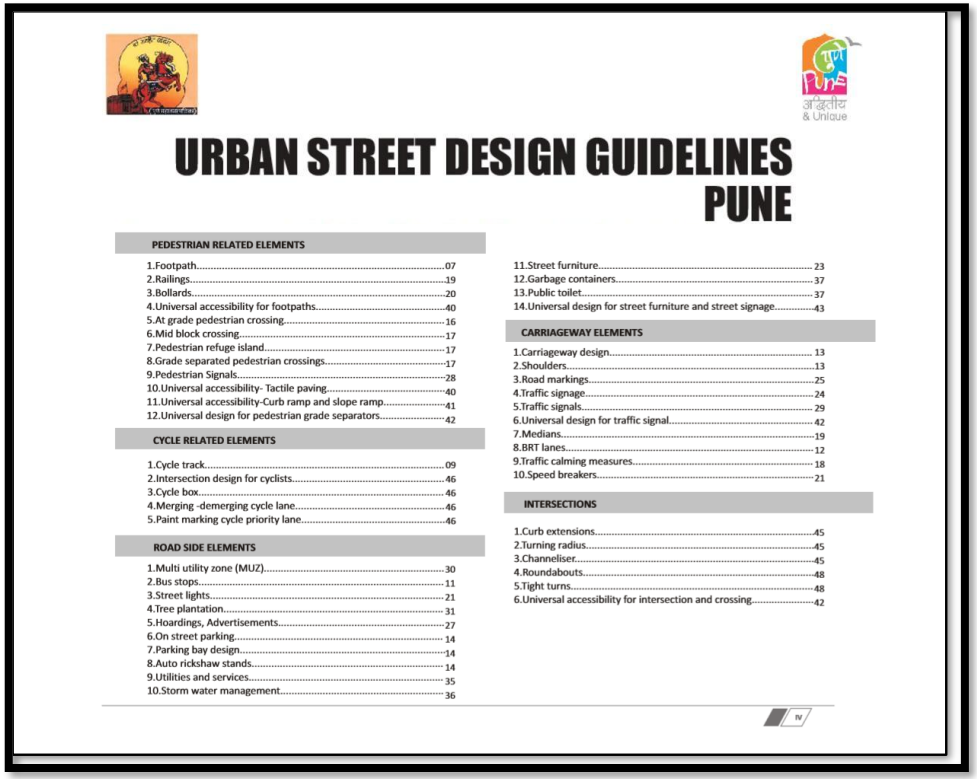
- **bus-only lanes**,
- sheltered **bicycle lanes**,
- median **traffic islands** for pedestrian crossing and reduced curbside parking

Sustainable streets in NYC

Source: https://www.iea.org/publications/freepublications/publication/Renewed_Cities_WEB.pdf

Transport: sustainable streets

Urban policies that enable sustainable streets include the development of **urban planning and street design guidelines**, e.g. City of Pune



URBAN STREET DESIGN GUIDELINES
PUNE

Source: Adapted from https://www.pmc.gov.in/en/urban-street-design-guidelines-usdg-1

Transport: public transport services

Towards efficient public transport options:

Public bike-share systems

Electric mobility is not limited to cars

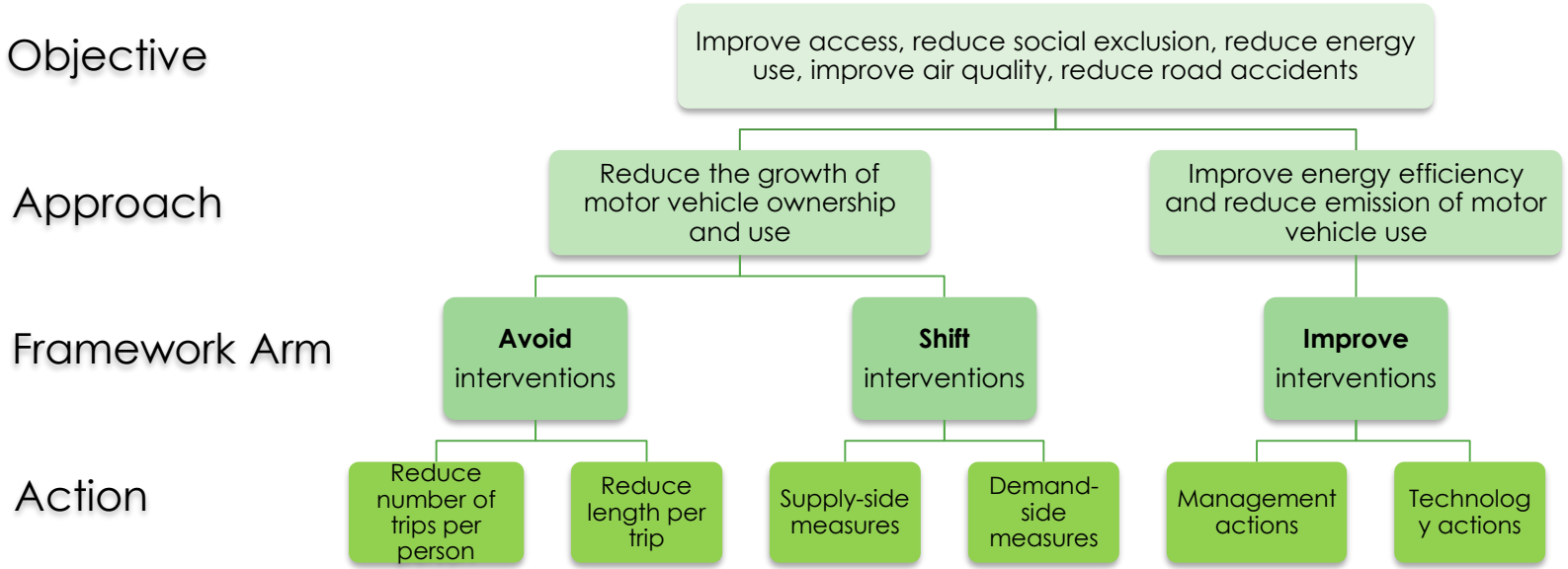
Public transit connections

Enabling policies effect:

- **Targets** to phase in zero-emission vehicles
- **Public procurement programmes** for zero-emission public vehicles
- **Fuel economy standards**
- Increased **funding streams** for public transport services
- **Incentive provision** to increase public transport uptake

Transport: “Avoid-Shift-Improve” Framework

Municipalities can encourage an **integrated approach** to sustainable urban mobility that encompasses ‘**avoid**’, ‘**shift**’ and ‘**improve**’ actions:



Source: Adapted from ESMAP - https://openknowledge.worldbank.org/bitstream/handle/10986/21305/936760NWP0Box30oralNote0Transport04.pdf?sequence=1

Transport: "Avoid-Shift-Improve" Framework

	AVOID	SHIFT	IMPROVE
EE OPPORTUNITIES	• **Access and proximity** to transit • Pedestrian, bicycle and transit-**friendly design**	• **Car pooling** options • **Non-motorised** transport	• **Energy-efficient vehicles** and technologies
POLICY RESPONSE	• **Information tools** to raise awareness of real travel costs • Promotion of **car-pooling** • Parking **standards** and **fees/levies**	• Improved **bus routes and services** • **Pricing strategies** • Road **space allocation** • Size & weight **standards** of vehicles	• Vehicle **standards** • **Speed limits** • **Subsidies** for alternative fuels • Vehicle fuel-economy/environment **performance labelling**

Source: https://www.iea.org/publications/freepublications/publication/Renewed_Cities_WEB.pdf

Transport: Strategies for action

IEA policy pathway:

PLAN	1 Identify transport needs and define objectives
	2 Identify and engage stakeholders early on
	3 Address potential barriers and secure necessary resources
	4 Establish policy framework and action plan
IMPLEMENT	5 Engage actors and begin implementation
	6 Raise awareness and communicate targets
	7 Manage implementation process
MONITOR	8 Collect, review and disseminate data
EVALUATE	9 Analyse data and evaluate effects of transport policy
	10 Adapt transport policy and plan next steps

Source: https://www.iea.org/publications/freepublications/publication/Renewed_Cities_WEB.pdf

Solid Waste Management

The solid waste management process

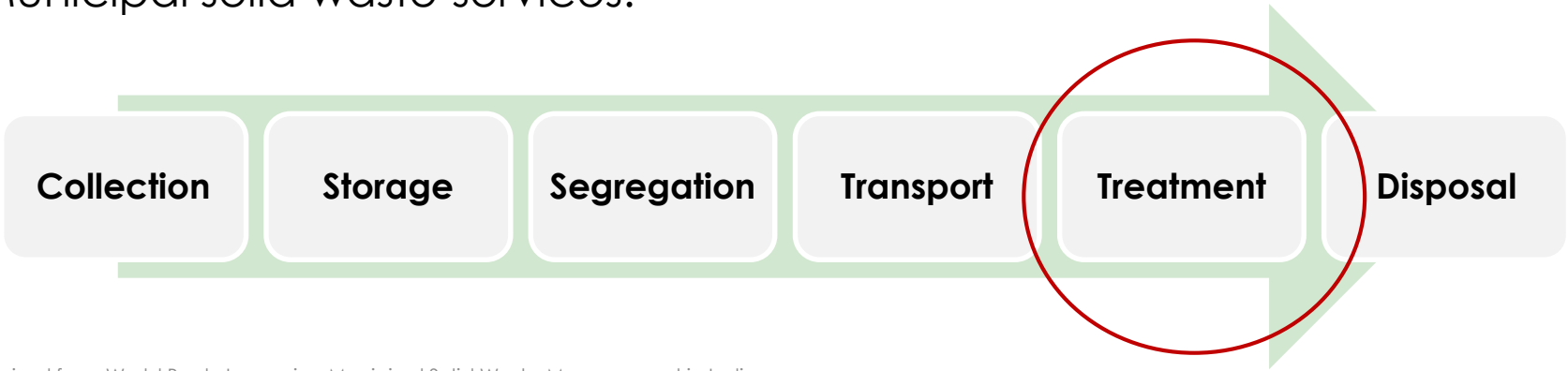
Waste-to-energy services

Solid waste management: the solid waste management process

- In India, solid waste management is primarily the responsibility and duty of municipal authorities

- Sources of waste:
  - Municipal
  - Private sector

- Municipal solid waste services:

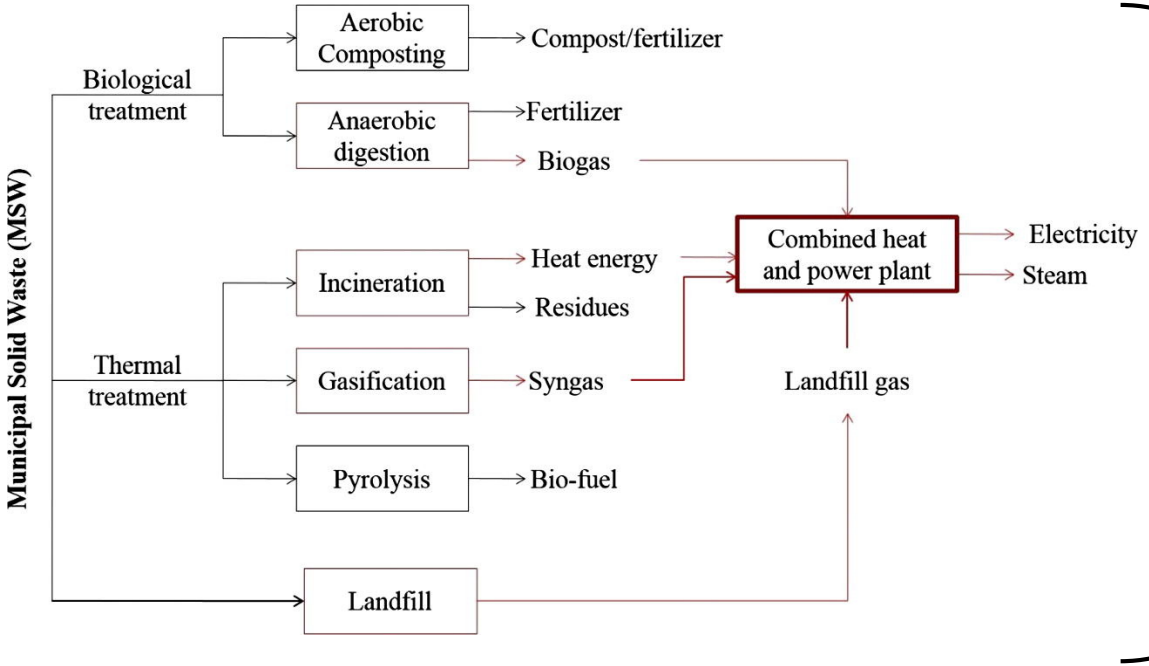


Source: Revised from World Bank, Improving Municipal Solid Waste Management in India - https://openknowledge.worldbank.org/bitstream/handle/10986/6916/425660PUB0Wast12732601OFFICIAL0USE1.pdf?sequence=1&isAllowed=y

Solid waste management: waste-to-energy services

Energy efficiency opportunities:

- Efficiency improvements of waste-to-energy technologies and systems

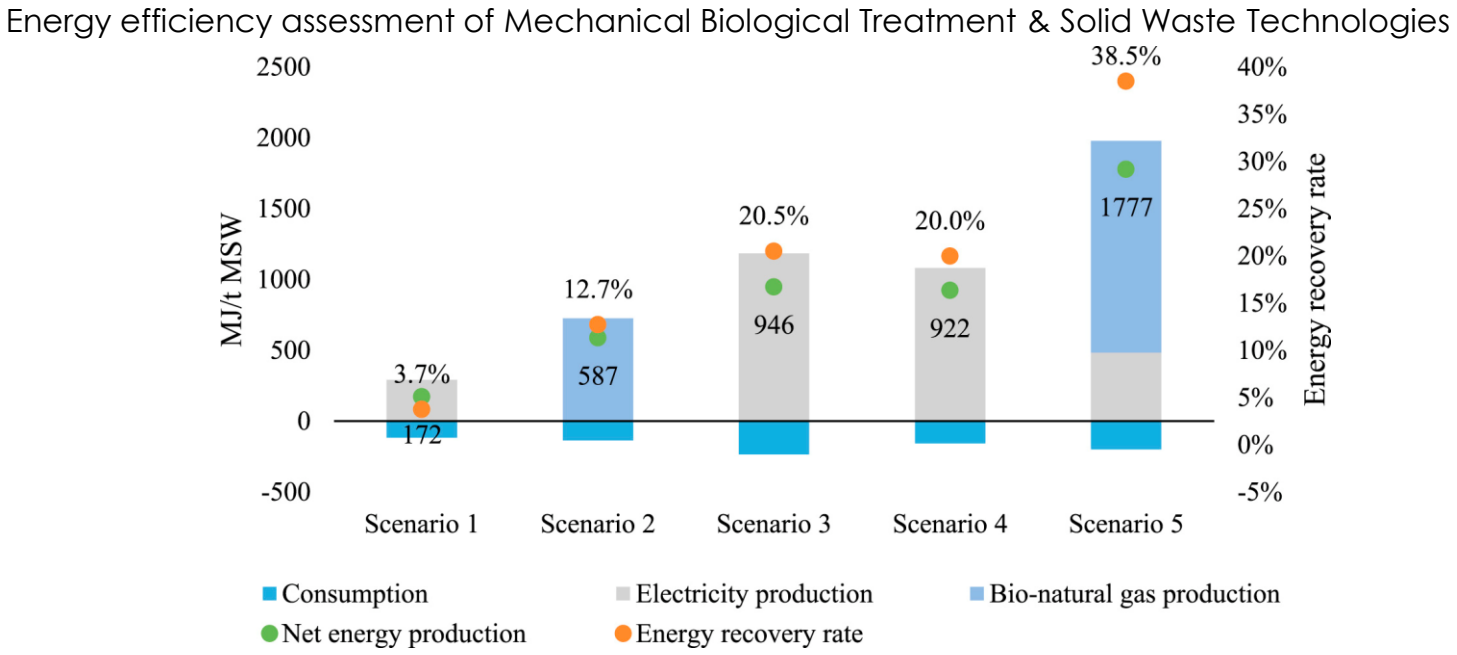


EE opportunities:

- Optimising existing waste conversion systems
- Upgrading to advanced WtE technologies

Source. : Tan et al. (2015) https://www.sciencedirect.com/science/article/pii/S0196890415001156#f0015

Solid waste management: waste-to-energy services



Implementing and using Mechanical Biological Treatment (MBT) systems in conjunction with mainstream Solid Waste treatment technologies can deliver greater energy efficiency overall

Source. : Fan et al. (2018) https://www.sciencedirect.com/science/article/pii/S0959652618300684#fig2

Solid waste management: waste-to-energy services

Enabling policies for energy efficiency in solid waste management:

- Policies that promote the implementation of Waste-to-Energy technologies, resource efficiency and integration solutions:
  - Provision of **public investment and infrastructure** for integration solutions
  - **Incentives** for the uptake of efficient technologies and efficiency improvements
  - **Subsidies** for adoption of efficient technologies

Water and Sewage

Opportunities for energy efficiency

The water energy nexus

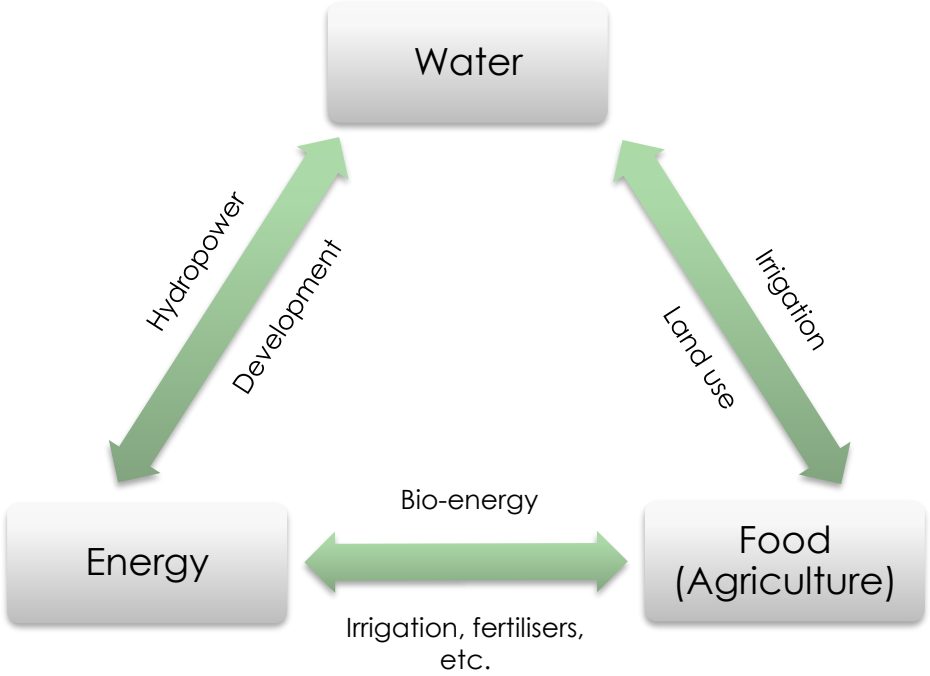
Water and Sewage: opportunities for energy efficiency

- EE benefits for water and wastewater utilities:
  - **Reduced costs** of energy
  - **Life extension** of infrastructure and equipment
  - **Job creation**
  - Public **health benefits**
  - Improved water and energy **security**

- EE opportunities in Water and Sewage:
  - Overall **efficiency improvements** in drinking water and wastewater systems
  - Water-energy nexus opportunities, that arise from **energy and water system integration**

Water and Sanitation: the water-energy nexus

Water and energy are **inextricably linked**: water use requires energy, and energy production requires water. These resources further have intricate ties to agriculture



Source : Reddy et al. (2018) A Water-Energy-Food Nexus Perspective on the Challenge of Eutrophication. *MDPI.* Available at http://www.mdpi.com/2073-4441/10/2/101/pdf

Water and Sanitation: the water-energy nexus

Water-energy nexus challenges for India:

- **Water-scarce** and **water stressed** country
- **Water constraints** affecting energy security
  - Population growth
  - Economic development
  - Resource use inefficiencies

- Water and energy's importance for **food security**

Large swathes of the Yamuna on the Dehli-Haranya border are running dry.

Source: https://indianexpress.com/article/cities/delhi/situation-hasnt-been-this-bad-since-1988-at-mouth-of-capital-the-yamuna-runs-dry-5117856/

Water and Sanitation: the water-energy nexus

Water-energy nexus opportunities for energy efficiency synergies:

- Technology mix prospects:
  - Less water intensive **energy systems**
  - Different **production processes** for energy within a resource base
- Co-production of water and energy services:
  - **Energy recovery** from wastewater
  - **Cogeneration**
  - **Heat recycling**

Source : UN Water DPAC, Partnerships for improving water and energy access, efficiency and sustainability - http://www.un.org/waterforlifedecade/water_and_energy_2014/pdf/water_and_energy_2014_final_report.pdf

Water and Sanitation: the water-energy nexus

- Urban policies that enable energy efficiency improvements include those that:
  - Encourage **water-energy synergies** and **integrated solutions**
  - Support utilities efforts of **energy efficiency measures**
  - Develop **multi-sector environment and energy programs** in which EE efforts at water/wastewater facilities compose one element
- Local partnerships to take advantage of existing opportunities

Source : http://www.un.org/waterforlifedecade/water_and_energy_2014/pdf/water_and_energy_2014_final_report.pdf

Barriers for energy efficiency in municipal services

Barriers for energy efficiency in municipal services

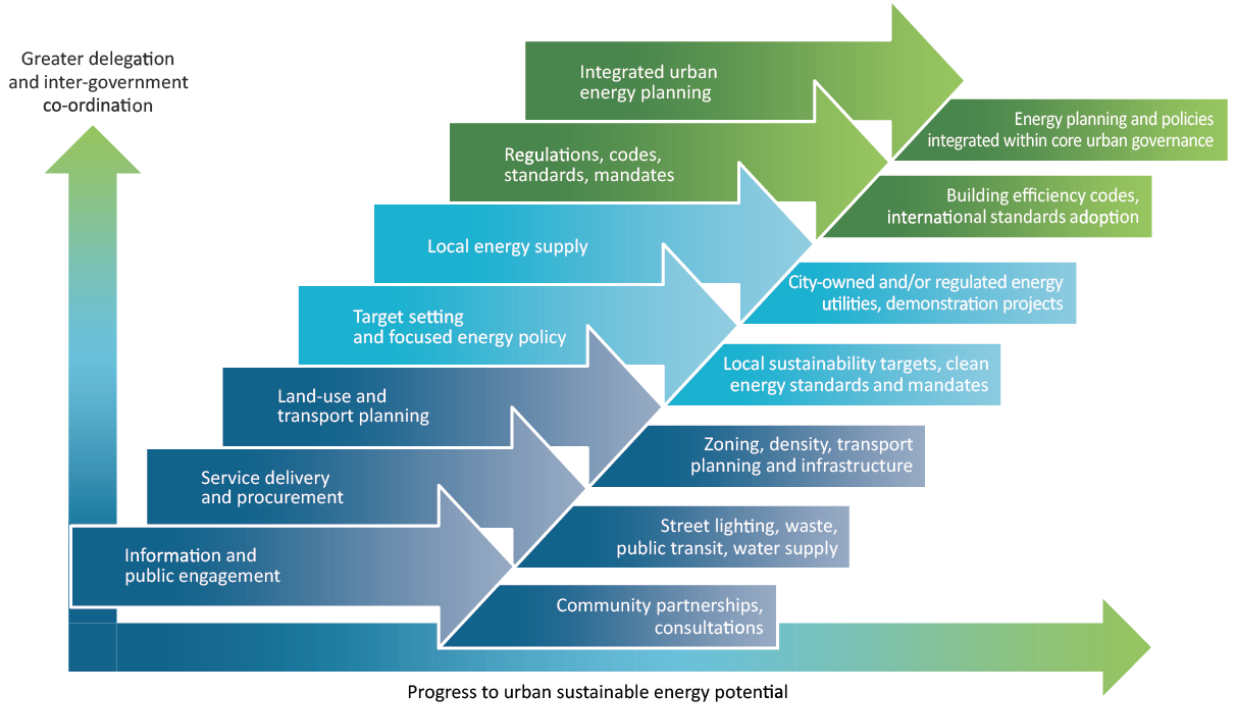
Barrier	Example
Market	• **Market organisation** and **price distortions** • **Split incentive** problems • **Transaction costs**
Financial	• **Up-front costs** and **dispersed benefits** • Perception of EE investments as **complicated and risky**, • Perception of projects having **high transaction costs** • **Lack of awareness** of financial benefits
Information and Awareness	• **Lack of sufficient information** and understanding
Regulatory and Institutional	• **Energy tariffs** that discourage EE investment • **Incentive structures** not conducive to energy efficiency • **Institutional bias** towards supply-side investments
Technical	• **Lack of affordable technologies** that are energy efficiency • **Insufficient capacity**

Source : https://www.iea.org/publications/freepublications/publication/gov_handbook.pdf

Governance and Action

Governance and action

Taxonomy of policies to achieve urban energy potential



Increased ambition to achieve the urban sustainable energy transition will require greater need for intergovernmental co-ordination and delegation

Additional Resources

- World Bank - Energy Efficient Cities: Assessment Tools and Benchmarking Practices
  http://www.esmap.org/sites/esmap.org/files/P115793_Energy%20Efficient%20Cities-Assessment%20Tools%20and%20Benchmarking%20Practices_Bose.pdf

- C40 Municipal Building Efficiency (MBE) Network
  https://www.c40.org/networks/municipal-building-efficiency

- Building Efficiency Accelerator
  http://buildingefficiencyaccelerator.org/

- District Energy in Cities Initiative
  http://www.districtenergyinitiative.org/

- NZEB Alliance India
  http://www.nzeb.in/

Activity

Activity: Ideas for energy efficiency initiatives

1. Break into groups, ideally 3-4 people per group
2. Each group should be assigned to a service/sector – Municipal Buildings, Street Lighting, Transport, Solid Waste Management, Water & Sanitation, and District Energy
3. Each group should:
   - As individuals within the group, get 5 post-its and come up with 5 different initiatives for furthering EE urban development in India as it relates to your service/sector. 1 idea per post-it
   - Cluster the ideas together in your group and combine common ideas where necessary
   - Pick the top 3 ideas to take back to the larger group
4. All groups together:
   - Share your top 3 ideas and share what the key enablers are for each of them.

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