



6. Utilities: Lighting and other urban services

Mel Slade

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IEA #energyefficientworld

6. Utilities: Lighting and other urban services

Trainer(s): Mel Slade

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?

6. Utilities: Lighting and other urban services

1. Energy use in Lighting

- Energy use and impacts,

2. Strategies for energy efficiency

- Lighting service, technology replacement, management systems

3. Activity

4. Other Urban Services

- **Waste management:** waste generation, impacts, energy recovery opportunity, technologies, and policies
- **District energy systems:** district energy concept; waste heat integration and sector coupling

5 mins

15 mins

20 mins

20 mins

1. Energy use in lighting

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Energy use and impacts

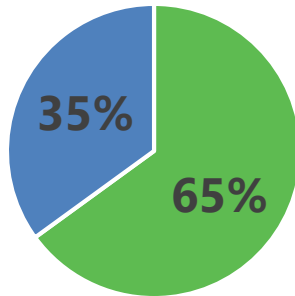
Where to start?

Tools

What are the steps?

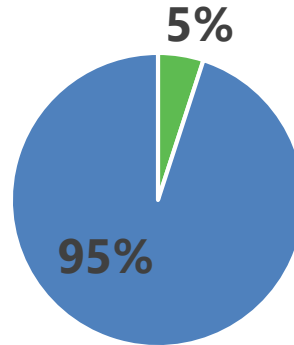
Electricity Cost Quezon City, Philippines

■ Streetlight costs ■ Other costs



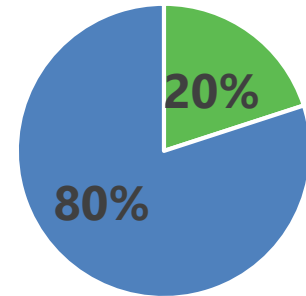
Public Budget Quezon City, Philippines

■ Streetlight costs ■ Other costs



Public Budget Smaller municipalities, India

■ Streetlight costs ■ Other costs



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

1. Energy use in lighting.

Need to sustain and improve lighting services

Where to start?

Tools

What are the steps?

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

1. Energy use in lighting.

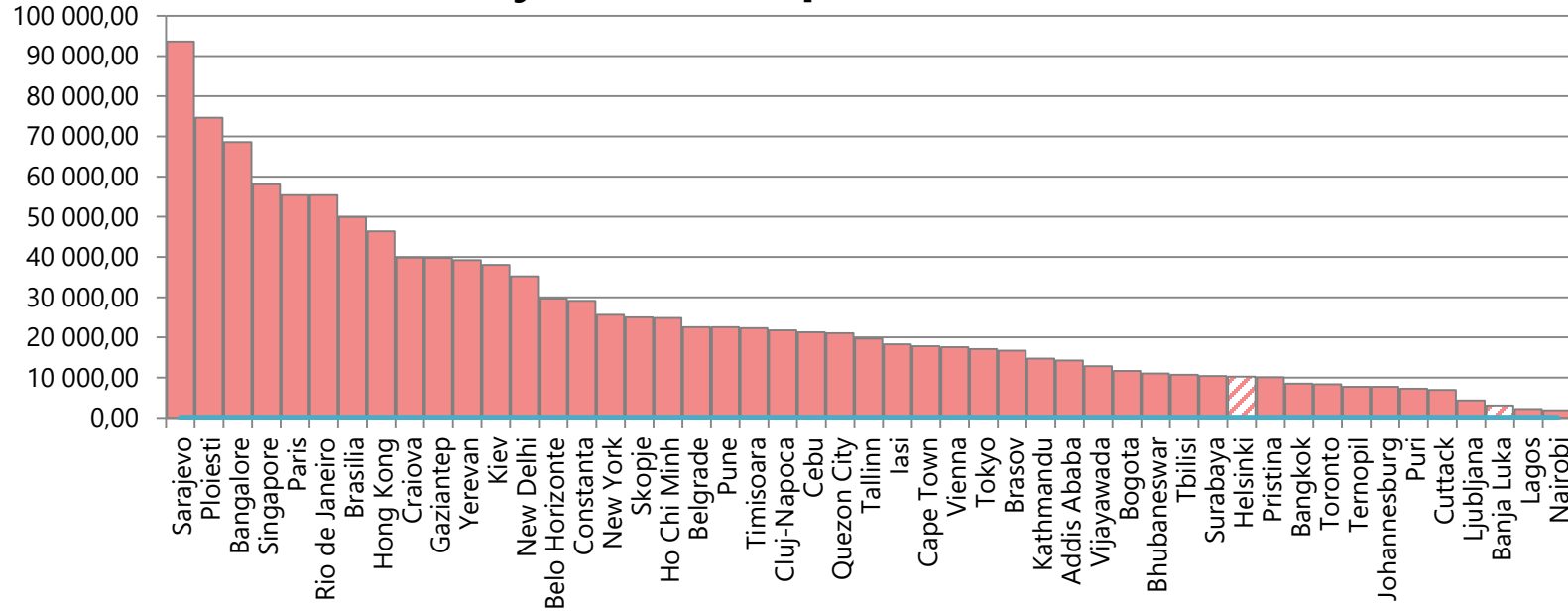
How does your city compare?

Where to start?

Tools

What are the steps?

Electricity Consumed per km of Lit Roads [kWh/km]



2. Strategies for energy efficiency

2. Strategies for energy efficiency

Where to start?

Tools

What are the steps?

Manage systems better



Replace technology



Install smarter systems

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

- Replace lamps with more efficient technologies

- Install smarter lighting management systems

2. Strategies for energy efficiency

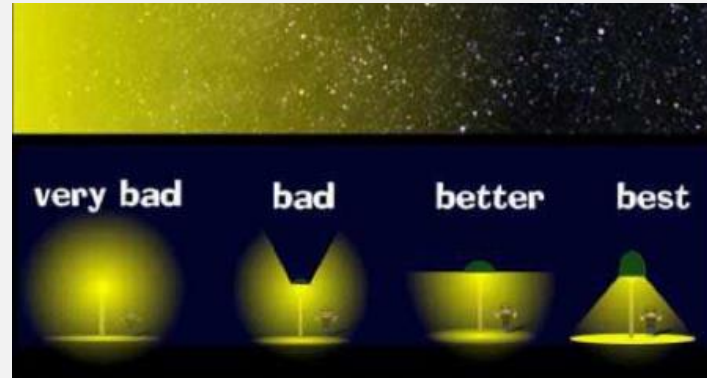
Where to start?

Tools

What are the steps?

Manage systems better

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



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

2. Strategies for energy efficiency

Where to start?

Tools

What are the steps?

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



2. Strategies for energy efficiency

Where to start?

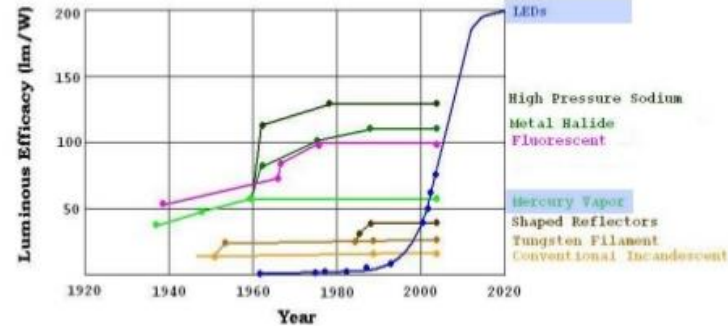
Tools

What are the steps?

Replace technology

- LED lamps significantly more efficient than other street lighting technology

- Replace lamps with more efficient technologies



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

2. Strategies for energy efficiency

Where to start?

Tools

What are the steps?

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**

2. Strategies for energy efficiency

Where to start?

Tools

What are the steps?

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



2. Strategies for energy efficiency

Where to start?

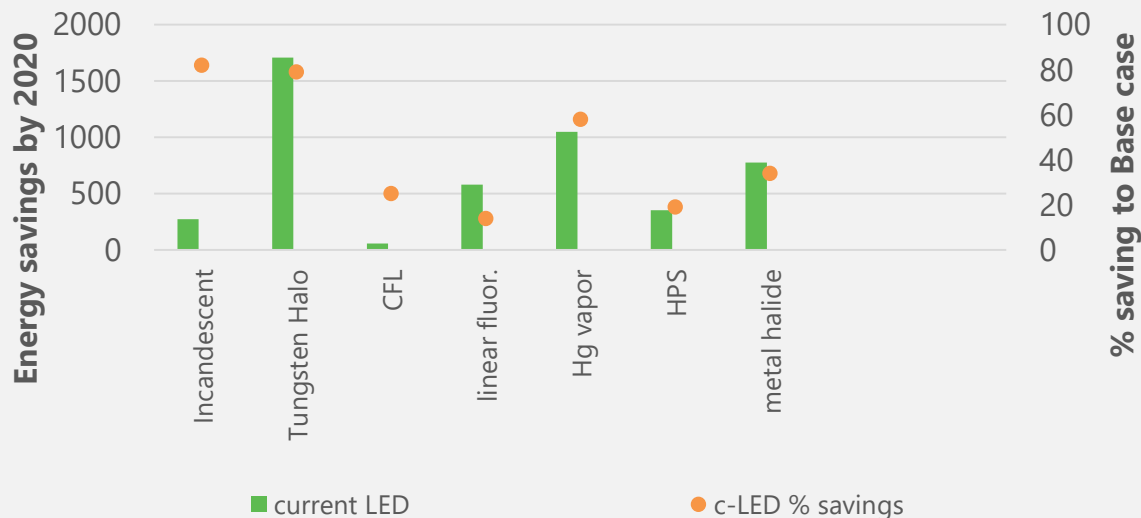
Tools

What are the steps?

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.



2. Strategies for energy efficiency

Where to start?

Tools

What are the steps?

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%

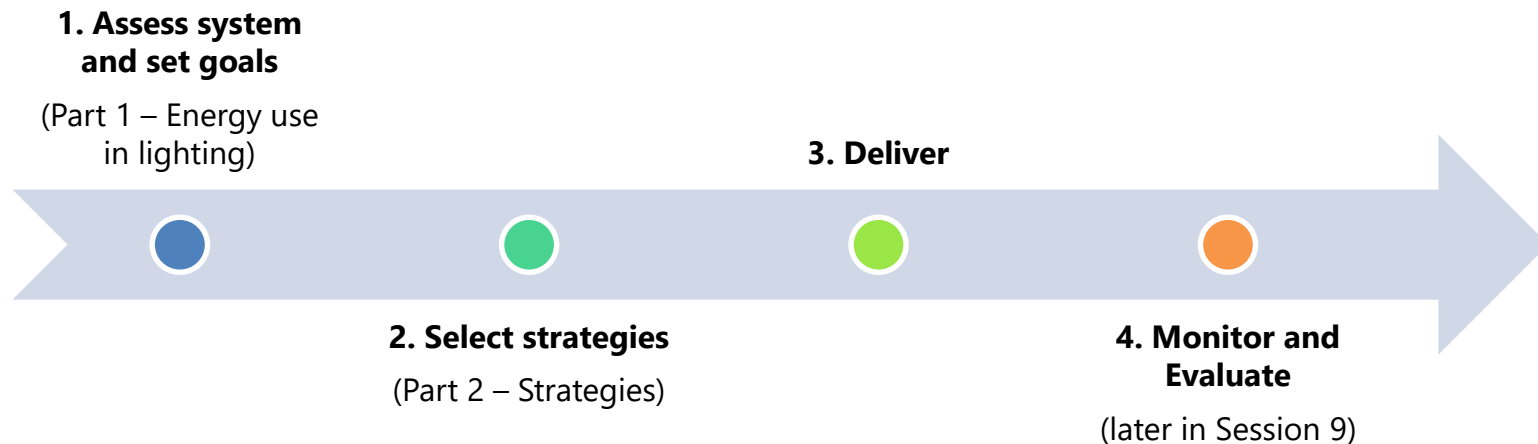


2. Strategies for energy efficiency. Steps

Where to start?

Tools

What are the steps?



2. Strategies for energy efficiency. Delivering change

Where to start?

Tools

What are the steps?

3. Deliver



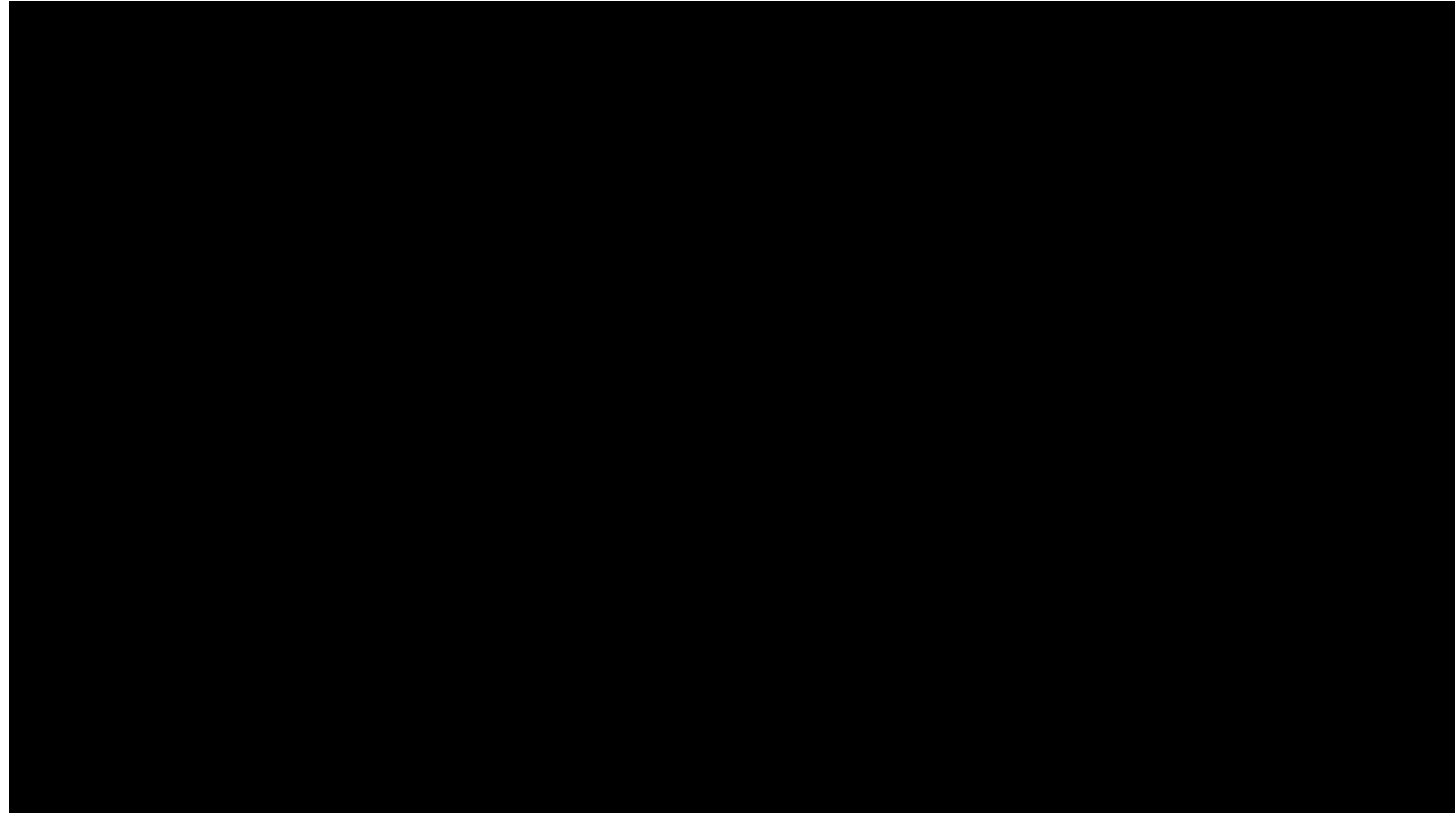
SITUATION	ACTION	DELIVERY MODEL	EXAMPLES
Does the municipality have sufficient resources to fund the program itself?	Allocate funds by establishing budget line item for project	Municipal Financing Model	<ul style="list-style-type: none"> • QUEZON CITY, PHILIPPINES • ONTARIO, CANADA (CITIES OPTING FOR 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • GUADALAJARA, MEXICO • BIRMINGHAM, UK

2. Strategies for energy efficiency. Delivering change

Where to start?

Tools

What are the steps?



3. Activity


3. Activity

Where to start?

Tools

What are the steps?

3. Deliver



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	?

3. Activity

Where to start?

Tools

What are the steps?

3. Deliver



ACTIVITY

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

3. Activity

Where to start?

Tools

What are the steps?

3. Deliver

Type of Risk	Risk Manifestation	Risk Mitigation Measure	Example
Technical Risk	Failure of LED luminaires	<ul style="list-style-type: none"> Obtain product warranty from LED luminaire manufacturer Extensively test luminaires with external technical assistance Obtain third-party certification of luminaires 	<p>Ontario, Canada</p> <p>Quezon City, Philippines</p> <p>Guadalajara, Mexico</p>
Performance Risk	Failure of installed LED system	<ul style="list-style-type: none"> Conduct extensive pilots Outsource risk to private sector by procuring "lighting service" with performance penalties in PPP contract Outsource risk to private sector contractors by using EPC contracts Conduct own maintenance Extensively search and procurement of a trusted operator 	<p>Quezon City, Philippines</p> <p>Birmingham, United Kingdom</p> <p>EESL in Vizag, India</p> <p>Guadalajara, Mexico</p> <p>Ontario, Canada</p>
Financial Risk	Failure to make payments	<ul style="list-style-type: none"> Secure state government guarantees Secure commercial bank guarantees Work with private sector with substantial resources 	<p>Guadalajara, Mexico</p> <p>AEL, India</p> <p>Birmingham, United Kingdom</p>

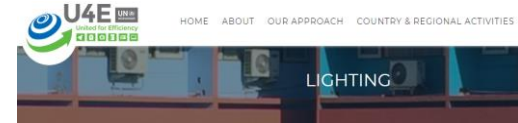
Key Resources. Lighting



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/>

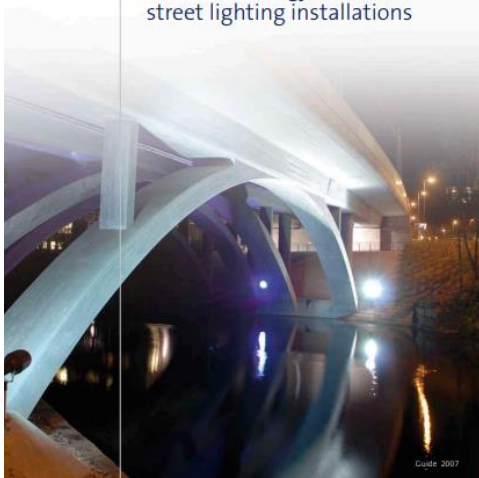


lites.asia (last update 2017)
<http://www.lites.asia/>

Key Resources. Lighting



Guide for energy efficient street lighting installations

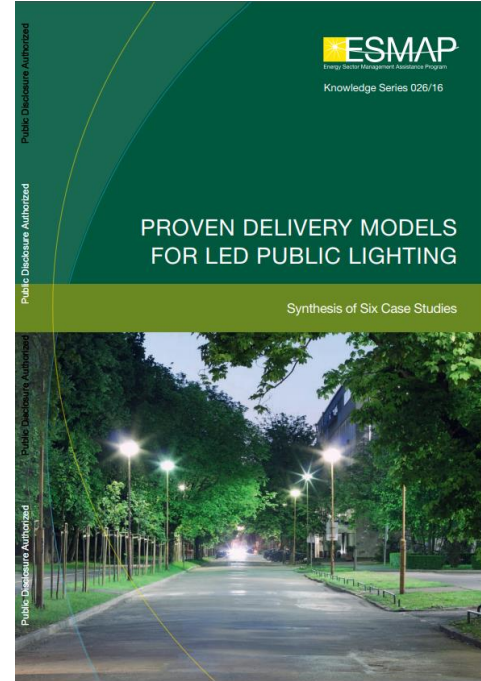


Guide 2007

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>

4. Other urban services

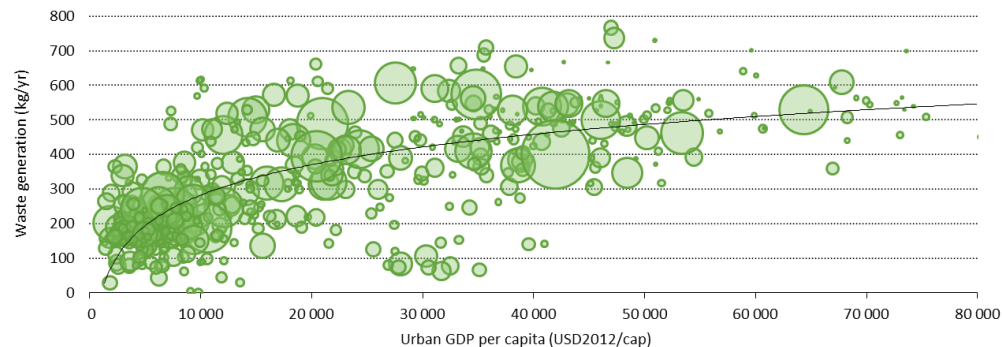
Waste Management

4. Waste Management. Trends

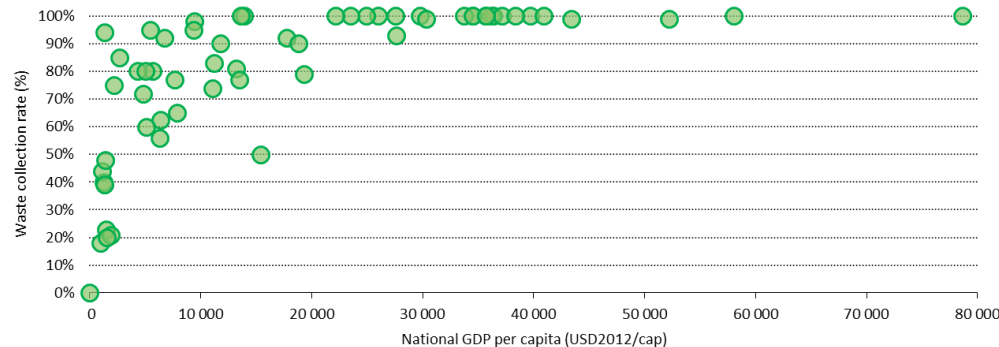
Where to start?

Tools

What are the steps?



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.**

4. Waste Management. Impacts

Where to start?

Tools

What are the steps?



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

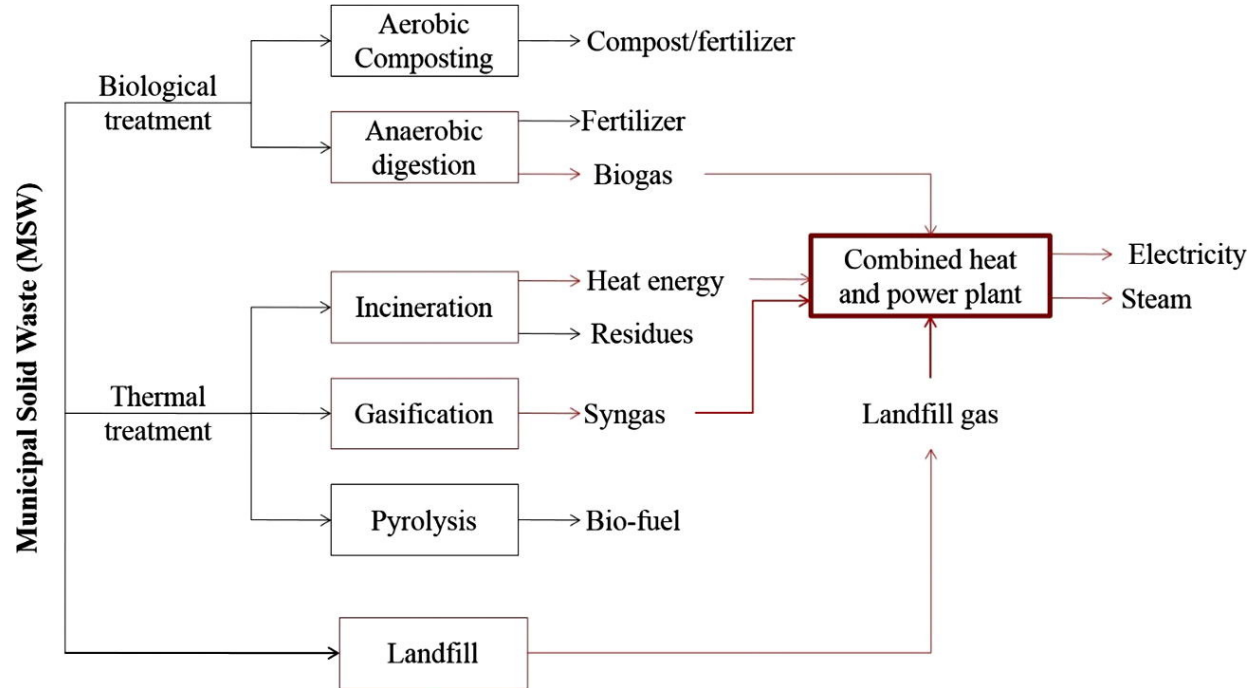
Unmanaged solid waste can result to multiple knock on effects that increase social problems for the local authority

4. Waste Management. Strategies

Where to start?

Tools

What are the steps?



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

4. Waste Management. Strategies

Where to start?

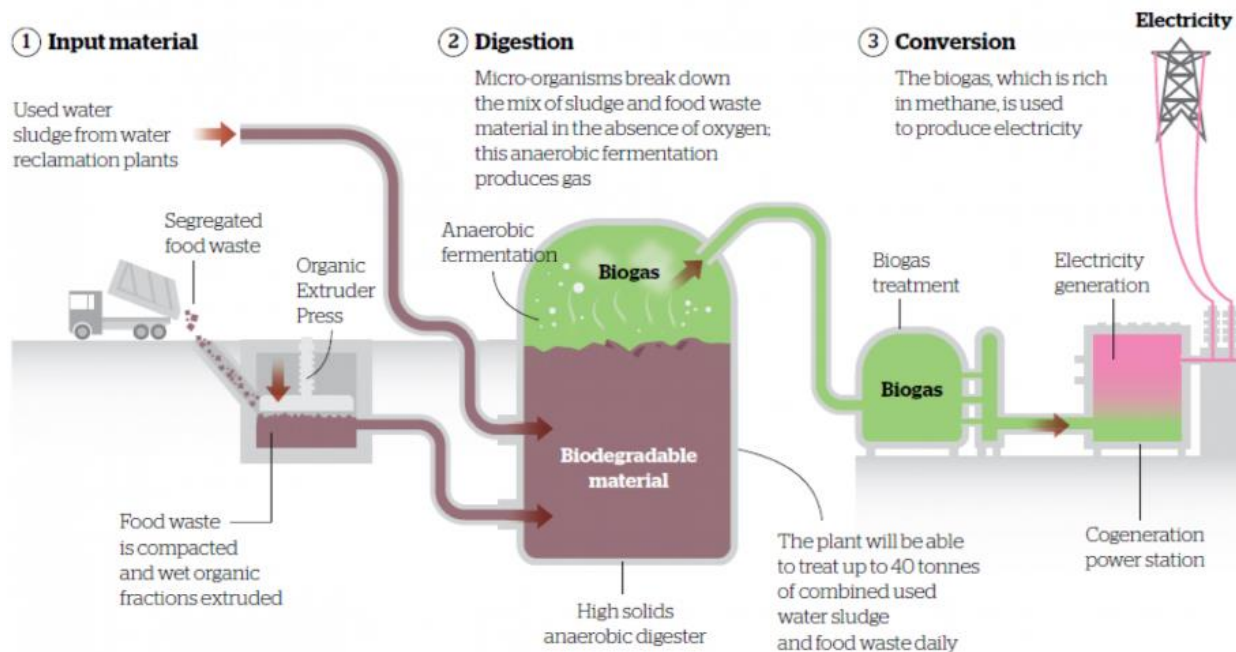
Tools

What are the steps?

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

How an anaerobic digester works



Source: Anaergia

TODAY

4. Waste Management. Strategies

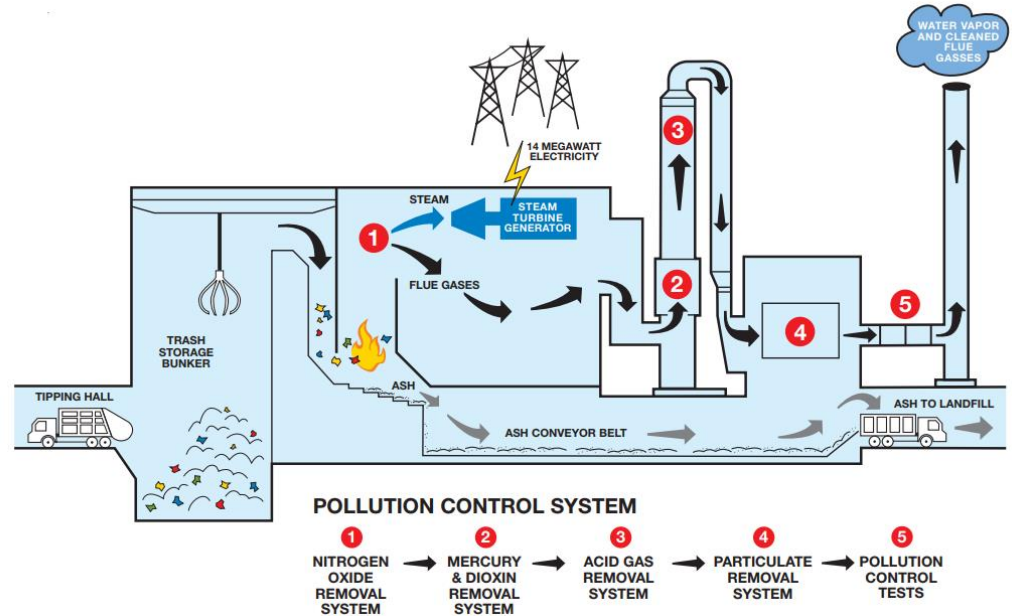
Where to start?

Tools

What are the steps?

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



Waste-to-Energy

- 90% reduction of trash volume
- Power generation
- Pollution control

ecomaine
www.ecomaine.org

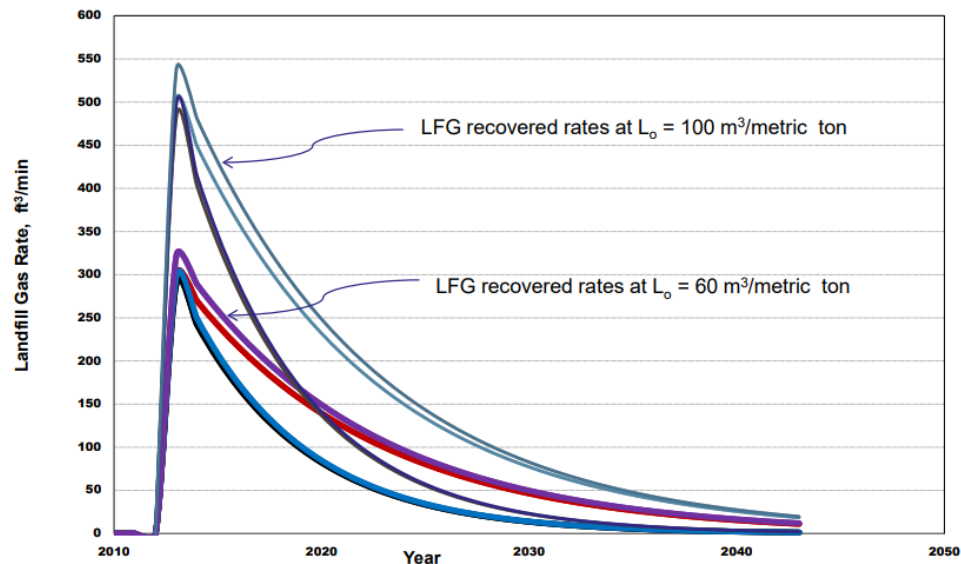
4. Waste Management. Strategies

Where to start?

Tools

What are the steps?

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



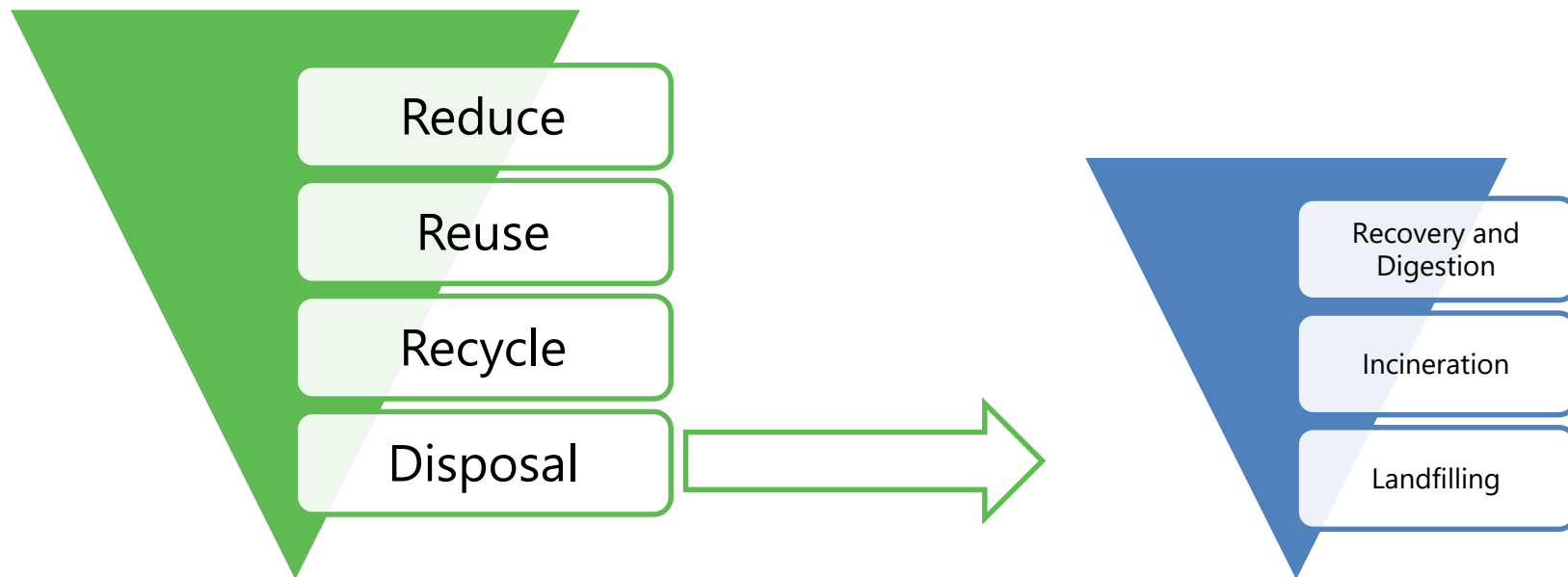
Installation of small engine generator set can allow the landfill to sell electricity with IRR of 1%

4. Waste Management. Strategies

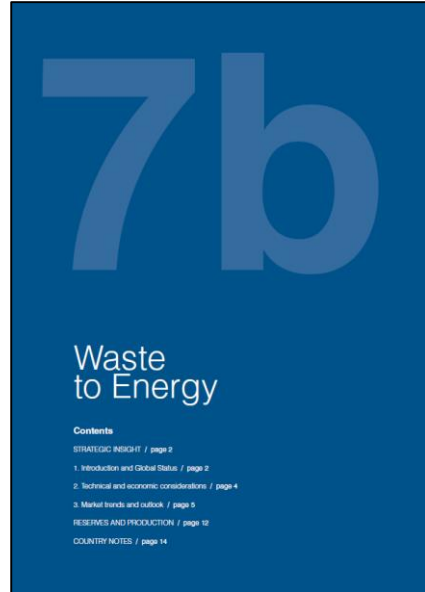
Where to start?

Tools

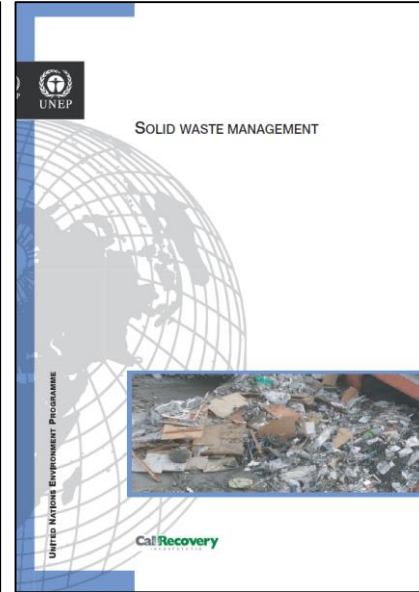
What are the steps?



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



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/solid_waste_management/Vol_I/Binder1.pdf

4. Other urban services

District Energy Systems

4. District Energy Systems. Case for DES

Where to start?

Tools

What are the steps?

1. Reduction of peak electricity

2. Fuel diversity

- Low value heat could produce heating or cooling
- Could connect with nearby LNG plants for excess cooling

3. Freed up space for buildings

- Could be used for stormwater retention

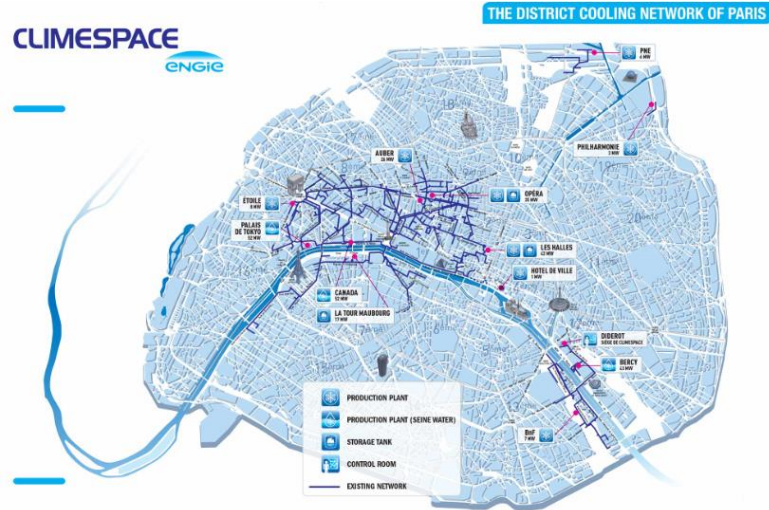
4. District Energy Systems. Case Studies

Where to start?

Tools

What are the steps?

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



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



4. District Energy Networks

Where to start?

Tools

What are the steps?

- In Cyberjaya Malaysia, **8.2 GWh of electricity savings** were achieved, and **4100 tonnes of CO2 emissions avoided**

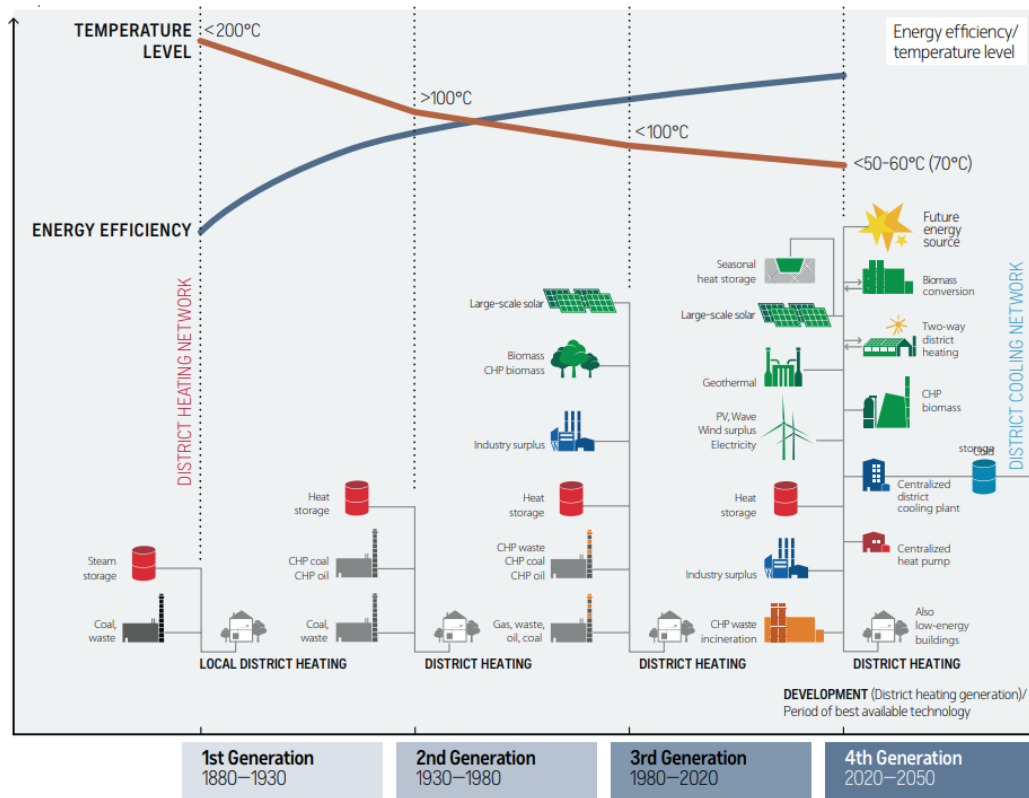


4. District Energy Networks

Where to start?

Tools

What are the steps?



Key Resources. District Energy



<https://www.districtenergy.org>



<http://www.districtenergyinitiative.org/>





www.iea.org



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