6. Utilities: Lighting and other urban services

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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?

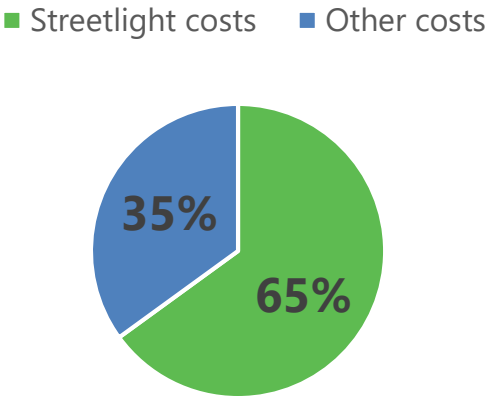
6. Utilities: Lighting and other urban services

1. **Energy use in Lighting** — 5 mins
   - Energy use and impacts,
2. **Strategies for energy efficiency** — 15 mins
   - Lighting service, technology replacement, management systems
3. **Activity** — 20 mins
4. **Other Urban Services** — 20 mins
   - **Waste management:** waste generation, impacts, energy recovery opportunity, technologies, and policies
   - **District energy systems:** district energy concept; waste heat integration and sector coupling

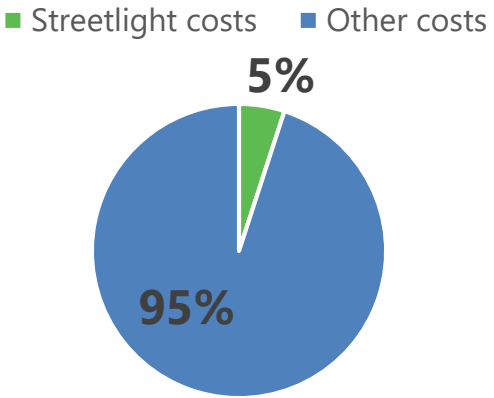
1. Energy use in lighting

1. Energy use in lighting.
Energy use and impacts

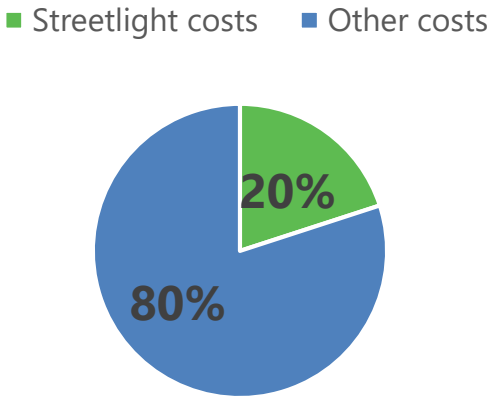
Electricity Cost
Quezon City, Philippines



Public Budget
Quezon City, Philippines



Public Budget
Smaller municipalities, India



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

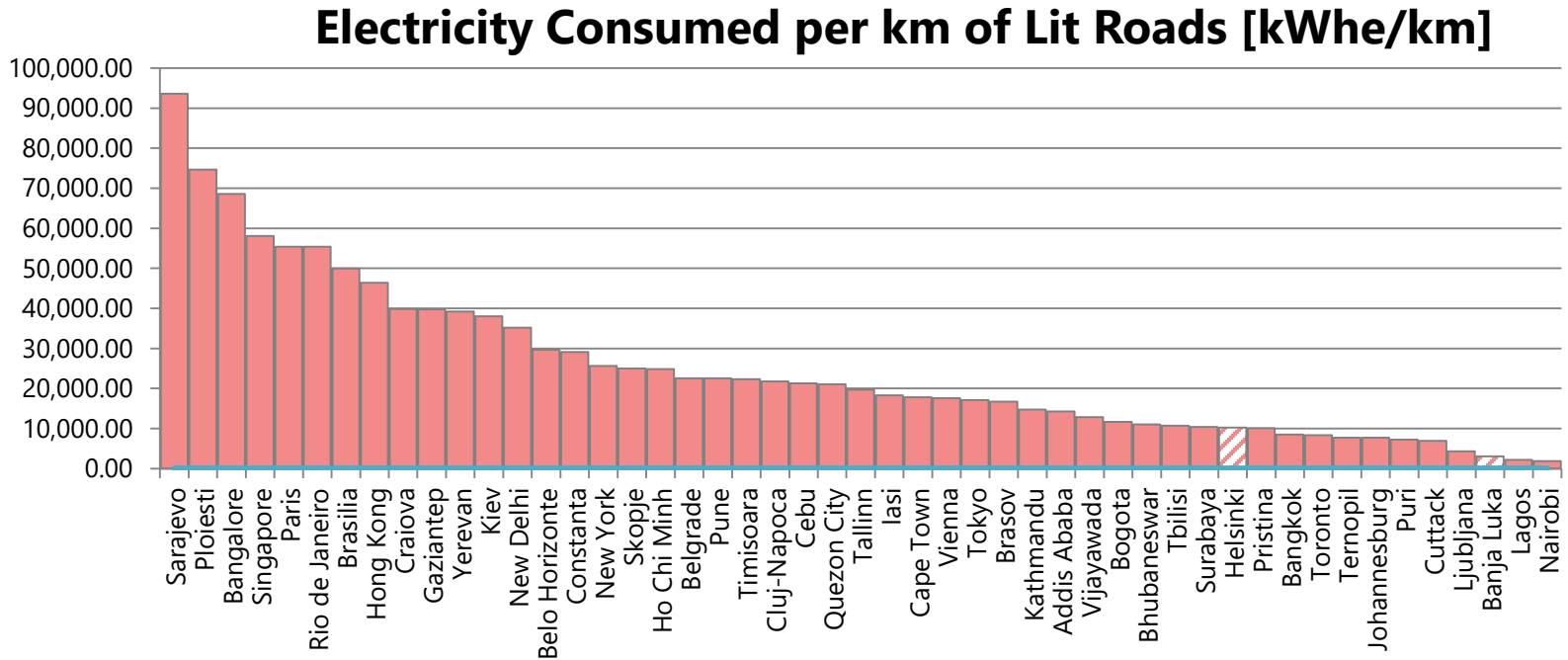
Road safety: 30% reduction in collision, 43% reduction in night time accidents

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-cut-crime-by-39.html

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



Source https://esmap.org/node/235

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

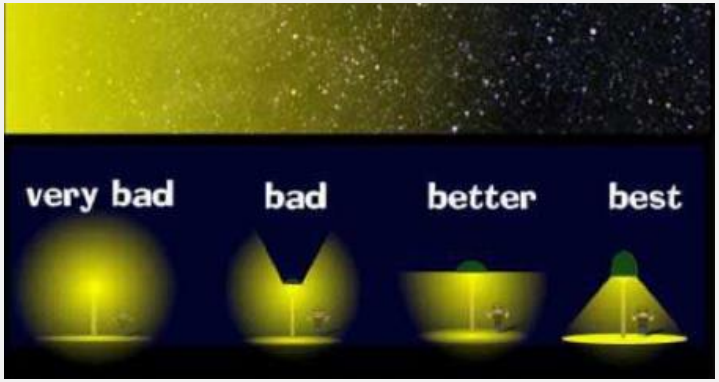
- Install smarter lighting management systems

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

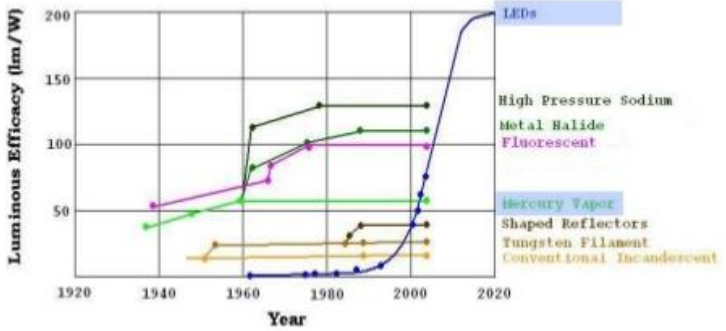
Source https://wbg.sabacloud.com/Saba/Web_spf/NA1PRD0002/common/ledetail/00003103

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/2012-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/Pages/LEDStreetlights.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

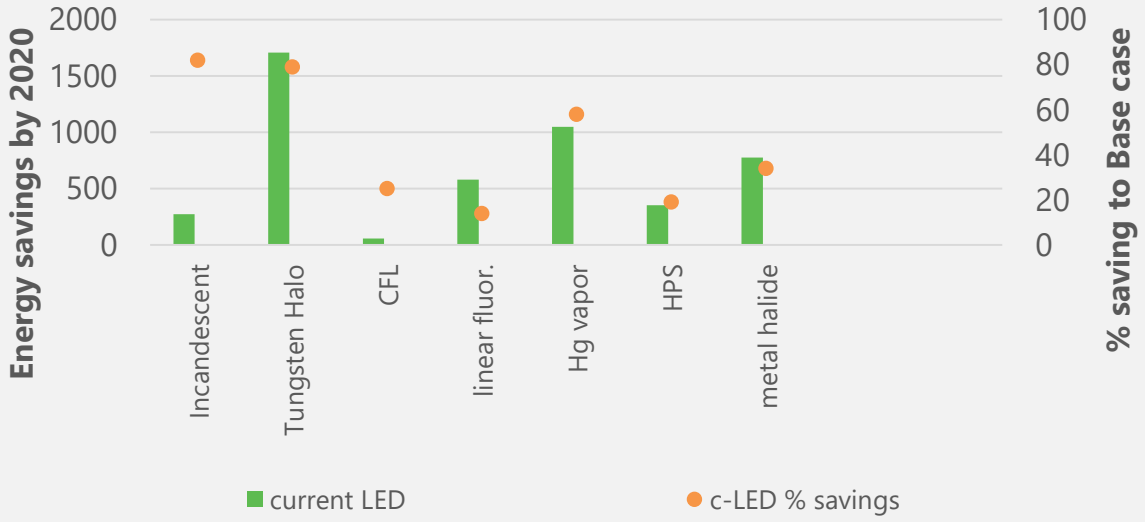
Source CleanTechnica - https://cleantechnica.com/2013/09/12/worlds-largest-led-streetlight-retrofit-completed-in-los-angeles/1514840416

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

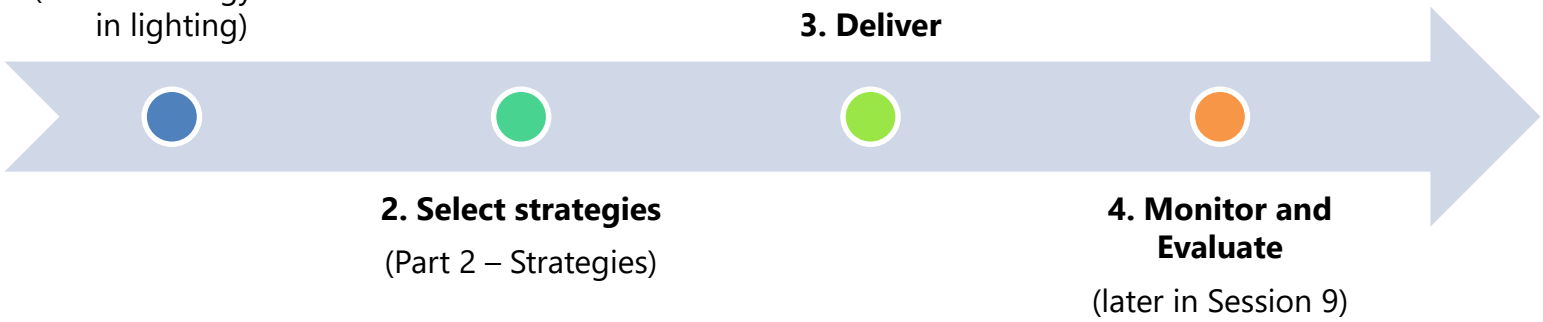
Install smarter systems

- 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_Public_lighting_cities_story_July_2011.pdf, https://www.videoblocks.com/video/ws-pan-traffic-in-front-of-saigon-opera-house-at-night--ho-chi-minh-vietnam-rups_k3qxiwlusrpj

2. Strategies for energy efficiency. Steps



2. Strategies for energy efficiency. Delivering change

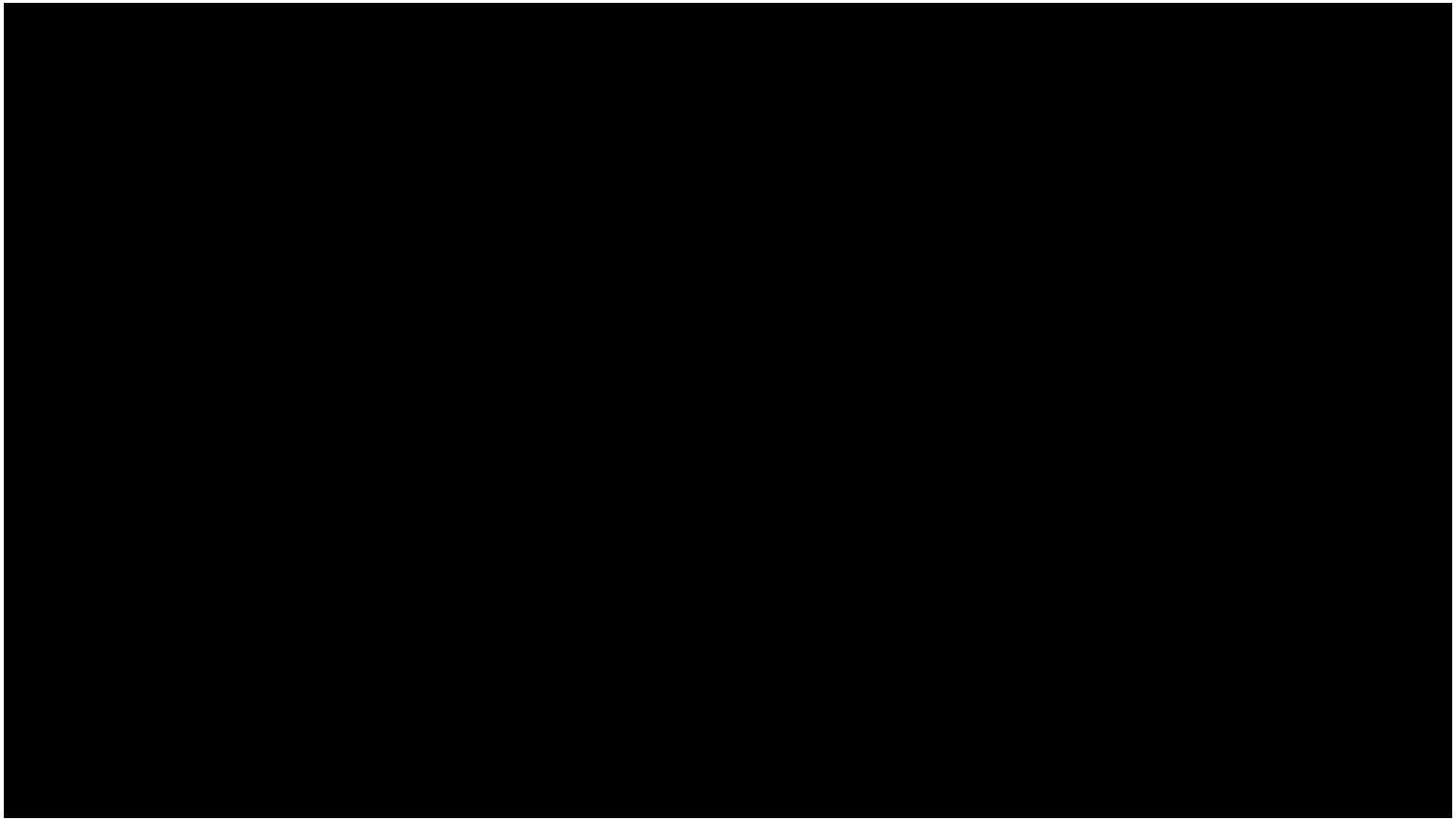
3. Deliver

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

Where to start? | Tools | What are the steps?



Source: IFC https://www.youtube.com/watch?v=q0dD_qIRDeE

3. Activity

3. Activity

3. Deliver

Type of Risk	Risk Manifestiation	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

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

3. Activity

3. Deliver

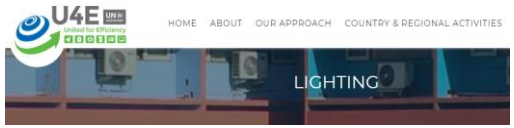
Type of Risk	Risk Manifestation	Risk Mitigation Measure	Example
Technical Risk	Failure of LED luminaires	• Obtain product warranty from LED luminaire manufacturer	Ontario, Canada
		• Extensively test luminaires with external technical assistance	Quezon City, Philippines
		• Obtain third-party certification 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.esmap.org/node/57252

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

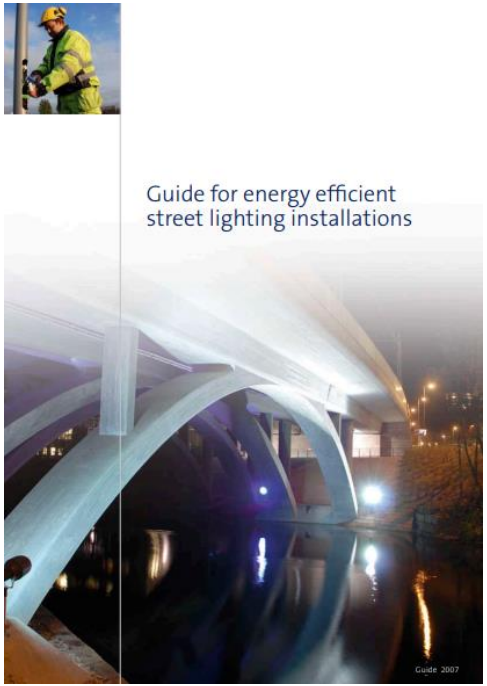


United 4 Efficiency
https://united4efficiency.org/products/lighting/

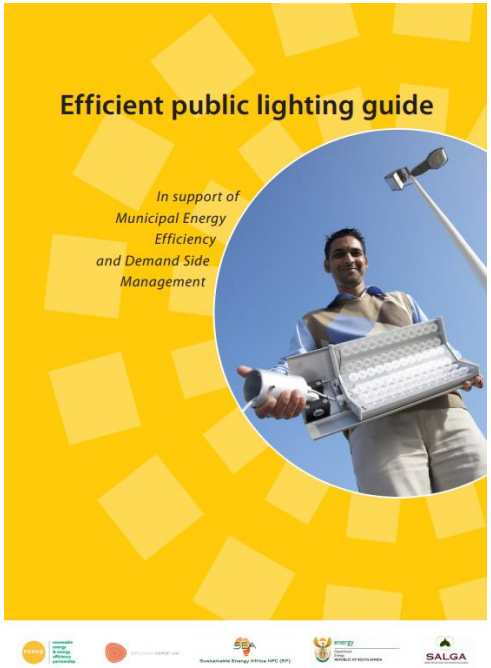
IEA's Technology Collaboration Platforms
https://ssl.iea-4e.org/

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

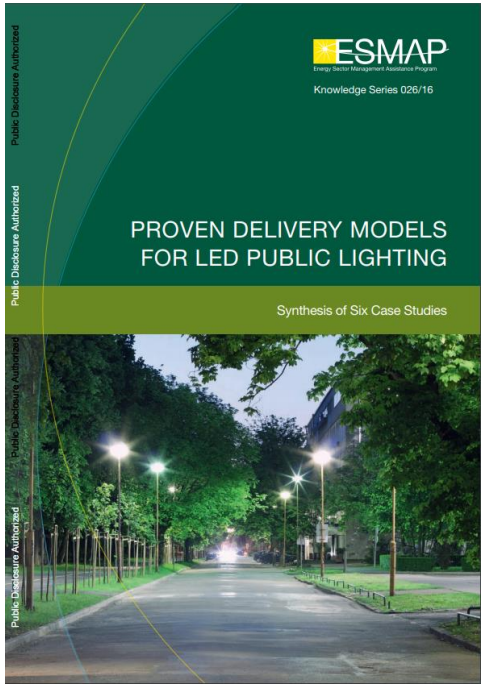
Key Resources. Lighting



Guide for energy efficient street lighting installations
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

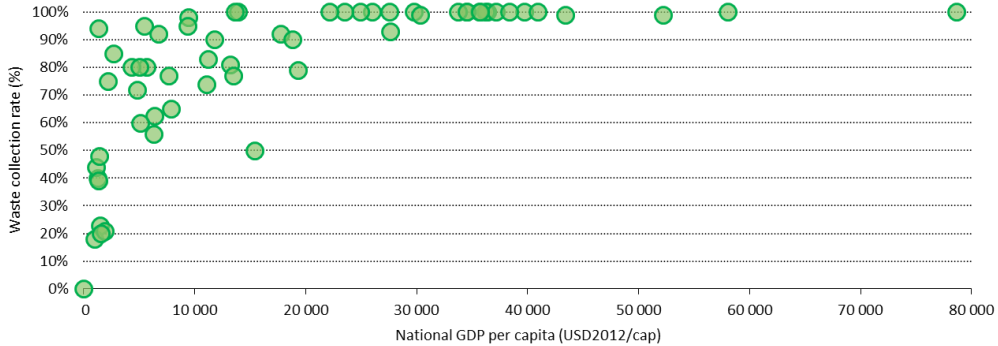
4. Other urban services

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.

Source Energy Technology Perspectives 2016

4. 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

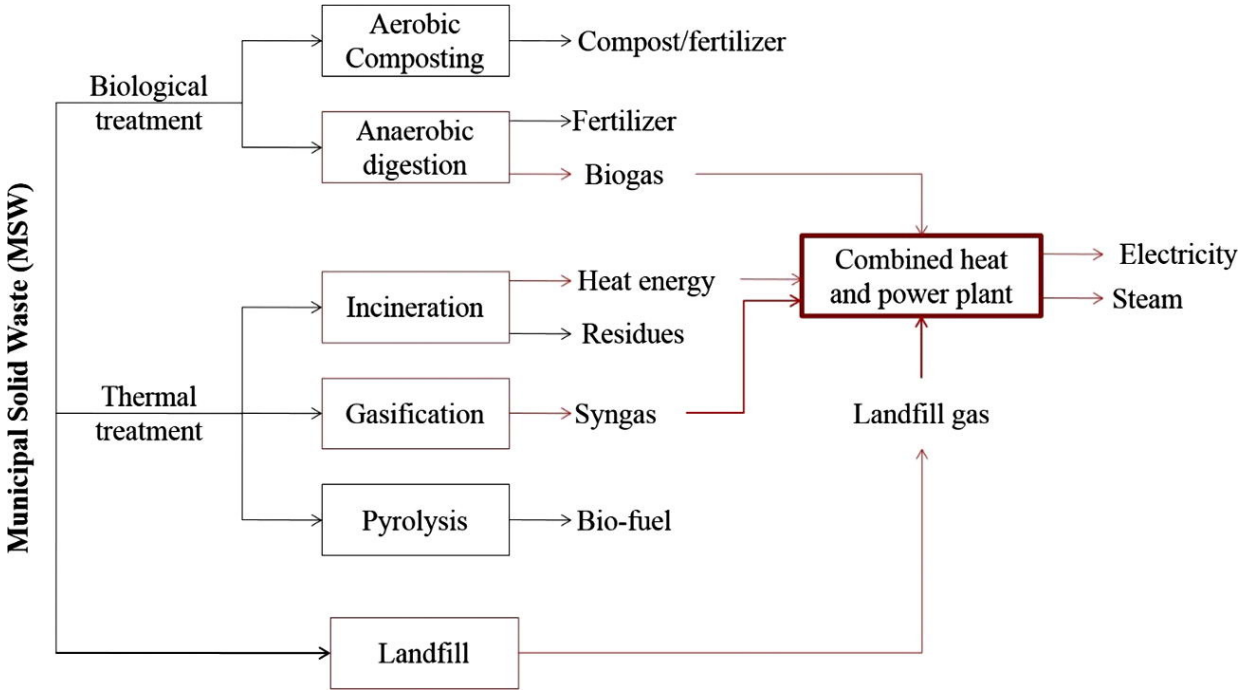
Migration of leachate into groundwater
Water treatment energy intensity increases (Session 5)

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_Aprilia-Aretha_new.pdf

4. Waste Management. Strategies

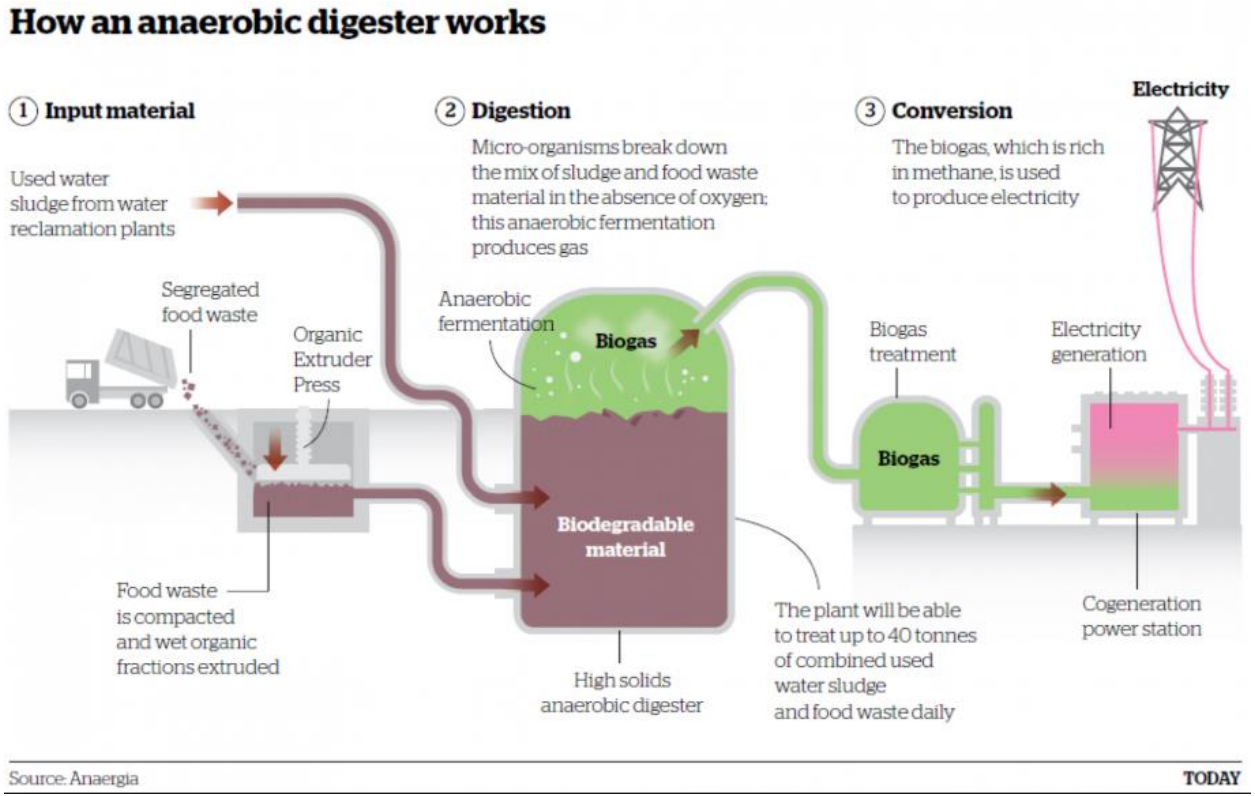


Opportunity for managing waste can also reduce the municipality's net energy consumption.

Source https://www.sciencedirect.com/science/article/pii/S0196890415001156#f0015

DIGESTION

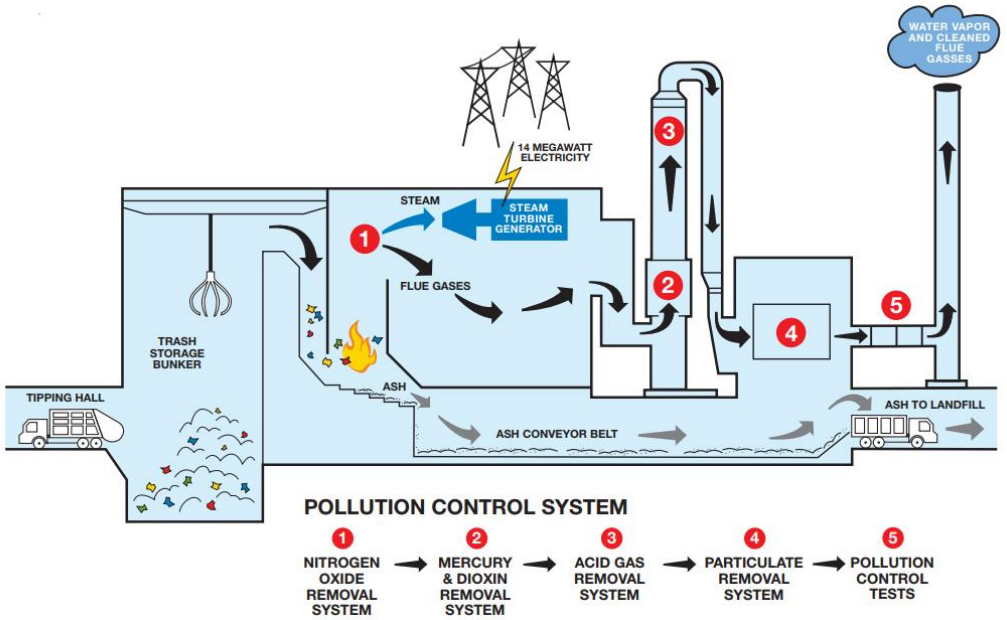
- For municipal waste with high organic wastes, it could be **digested to produce biogas**
- Controlled methane generation for gas networks or cogeneration use
- Requires land space



Source https://www.todayonline.com/sites/default/files/styles/photo_gallery_image_lightbox/public/22695557.PNG?itok=6ws-YEFQ

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

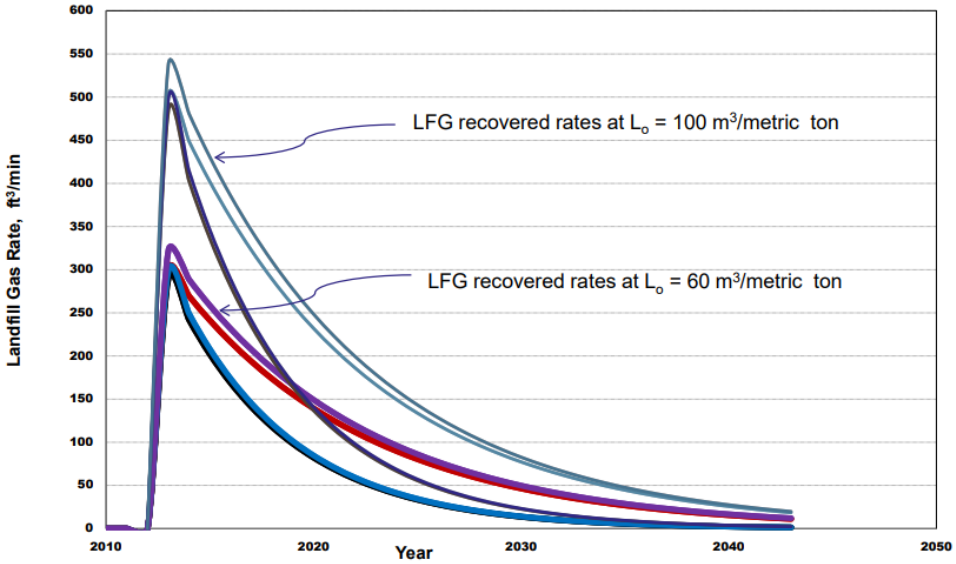
- 90% reduction of trash volume
- Power generation
- Pollution control

ecomaine
www.ecomaine.org

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

4. Waste Management. Strategies

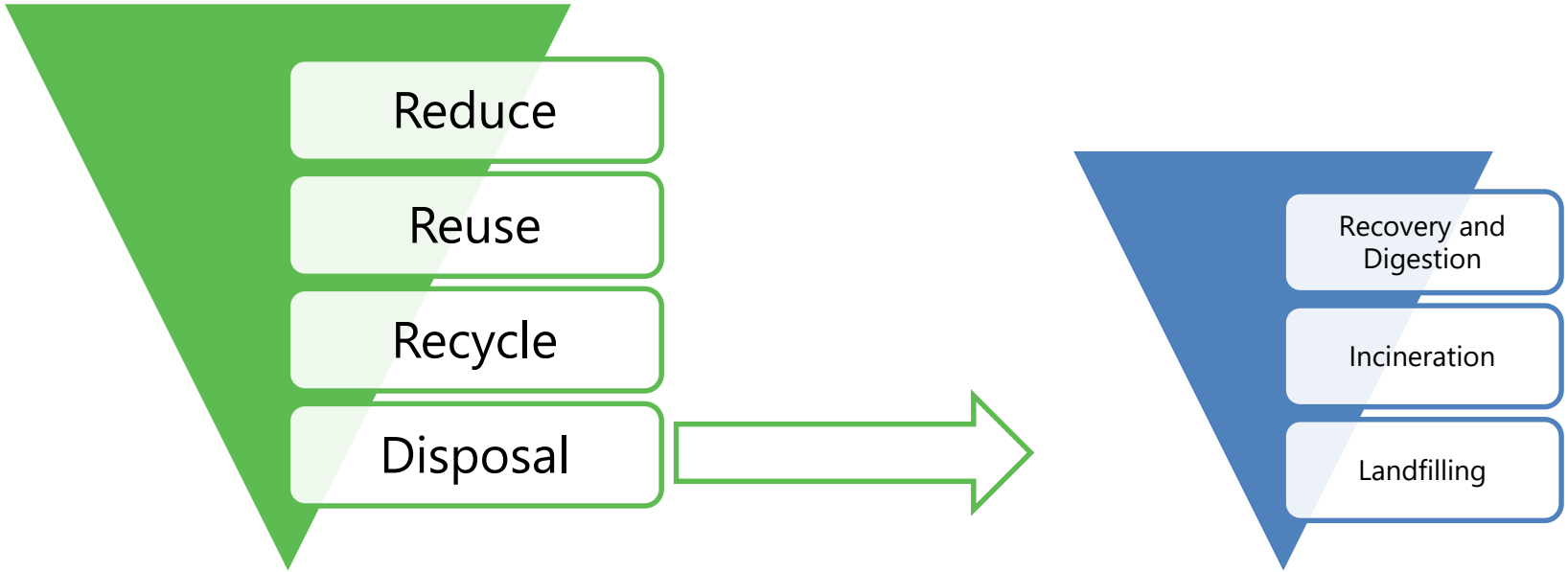
Case Study: Potential of Closed landfill with gas collection (Philippines)



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

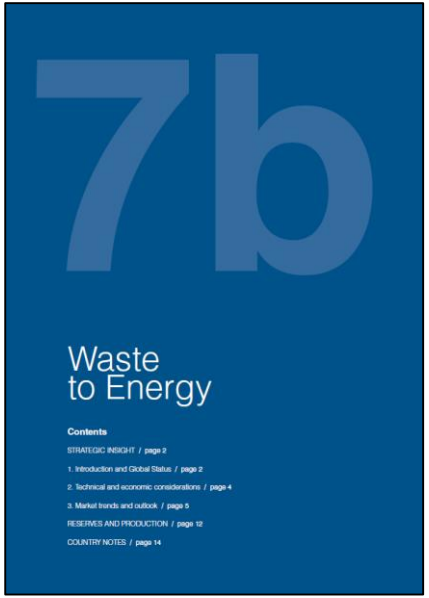
Source https://www.epa.gov/sites/production/files/2016-05/documents/09a_sfeir_presentation.pdf

4. Waste Management. Strategies

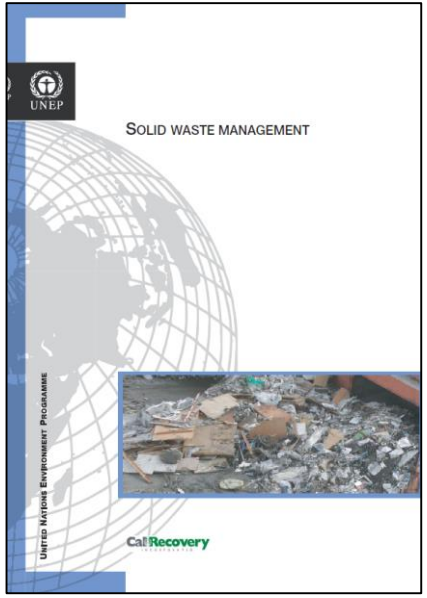


However, aim for reduction. Energy recovery allows reduction of existing waste but will not be a long term solution

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

4. Other urban services

District Energy Systems

4. District Energy Systems. Case for DES

1. **Reduction of peak electricity**

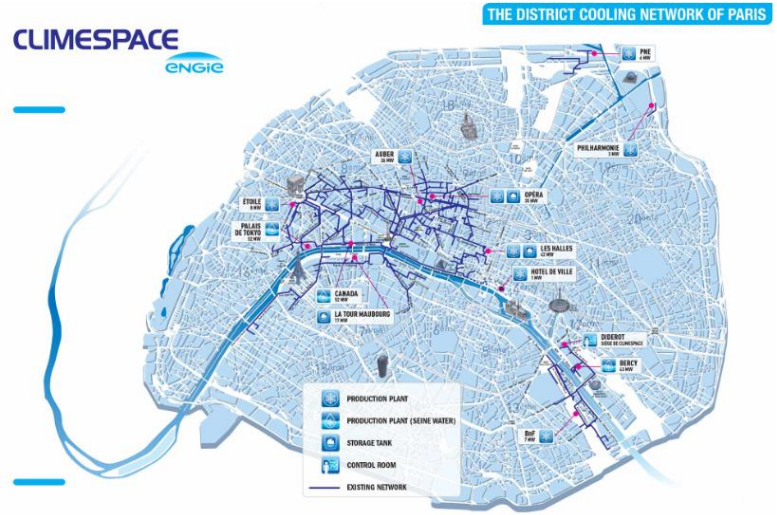
2. **Fuel diversity**
   - Low value heat could produce heating or cooling
   - Could connect with nearby LNG plants for excess cooling

3. **Freed up space for buildings**
   - Could be used for stormwater retention

Source DOI: 10.1007/978-3-642-32081-1_9

4. 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

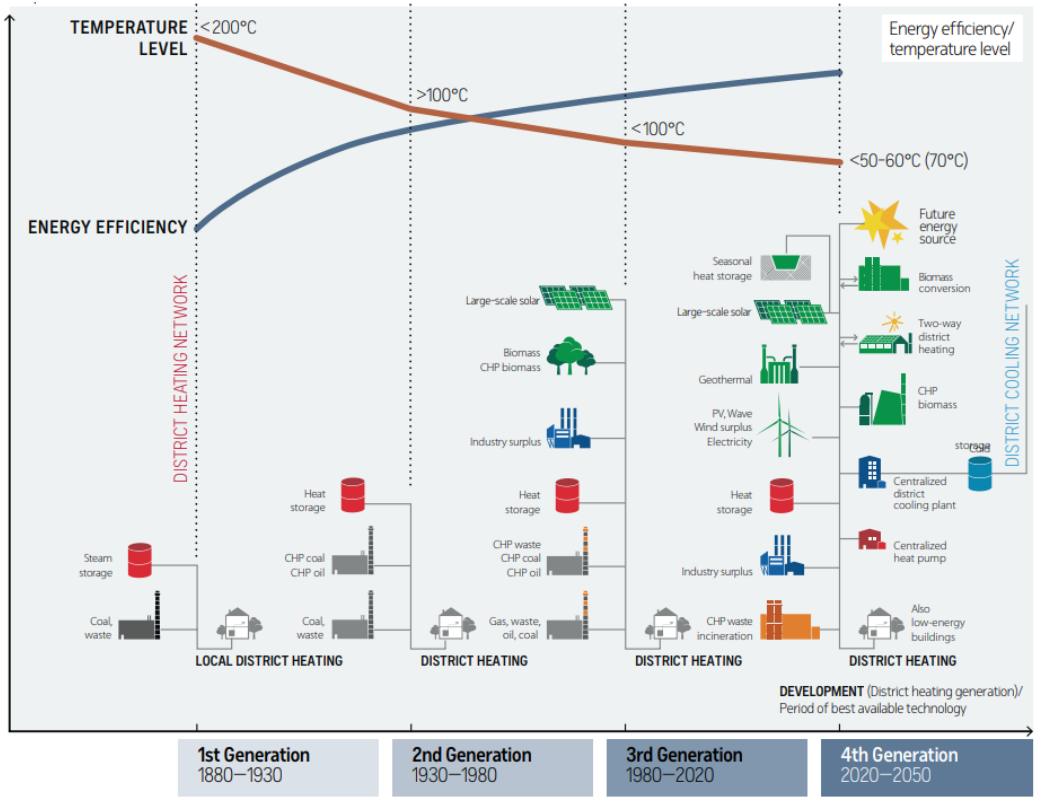
4. District Energy Networks

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

Source https://www.eco-business.com/news/keeping-it-cool-malaysia-looks-to-district-energy-systems/

4. District Energy Networks

Where to start? | Tools | What are the steps?



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_ene.pdf?sequence=2&isAllowed=y

Key Resources. District Energy

https://www.districtenergy.org

http://www.districtenergyinitiative.org/

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THAILAND 2019
ADVANCING PARTNERSHIP
FOR SUSTAINABILITY

International
Energy Agency
Secure
Sustainable
Together

Department of Alternative
Energy Development and Efficiency
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