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International
Energy Agency

6. Utilities 2: Lighting and other urban services

Mel Slade, IEA

Pretoria, 15 Oct 2019

IEA #energyefficientworld

Training Overview

6. Utilities: Lighting and other urban services

Scenario: Local residents are complaining about dark and unsafe streets

Question: What can you do to reduce energy use in public lighting and improve service delivery?

Training Overview

1. **Energy use in Lighting** — 10 mins
   - Energy use and impacts
2. **Strategies for energy efficiency** — 10 mins
   - Lighting service, technology replacement, management systems
3. **Activity: risk mitigation measures in lighting** — 10 mins
4. **Other Urban Services** — 30 mins
   - **District energy systems:** district energy concept; waste heat integration and sector coupling
   - **Waste management:** waste generation, impacts, energy recovery opportunity, technologies, and policies

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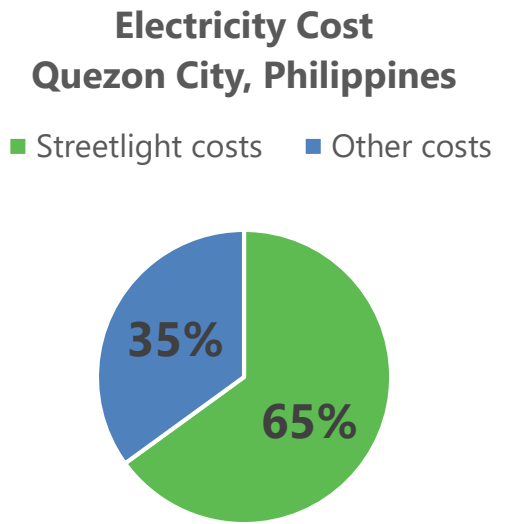
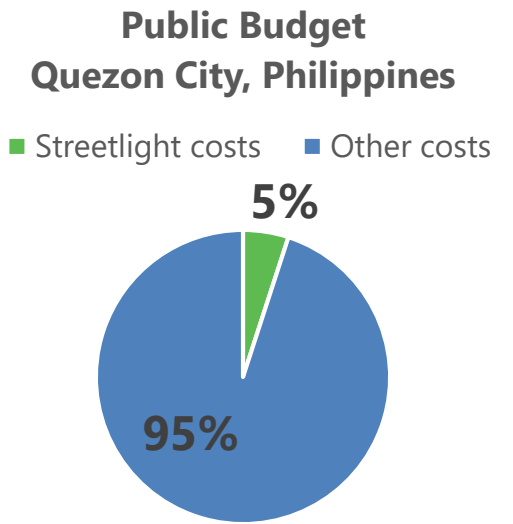
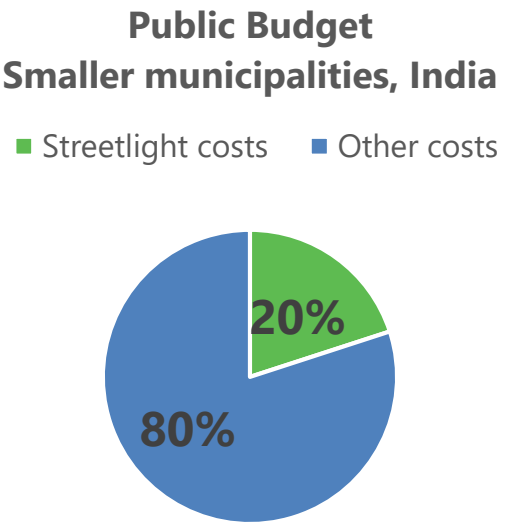
1. Energy use in lighting

1. **Energy use in lighting:** Energy use and impacts







From a national point of view, costs of public lighting are small.
However it is a big strain on local budgets.

Source http://blogs.worldbank.org/energy/led-street-lighting-unburdening-our-cities

1. **Energy use in lighting.** Need to sustain/improve lighting services

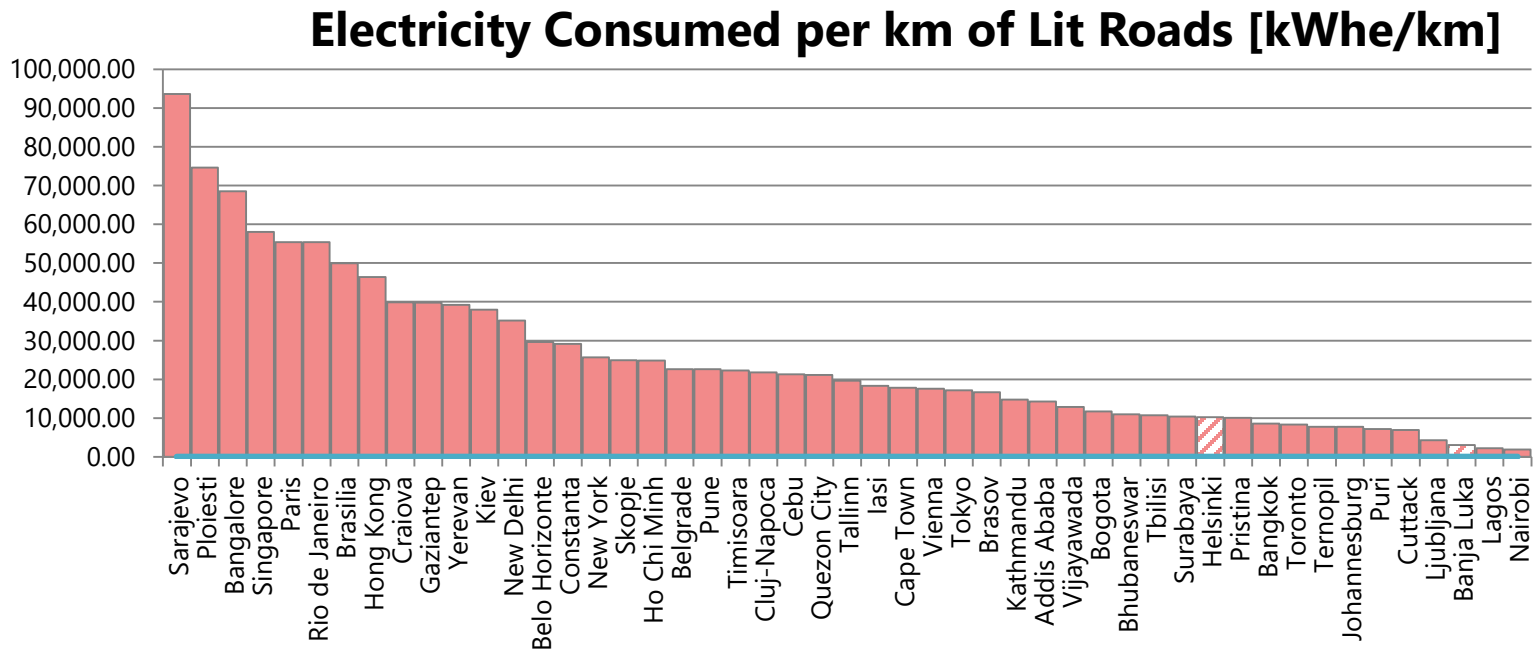
Road safety: 30% reduction in collision, 43% reduction in night time accidents

Lower crime: 7% reduction in New York, 39% reduction in UK

Inability to sustain optimum lighting service affects important social service provided by public lighting. Expanding these are the common goals of a growing municipality

Source https://www.rospa.com/rospaweb/docs/advice-services/road-safety/roads/street-lighting.pdf; https://www.ledsmagazine.com/articles/2018/03/major-study-finds-outdoor-lighting-reduces-crime-by-39.html

1. **Energy use in lighting.** How does your city compare?



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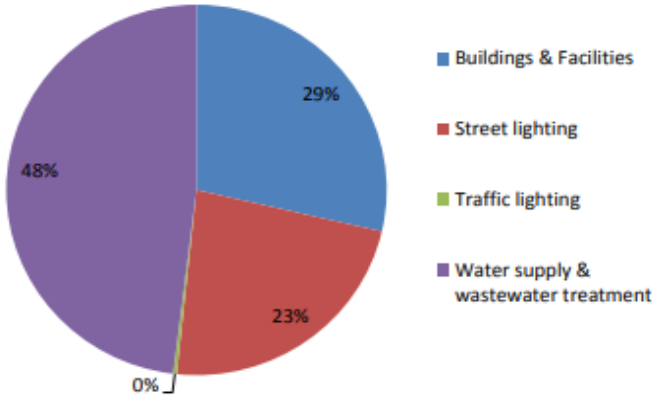
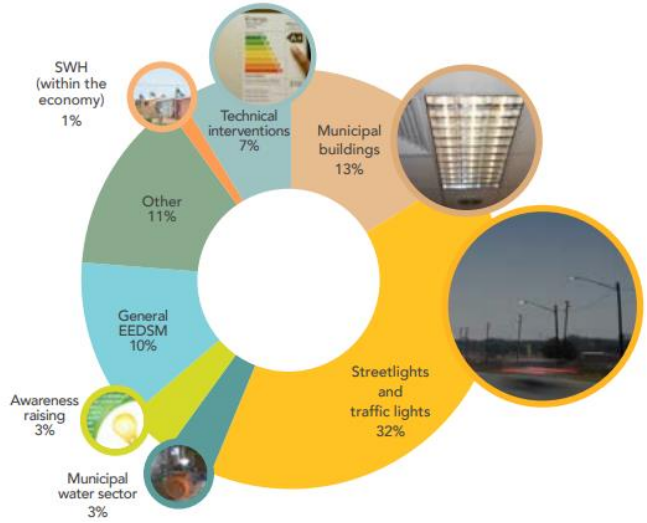
1. Energy use in lighting. How does your city compare?

Potential electricity savings per sector (MWh/a) across the nine cities of the South African Cities Network (SACN)



Source: South African Cities Network (2014) http://sacitiesnetwork.co.za/wp-content/uploads/2014/07/Modelling-Energy-Efficiency-Potential-in-SACN-Cities-full-report.pdf

Breakdown of energy efficiency projects identified within South African cities Integrated Development Plans



Source: Sustainable Energy and Climate change in municipal IDPS (2017)http://www.cityenergy.org.za/uploads/resource_475.pdf

The potential impact for energy savings in street lighting in South African municipalities is significant (~23%). Progress in retrofitting of street lighting has already occurred with more planned as stated in IDPs.

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2. Strategies for energy efficiency

2. Strategies for energy efficiency

Manage systems better

- Proper design and orientation of fixtures
- Fixing broken wiring, burnt or damaged lamps and posts

Replace technology

- Replace lamps with more efficient technologies

Install smarter systems

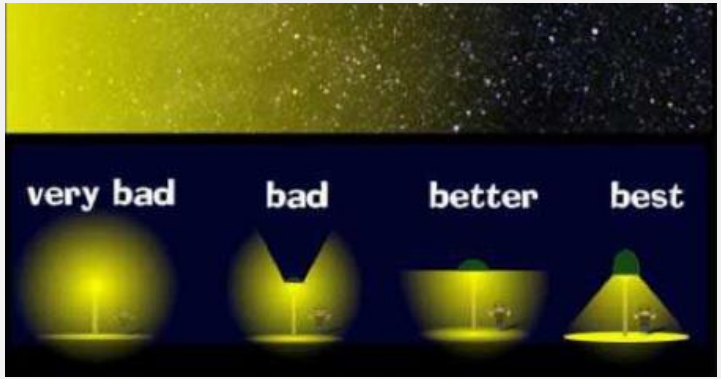
- Install smarter lighting management systems

2. Strategies for energy efficiency

Manage systems better

- **Proper design and orientation of fixtures**
- Fixing broken wiring, burnt or damaged lamps and posts

- Saving energy can already be done with same technologies, using only **better design**



Source http://www.science.smith.edu/~jlowenth/lightpollution/lightpollution.html

2. Strategies for energy efficiency

Manage systems better

- Proper design and orientation of fixtures
- **Fixing broken wiring, burnt or damaged lamps and posts**

- Proper maintenance reduce excess electricity use caused by faulty fixtures

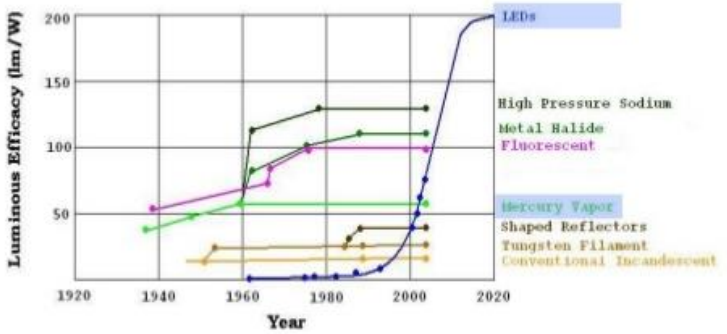
Source https://wbg.sabacloud.com/Saba/Web_spf/NA1PRD0002/common/ledetail/00003103

2. Strategies for energy efficiency

Replace technology

- Replace lamps with more efficient technologies

- LED lamps significantly more efficient than other street lighting technology



Light Source	Lumens/watt
High Pressure Sodium	80-140
LED	114-160

Source https://www.slideshare.net/ChristineGupta/ppt2-hps-comparison

2. Strategies for energy efficiency

Replace technology

- Replace lamps with more efficient technologies

- **Case Study:** Ann Arbor, USA pilot project spent 472$ additional cost per fixture but pays back in 4.7 years, resulting to 97% positive response

80%

Energy use reduction

100$

Saving per fixture

2200 tons **Avoided CO2 emissions**

Source https://www.c40.org/case_studies/led-street-lighting-pilot-project-reduces-energy-use-by-80; https://www.a2gov.org/departments/systems-planning/planning-areas/energy/LED-Streetlights.aspx

2. Strategies for energy efficiency

Replace technology

- Replace lamps with more efficient technologies

- **Case Study:** Before and after illustration of street lighting retrofit in Los Angeles, CA that saw the installation of over 140,000 LEDs

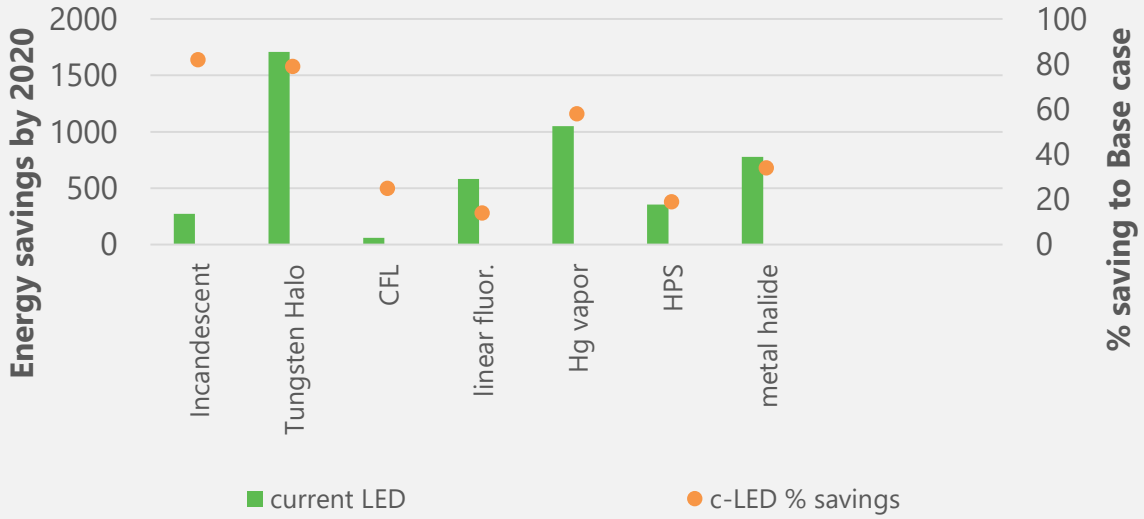
Source CleanTechnica - https://cleantechnica.com/2013/09/17/worlds-largest-led-streetlight-retrofit-completed-in-los-angeles/1514840416

2. Strategies for energy efficiency

Replace technology

- Replace lamps with more efficient technologies

- **Case Study:** Potential in India to save on street lighting by 2020 using the current generation LED lamps in replacing the existing lamp technologies.



Source https://ies.lbl.gov/sites/all/files/lbnl6576e.pdf

2. Strategies for energy efficiency

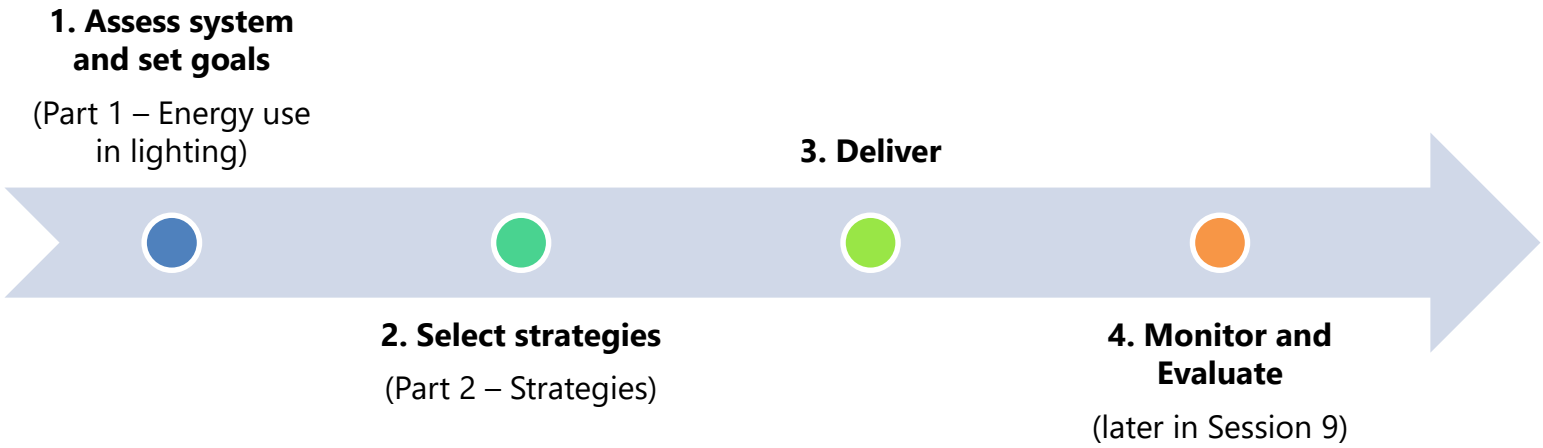
Install smarter systems

- Install smarter lighting management systems

- **Case Study:** Ho Chi Minh and Quy Nhon City, Vietnam. Dimming system (bipower ballasts) in 30000 streetlights during low traffic, cutting energy consumption by 40%

Source http://www.vn.undp.org/content/dam/vietnam/docs/Publications/29434_Publication_Lighting_Case_Study_July_2011.pdf, https://www.videoblocks.com/video/ws-pan-traffic-in-front-of-saigon-opera-house-at-night--hochiminh-vietnam-asia_k3qxiwlusrpj

2. Strategies for energy efficiency. Steps



2. Strategies for energy efficiency. Delivering change

3. Deliver

Situation	Action	Delivery Model	Examples
Does the municipality have sufficient resources to fund the program itself?	Allocate funds by establishing budget line item for project	Municipal Financing Model	• Quezon City, Philippines • Ontario, Canada (cities opting for the Design-Upgrade-Transfer model)
Are there ESCOs active or planning to be active in the local market?	Negotiate an energy service performance contract with ESCOs	Private ESCO Model Public ESCO Model	• AEL, India • EESL in Vizag, India • Ontario, Canada (cities opting for shared savings EPC model)
Are leasing or private financing programs available?	Determine eligibility criteria and negotiate financing agreements	PPP Model Lease to Own Model	• Guadalajara, Mexico • Birmingham, UK

Source https://www.esmap.org/node/57252

2. Strategies for energy efficiency. Delivering change

3. Activity

3. Activity : Risk mitigation measures

3. Deliver

Think about possible options in order to mitigate these common risks associated with public lighting

Type of Risk	Risk Manifestation	Risk mitigation measures
Technical risk	Failure of luminaries	?
Performance risk	Failure of installed lighting system	?
Financial risk	Failure to make payments	?

Source https://www.esmap.org/node/57252

3. Activity

3. Deliver

ACTIVITY

Take 15-20 minutes to discuss possible risk mitigation methods in delivering energy efficient public lighting

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3. Activity

3. Deliver

Type of Risk	Risk Manifestation	Risk Mitigation Measure	Example
Technical Risk	Failure of LED luminaires	• Obtain product warranty from LED luminaire manufacturer	Ontario, Canada
		• Extensively test luminaires with external technical assistance	Quezon City, Philippines
		• Obtain third-party certification of luminaires	Guadalajara, Mexico
Performance Risk	Failure of installed LED system	• Conduct extensive pilots	Quezon City, Philippines
		• Outsource risk to private sector by procuring "lighting service" with performance penalties in PPP contract	Birmingham, United Kingdom
		• Outsource risk to private sector contractors by using EPC contracts	EESL in Vizag, India
		• Conduct own maintenance	Guadalajara, Mexico
		• Extensively search and procurement of a trusted operator	Ontario, Canada
Financial Risk	Failure to make payments	• Secure state government guarantees	Guadalajara, Mexico
		• Secure commercial bank guarantees	AEL, India
		• Work with private sector with substantial resources	Birmingham, United Kingdom

Source https://www.es...node/57252

Resources

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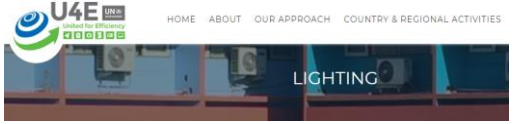
Key Resources. Lighting

Tracking Clean Energy Progress
https://www.iea.org/tcep/buildings/lighting/

SEAD Street lighting tool
https://superefficient.org/tools/street-lighting-tool



United 4 Efficiency
https://united4efficiency.org/products/lighting/

IEA's Technology Collaboration Platforms
https://ssl.iea-4e.org/

lites.asia (last update 2017)
http://www.lites.asia/

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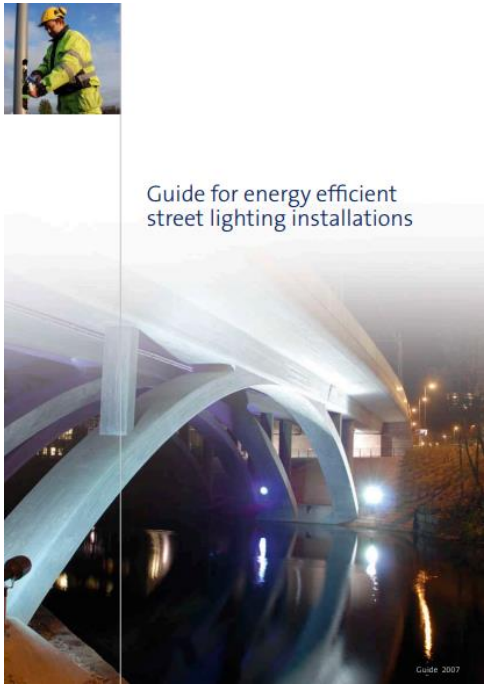
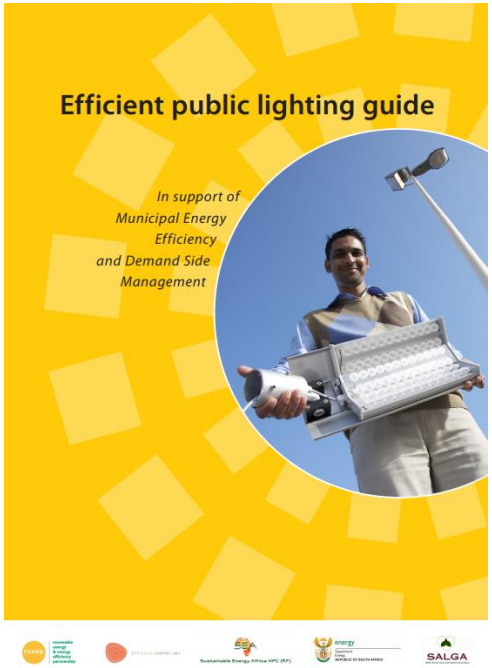
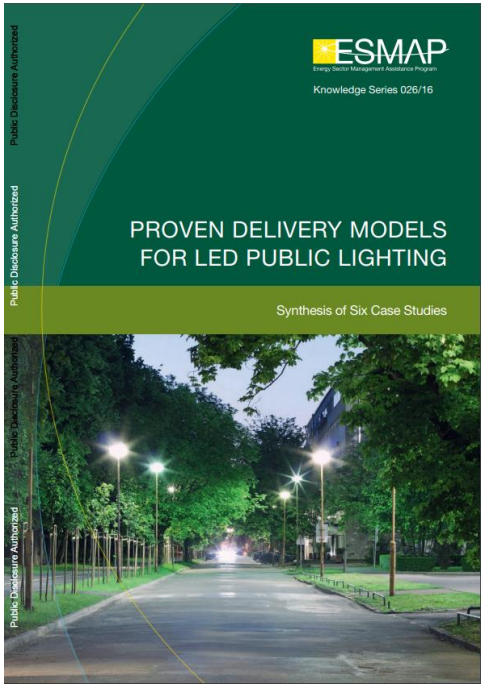
Key Resources. Lighting



Guide for energy efficient street lighting installations
https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/e-street_e_street_guide_en.pdf



Efficient public lighting guide (South Africa)
http://www.cityenergy.org.za/uploads/resource_17.pdf



Proven Delivery Models for LED Public Lighting
https://www.esmap.org/node/57252

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6. Utilities 2: Other urban services

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1. District Energy Systems

District Energy Systems: The Case for DES

1. Reduction of peak electricity

- For heating/cooling systems normally connected to the grid, having alternative sources reduces peak

2. Fuel diversity

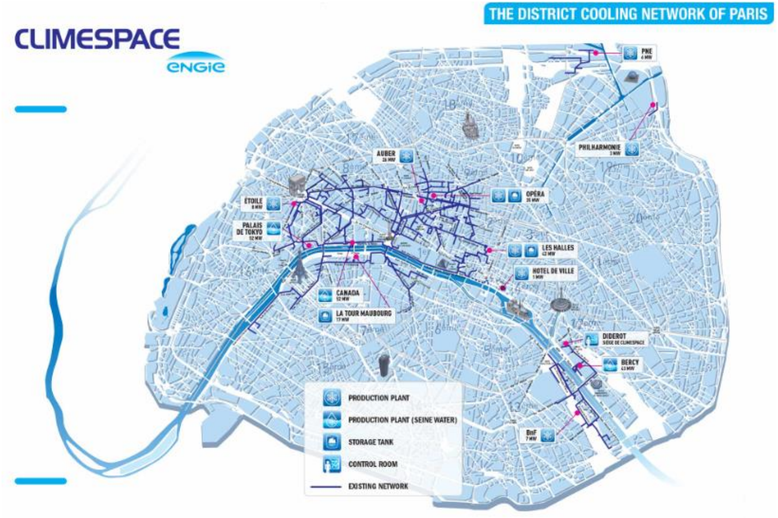
- Low value heat could produce heating or cooling

3. Frees up space for buildings

- Space could be used for stormwater retention for water recycling
- Space could also be used for green roofs to help reduce urban heat island effect

District Energy Systems: Case Studies

- In Paris, district cooling led to:
  - **35% lower electricity** consumption
  - **50% reduction** in CO2 emissions



Source https://www.climespace.fr/en/district-cooling/

- In India, a reduction from 240MW to 135 MW **(44% lower)** in electricity consumption is expected from the GIFT City

Source https://www.rehva.eu/fileadmin/REHVA_Journal/REHVA_Journal_2018/RJ1/RJ.39-45/39-45_RJ1801.pdf

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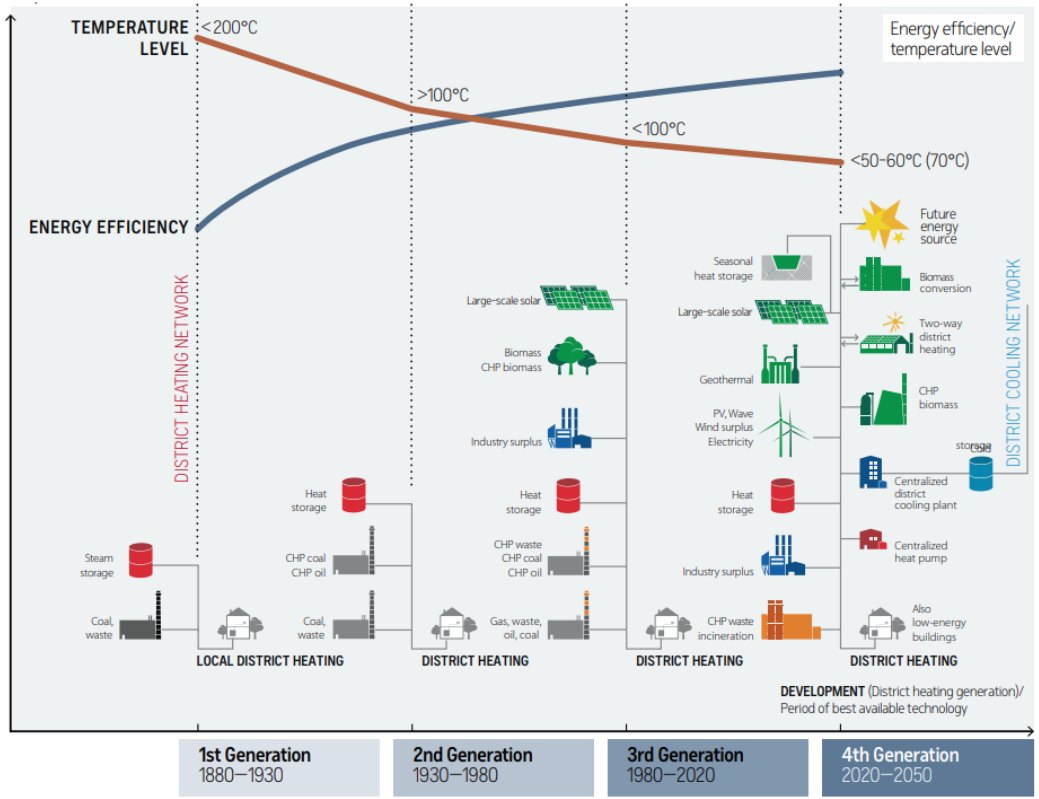
District Energy Systems : Becoming more efficient and sustainable



1G
STEAM
Steam system, steam pipes in concrete ducts

2G
IN SITU
Pressurized hot-water system
Heavy equipment
Large "build on site" stations

3G
PRE-FABRICATED
Pre-insulated pipes
Industrialized compact substations (also with insulation)
Metering and monitoring

4G
4TH GENERATION
Low energy demands
Smart energy (optimum interaction of energy sources, distribution and consumption)
Two-way district heating

Source http://wedocs.unep.org/bitstream/handle/20.500.11822/9317/-District_energy_in_cities_unlocking_the_potential_of_energy_efficiency_and_renewable_energy.pdf?sequence=2&isAllowed=y

Key Resources

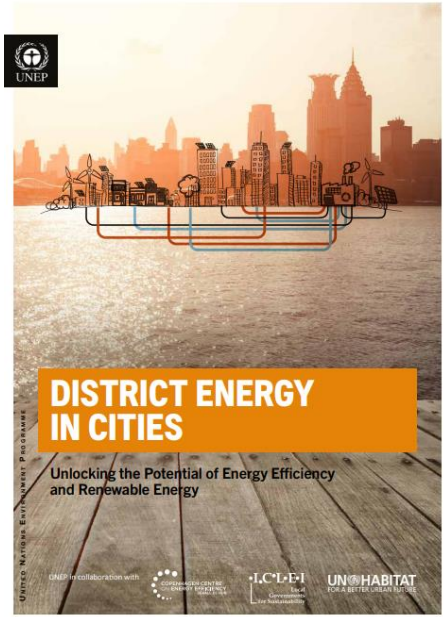
INTERNATIONAL DISTRICT ENERGY ASSOCIATION

https://www.districtenergy.org

DISTRICT ENERGY IN CITIES INITIATIVE

UN environment

http://www.districtenergyinitiative.org/



http://wedocs.unep.org/bitstream/handle/20.500.11822/9317/-District_energy_in_cities_unlocking_the_potential_of_energy_efficiency_and_renewable_ene.pdf?sequence=2&isAllowed=y

IEA DHC|CHP

INTERNATIONAL ENERGY AGENCY
TECHNOLOGY COLLABORATION PROGRAMME ON
District Heating and Cooling including Combined Heat and Power

https://www.iea-dhc.org

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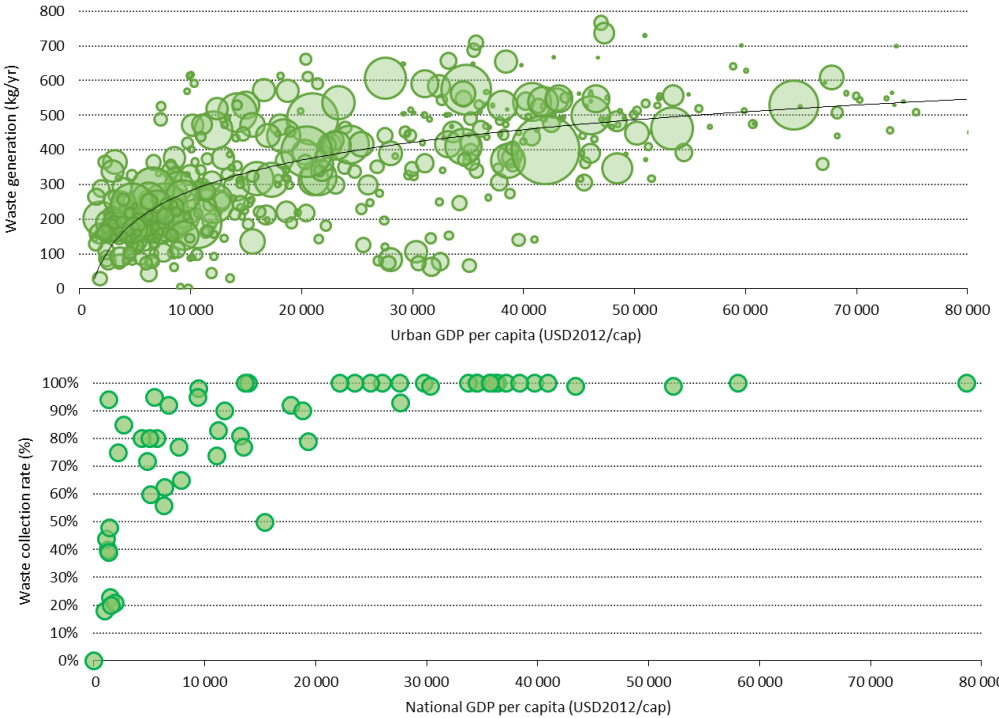
2. Waste

Waste Management. Trends



Waste generation per capita

Waste collection rate

Solid waste generation is often driven **by purchasing power**.
Their subsequent collection would be crucial in the energy recovery.

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Waste Management. Impacts

Bantar Gebang Landfill, Indonesia
https://www.dailymail.co.uk/travel/travel_news/article-4455690/Images-reveal-life-inside-Indonesian-rubbish-dump.html

GHG and other emissions
682.2 ktCO2-eq per year (estimated in Jakarta)
Additional air pollution from uncontrolled incineration

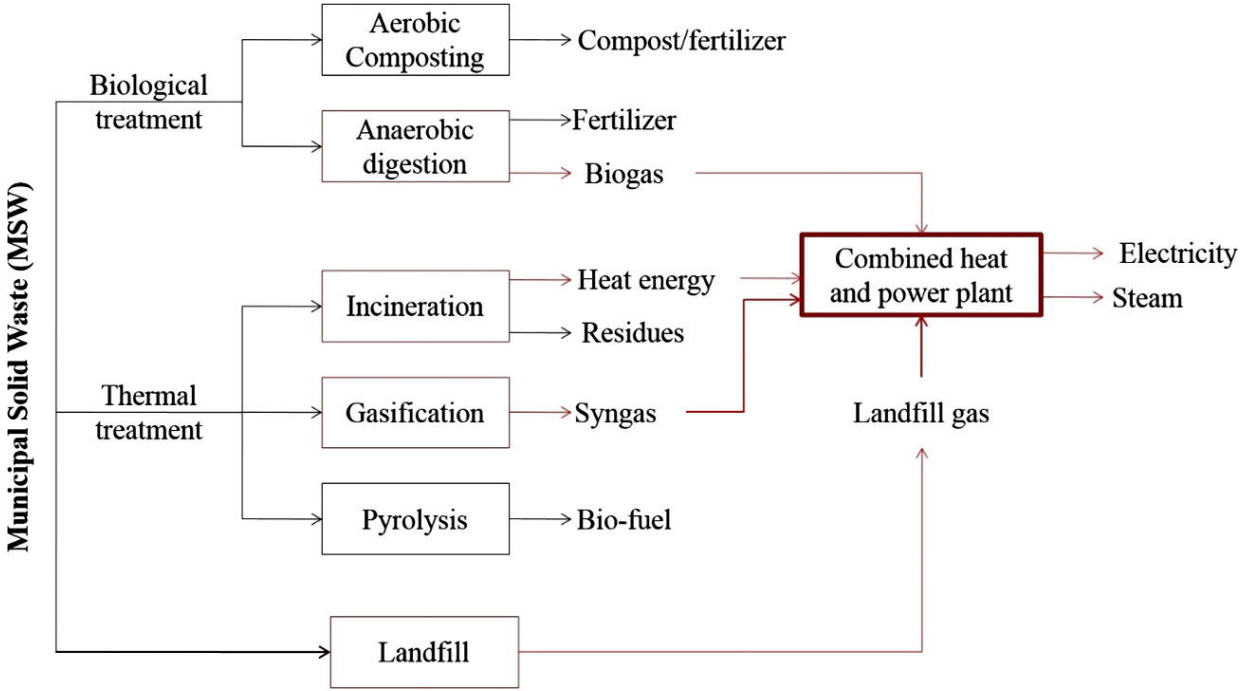
Migration of leachate into groundwater
Water treatment energy intensity increases (Session 5)

Changes in surrounding flora and fauna

Unmanaged solid waste can result to multiple knock on effects that increase social problems for the local authority

Source http://www.ilcan.or.id/wp-content/uploads/2015/12/GHG-Emission-Estimation-from-Housesold-SWM-in-Jakarta-and-Surabaya_Amilia-Zuhra_new.pdf

Waste Management. Strategies



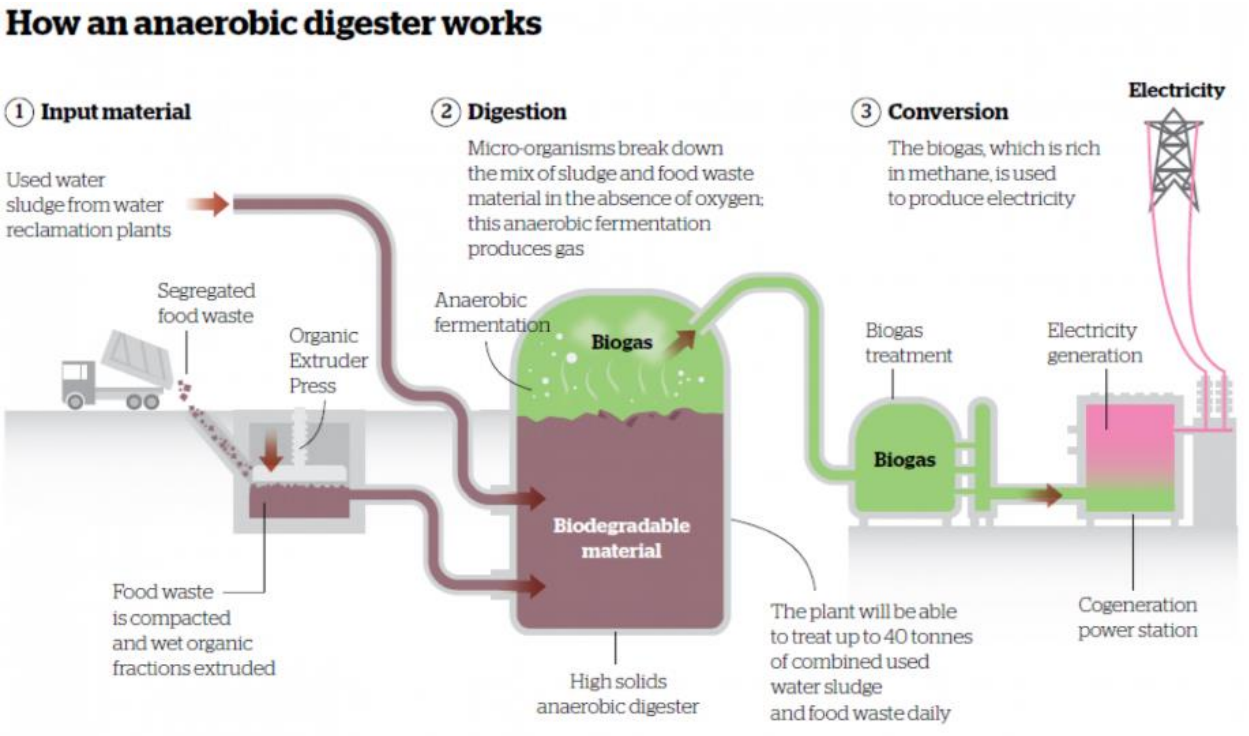
Opportunity for managing waste can also reduce the municipality's net energy consumption.

Source https://www.sciencedirect.com/science/article/pii/S0196890419307156#f0015

Waste Management. Strategies

DIGESTION

- For municipal waste with high organic wastes, it could be **digested to produce biogas**
- Controlled methane generation for gas networks or cogeneration use
- Requires land space

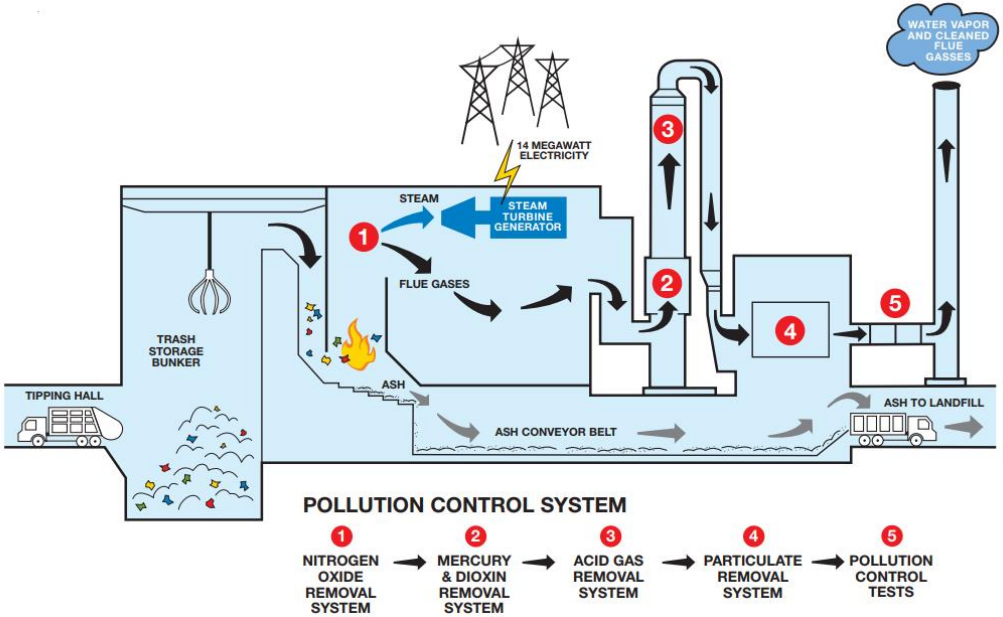


Source
https://www.todayonline.com/sites/default/files/styles/photo_gallery_image_lightbox/public/2269555?itok=Gws-YEEQ

Waste Management. Strategies

INCINERATION

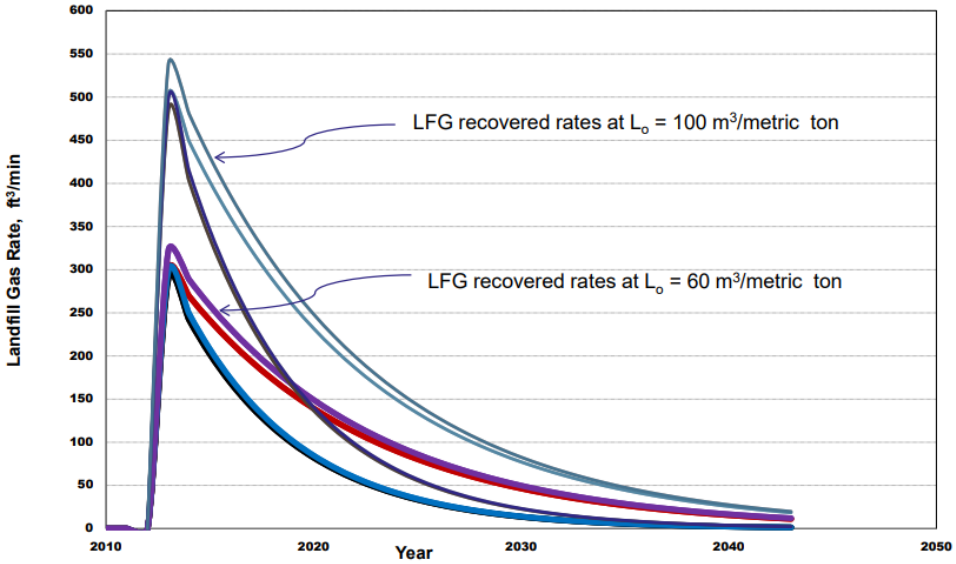
- Recovery of high value energy that can be use for **electricity generation** and **heating** if there is high amount of combustibles in the municipal waste (less organic waste)
- Reduces stronger GHG emissions (landfill methane converted to CO2 instead)
- High capital costs



Source https://www.ecomaine.org/our-facility/waste-to-energy-plant/

Waste Management. Strategies

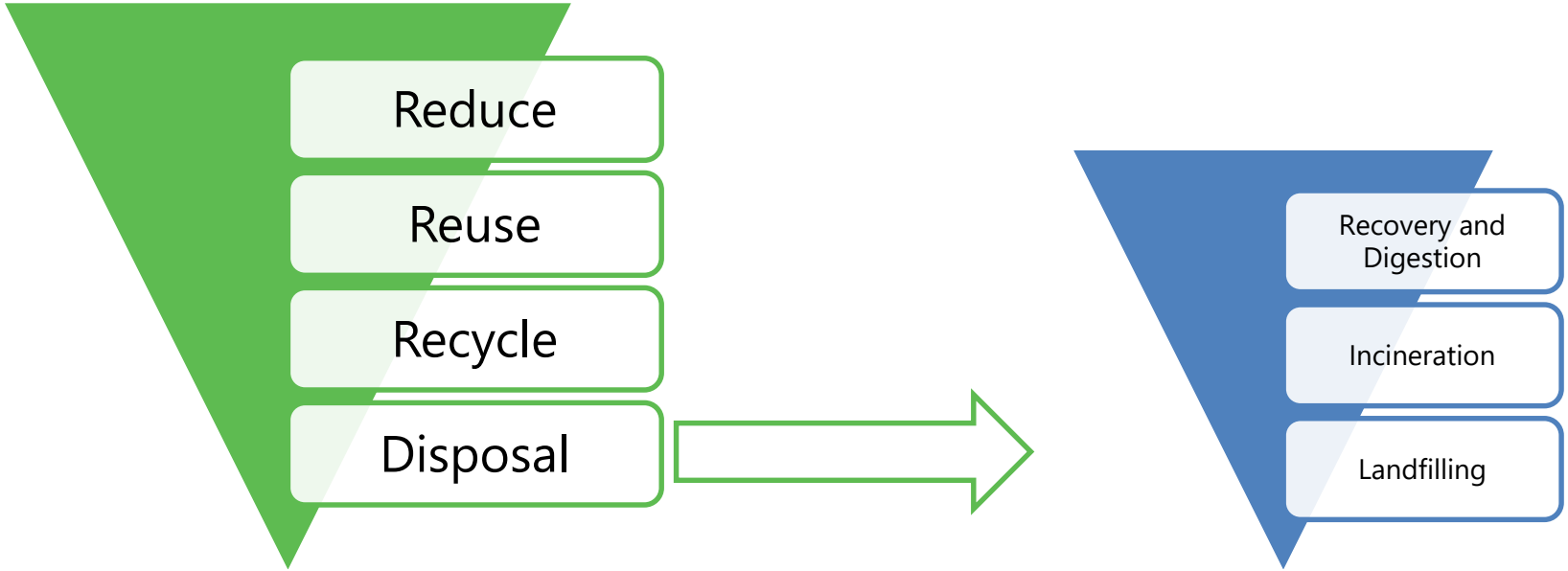
Case Study: Potential of Closed landfill with gas collection (Philippines)



Installation of small engine generator set can allow the landfill to sell electricity with IRR of 1%

Source https://www.epa.gov/sites/production/files/2016-05/documents/09a_sfes_presentation.pdf

Waste Management. Strategies



However, aim for reduction. Energy recovery allows reduction of existing waste but will not be a long term solution

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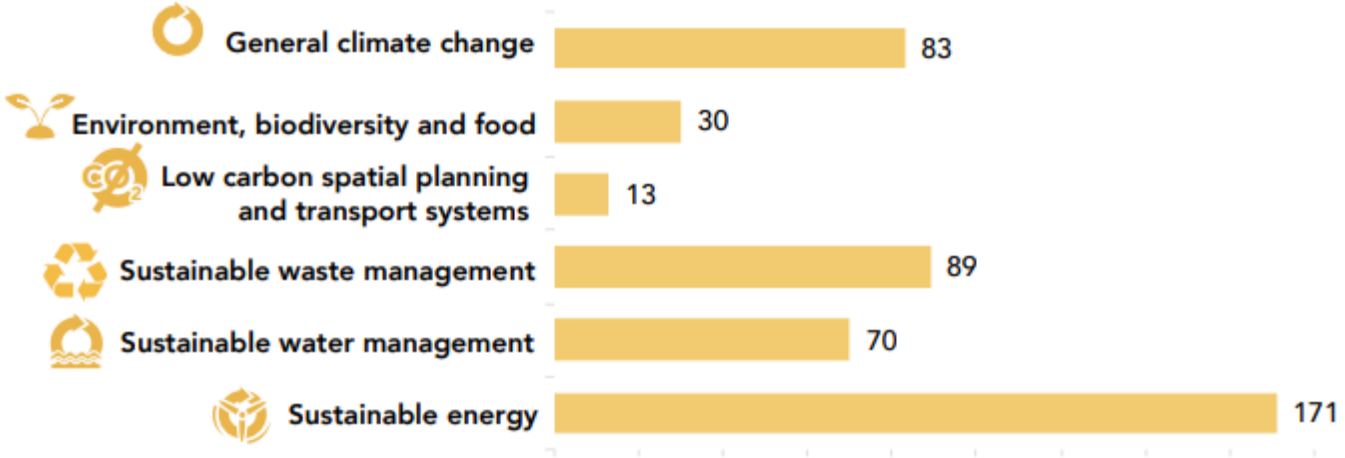
Waste Management in South Africa's Integrated Development Plans

Breakdown of number of projects by project category in IDPs



Source: Sustainable Energy and Climate change in municipal IDPS (2017)http://www.cityenergy.org.za/uploads/resource_475.pdf

Sustainable waste management was the second most prevalent project type after energy efficiency among IDP plans. Recycling projects made up all of the sustainable waste management projects listed.

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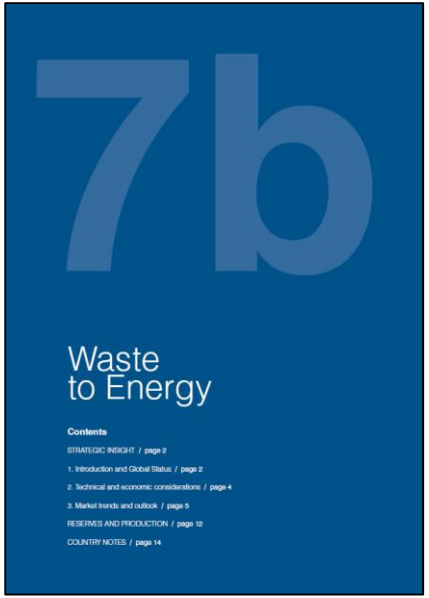
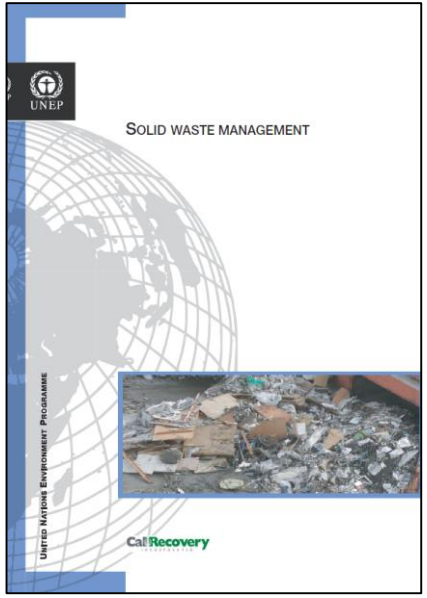
Key Resources. Waste Management



Waste to Energy technologies
https://www.worldenergy.org/wp-content/uploads/2013/10/WER_2013_7b_Waste_to_Energy.pdf



Solid Waste Management
http://www.unep.or.jp/ietc/publications/spc/solid_waste_management/Vol_I/Binder1.pdf

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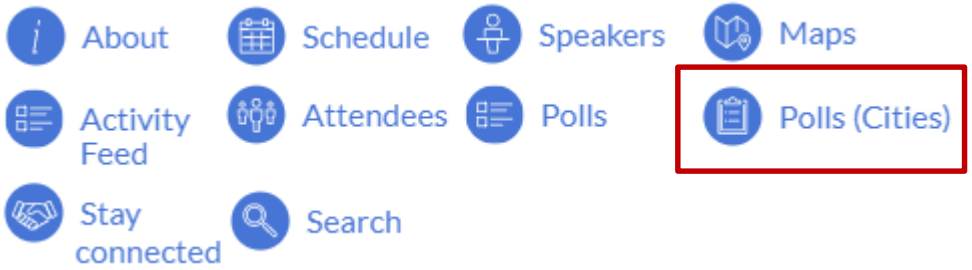
Poll Time! Cities 4: Barriers

Access the polls here:



Q: What are the common barriers that you find in implementing municipal EE projects

- ❑ Financing
- ❑ Lack of local authority
- ❑ Lack of capacity
- ❑ Lack of public support

Results

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