6. Utilities: Lighting and other urban services

Mel Slade
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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
1. Energy use in lighting
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?

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?

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

Source: https://esmap.org/node/235
2. Strategies for energy efficiency
2. Strategies for energy efficiency

Where to start?

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

Manage systems better

Tools

- Replace lamps with more efficient technologies

Replace technology

What are the steps?

- Install smarter lighting management systems

Install smarter systems

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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](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

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

Source: https://www.slideshare.net/ChristineGupta/2012-hps-comparison
2. Strategies for energy efficiency

Where to start?
Tools
What are the steps?

• **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

Replace technology

• Replace lamps with more efficient technologies

**80%**
Energy use reduction

**2200 tons**
Avoided CO2 emissions

**100$**
Saving per fixture

2. Strategies for energy efficiency

Where to start?

Tools

What are the steps?

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

Replace technology

• Replace lamps with more efficient technologies

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.

![Energy savings by 2020 graph](https://ies.lbl.gov/sites/all/files/lbnl6576e.pdf)

- Incandescent
- Tungsten Halo
- CFL
- Linear fluorescent
- Hg vapor
- SPH
- Metal halide

- current LED
- c-LED % savings

Source: [https://ies.lbl.gov/sites/all/files/lbnl6576e.pdf](https://ies.lbl.gov/sites/all/files/lbnl6576e.pdf)
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?

1. Assess system and set goals
   (Part 1 – Energy use in lighting)

2. Select strategies
   (Part 2 – Strategies)

3. Deliver

4. Monitor and Evaluate
   (later in Session 9)
### 3. Deliver

#### Situation
- Does the municipality have sufficient resources to fund the program itself?
- Are there ESCOs active or planning to be active in the local market?
- Are leasing or private financing programs available?

#### Action
- Allocate funds by establishing budget line item for project
- Negotiate an energy service performance contract with ESCOs
- Determine eligibility criteria and negotiate financing agreements

#### Delivery Model
- Municipal Financing Model
- Private ESCO Model
- PPP Model: Lease to Own Model

#### Examples
- **Quezon City, Philippines**
- **Ontario, Canada (Cities opting for the Design-Upgrade-Transfer model)**
- **AEL, India**
- **EESL in Vizag, India**
- **Ontario, Canada (Cities opting for shared savings EPC model)**
- **Guadalajara, Mexico**
- **Birmingham, UK**

Source: [https://www.esmap.org/node/57252](https://www.esmap.org/node/57252)
## 2. Strategies for energy efficiency. Delivering change

<table>
<thead>
<tr>
<th>Where to start?</th>
<th>Tools</th>
<th>What are the steps?</th>
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</table>

Source: IFC [https://www.youtube.com/watch?v=q0dD_qjRDeE](https://www.youtube.com/watch?v=q0dD_qjRDeE)
3. Activity
### 3. Activity

#### Where to start?

#### Tools

#### What are the steps?

### 3. Deliver

<table>
<thead>
<tr>
<th>Type of Risk</th>
<th>Risk Manifestation</th>
<th>Risk mitigation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical risk</td>
<td>Failure of luminaries</td>
<td>?</td>
</tr>
<tr>
<td>Performance risk</td>
<td>Failure of installed lighting system</td>
<td>?</td>
</tr>
<tr>
<td>Financial risk</td>
<td>Failure to make payments</td>
<td>?</td>
</tr>
</tbody>
</table>

Source: [https://www.esmap.org/node/57252](https://www.esmap.org/node/57252)
3. Activity

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

#### Where to start?

#### Tools

#### What are the steps?

### 3. Deliver

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<th>Risk Mitigation Measure</th>
<th>Example</th>
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</table>
| Technical Risk | Failure of LED luminaires | - Obtain product warranty from LED luminaire manufacturer  
- Extensively test luminaires with external technical assistance  
- Obtain third-party certification of luminaires | Ontario, Canada  
Quezon City, Philippines  
Guadalajara, Mexico |
| Performance Risk | Failure of installed LED system | - 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 | Quezon City, Philippines  
Birmingham, United Kingdom  
EESL in Vizag, India  
Guadalajara, Mexico  
Ontario, Canada |
| Financial Risk | Failure to make payments | - Secure state government guarantees  
- Secure commercial bank guarantees  
- Work with private sector with substantial resources | Guadalajara, Mexico  
AEL, India  
Birmingham, United Kingdom |

Source: [https://www.esmap.org/node/57252](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**
  

- **Efficient public lighting guide (South Africa)**
  

- **Proven Delivery Models for LED Public Lighting**
  
  https://www.esmap.org/node/57252
4. Other urban services

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

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

Where to start?
Tools
What are the steps?

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

Bantar Gebang Landfill, Indonesia

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

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

Source: https://www.sciencedirect.com/science/article/pii/S0196890415001156#f0015
4. 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

4. 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/
Installation of small engine generator set can allow the landfill to sell electricity with IRR of 1%

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

Solid Waste Management
4. Other urban services

District Energy Systems

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

Where to start?

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

Tools

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

What are the steps?
4. District Energy Networks

- 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?

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 substation (also with insolation)
Metering and monitoring

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

Key Resources. District Energy

https://www.districtenergy.org

http://www.districtenergyinitiative.org/