



Where to start:

Energy efficiency potential in municipalities

Municipal and Utility Services: Session 2

John Dulac

New Delhi 10 December 2018

 #energyefficientworld

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:** Enabling public energy efficiency investment
8. **What are the steps:** Enabling 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 and utility services

2. Where to start: Energy efficiency potential in municipalities

Trainer(s): John Dulac

Purpose: To teach the fundamentals and potentials of energy efficiency in different municipal services and areas of municipal jurisdiction.

Scenario: Your municipality has set a target to cut emissions and lower energy spending by 2030.

Question: How can energy efficiency reach these goals?

- 1. Concept of energy efficiency potential**
- 2. What is the potential of energy efficiency in municipal services?**
 - A. Public buildings
 - B. Transport
 - C. Utilities
 - D. Waste
- 3. How do I calculate potential?**

1. Concept of energy efficiency potential

1. Concept of energy efficiency potential

- **Technical potential:** analysing the total energy efficiency potential without any economic or market constraints (e.g. analysing the energy savings potential if all buildings used best available technology)
- **Economic potential:** analysing the energy efficiency potential assuming economic constraints for cost effectiveness (e.g. analysing the energy savings potential if buildings used the most-efficient cost-effective technology)
- **Market potential:** analysing the energy efficiency potential assuming market constraints in implementing energy efficiency (e.g. analysing the energy savings potential using an adoption curve to estimate typical market implementation given the available policies and technologies)

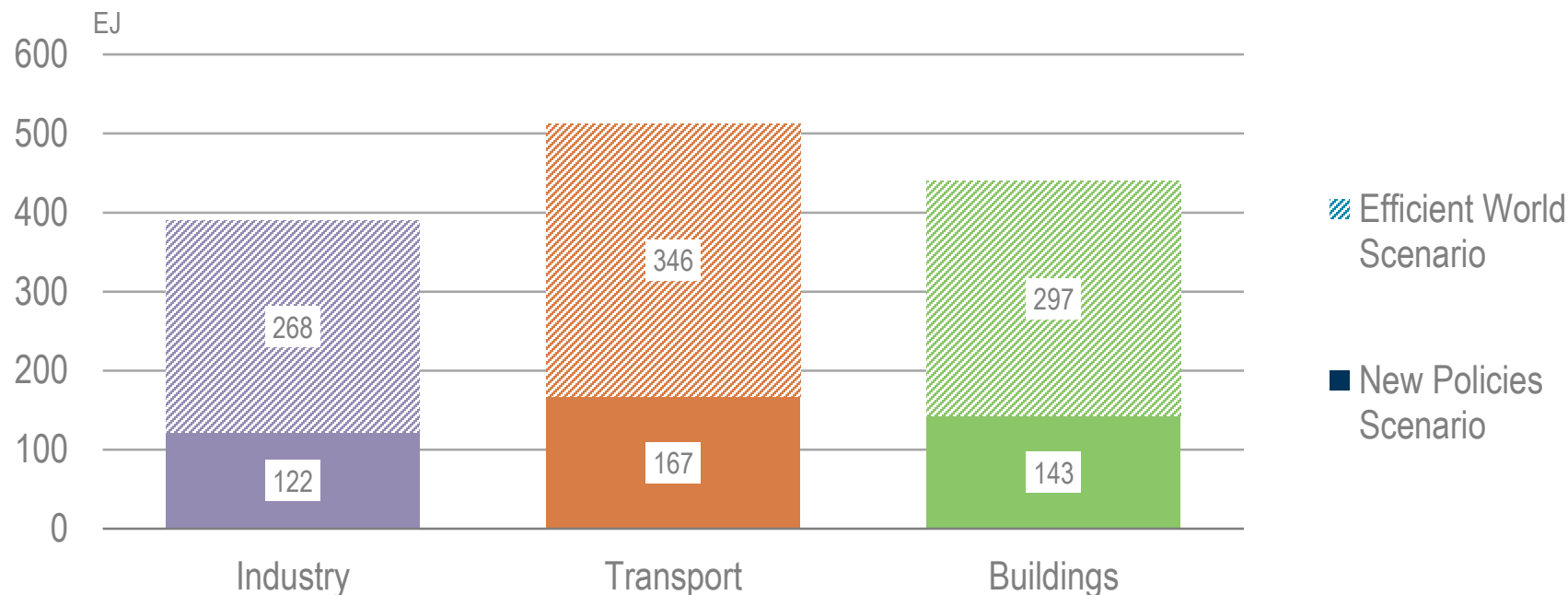
2. What is the potential of energy efficiency in municipal services?

A. Public buildings

Public administration buildings, schools, hospitals, libraries, museums, social housing

2. What is the potential of energy efficiency in municipal services?

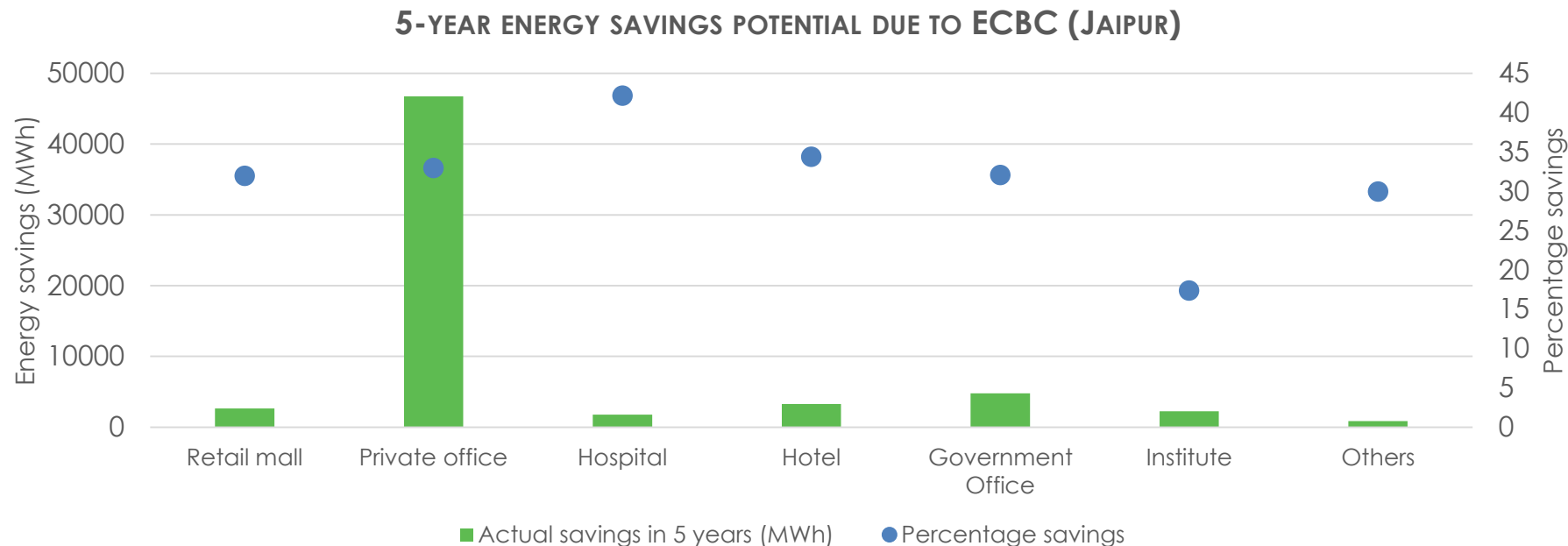
A. Public buildings



68% of the buildings potential is not realised with current trends.

2. What is the potential of energy efficiency in municipal services?

A. Public buildings: India's Energy Conservation Building Code (ECBC)



Enforcement of existing codes can give high energy savings, both in relative and absolute terms

2. What is the potential of energy efficiency in municipal services?

B. Transport

2. What is the potential of energy efficiency in municipal services?

B. Transport

- Potential of **obtaining lower emissions and energy use** based on planning design, influencing transport



East York - 1.31 tCO₂e/cap (residential only)

High-density apartment complexes within walking distance to a shopping center and public transit:
1,31 tCO₂e/capita



Etobicoke - 6.62 tCO₂e/cap (residential only)

High-density single family homes close to the city center and accessible by public transit:
6,62 tCO₂e/capita



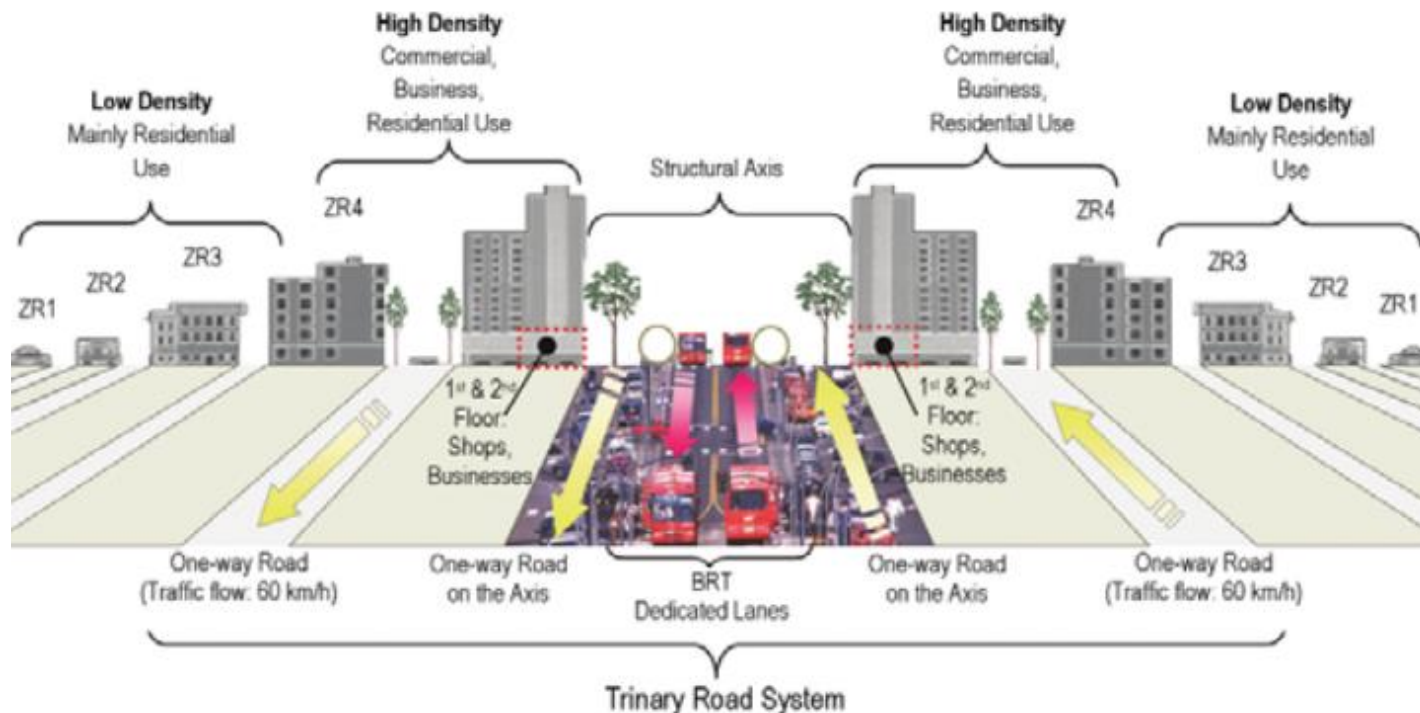
Whitby 13.02 tCO₂e/cap (residential only)

Suburbs with large, low-density single family homes that are distant from commercial activity and public transit:
13,02 tCO₂e/capita

What is the potential of energy efficiency in municipal services?

B. Transport

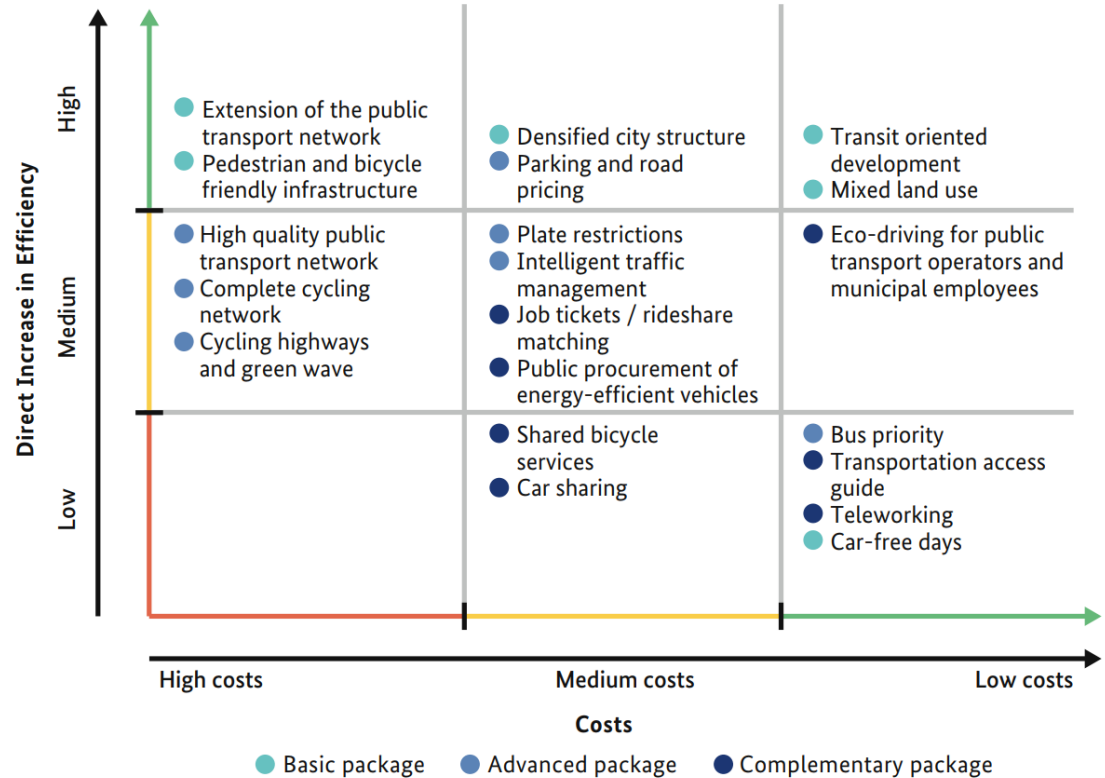
- Land use planning example in Curitiba



2. What is the potential of energy efficiency in municipal services?

B. Transport

- Some transport policies which have high potentials to **increase efficiency at low cost** are handled by municipalities



2. What is the potential of energy efficiency in municipal services?

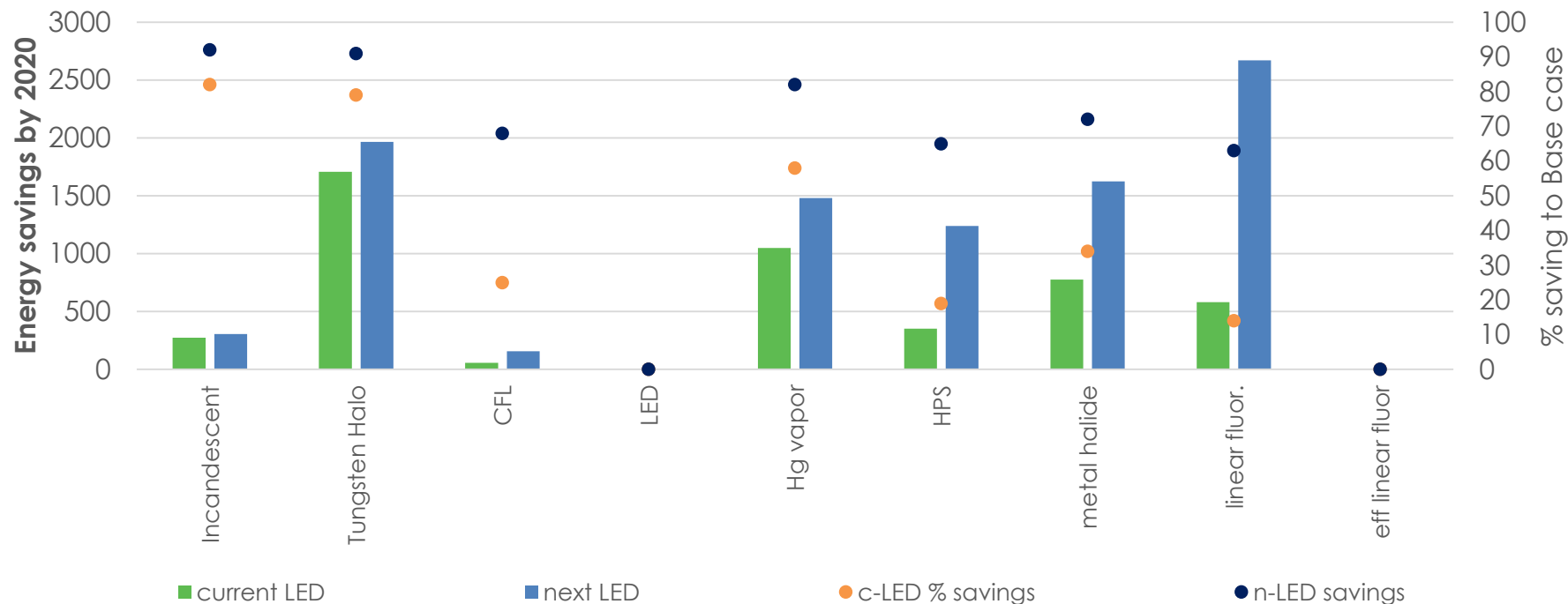
C. Utilities

Lighting, water supply and sewage, energy

2. What is the potential of energy efficiency in municipal services?

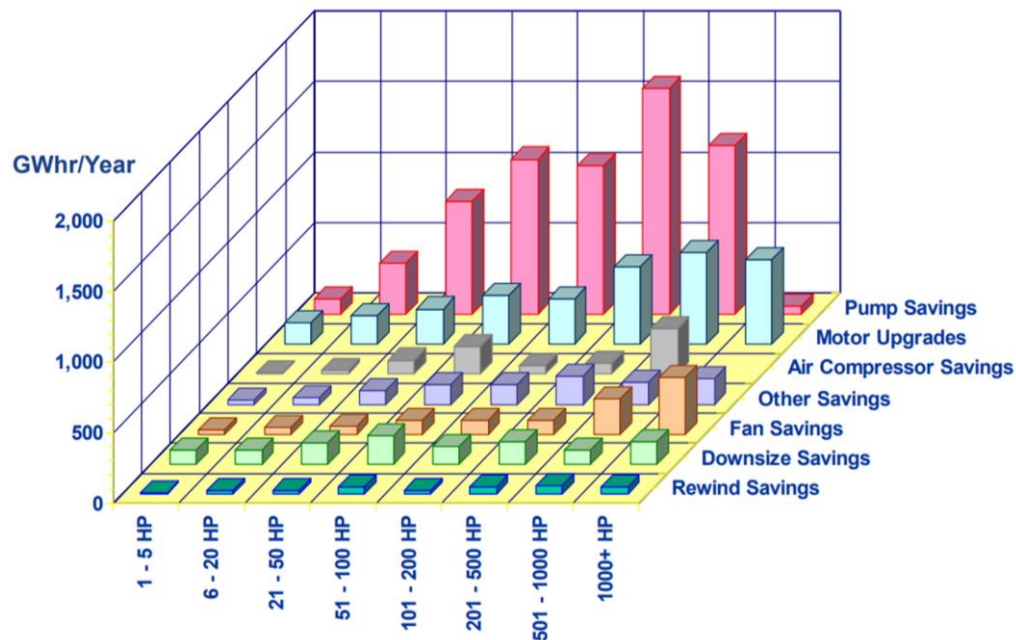
C. Utilities: Lighting

- Potential in India to save on street lighting by 2020 using the current generation and next generation LED lamps in replacing the existing lamp technologies.



2. What is the potential of energy efficiency in municipal services?

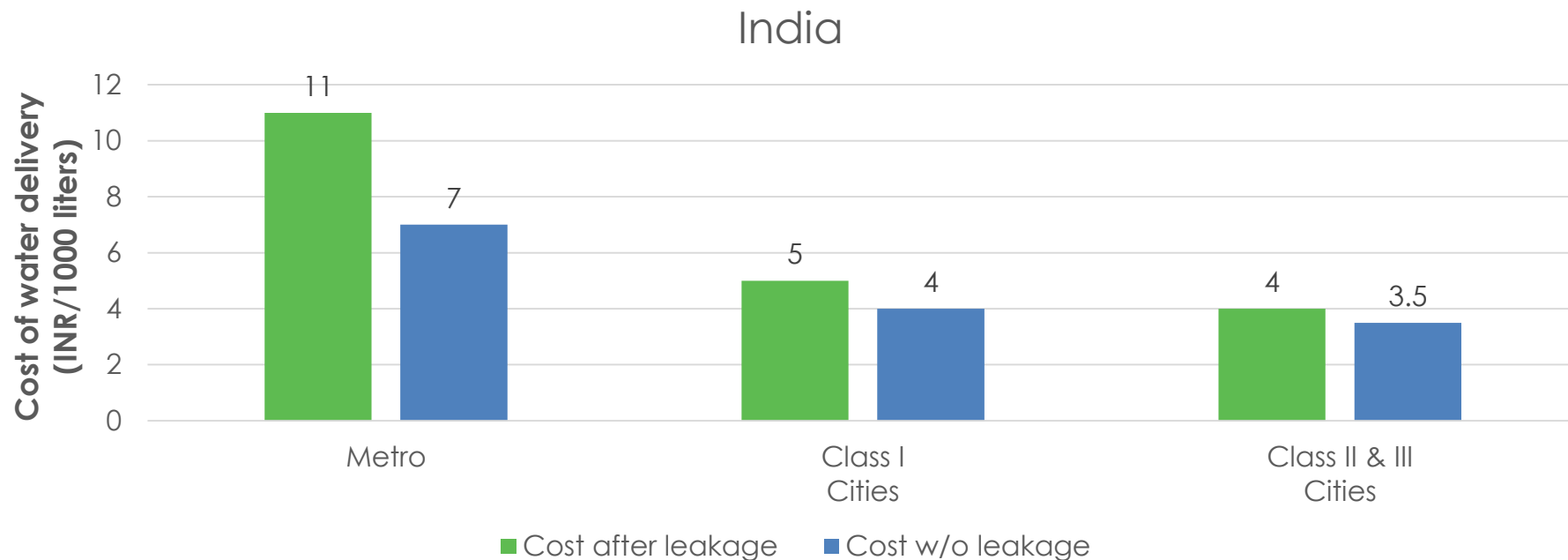
C. Utilities: Water supply – energy savings from motors



Savings based on the sizes of the motors and hours of operation could go up to 1 500 GWhr/yr.

2. What is the potential of energy efficiency in municipal services?

C. Utilities: Water supply – energy and cost savings from leakage

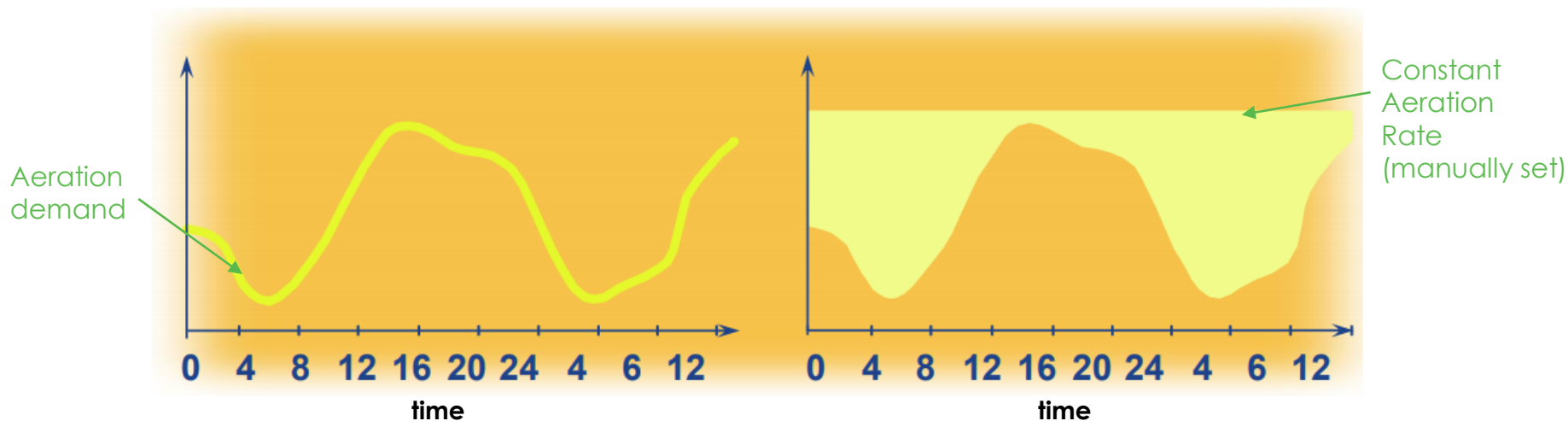


**Leakages increase operation costs due to excess pumping energy use.
In bigger networks in metro cities, the leakages are often larger.**

2. What is the potential of energy efficiency in municipal services?

C. Utilities: Sewage – efficiency

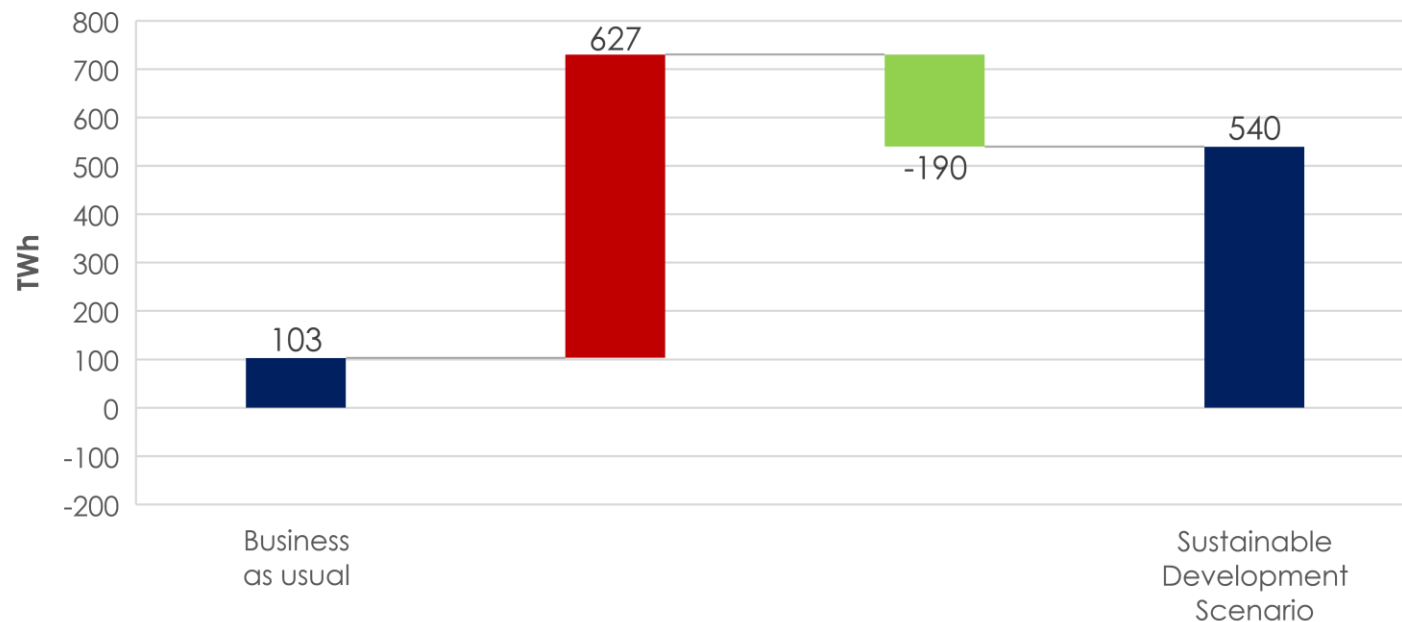
Sewage treatment: Fluctuations in biological load can change over a 24-hr period, hence aeration could be adjusted if it were automatic.



Manual or poor control can cause excess energy use by as much as 50-65%.

2. What is the potential of energy efficiency in municipal services?

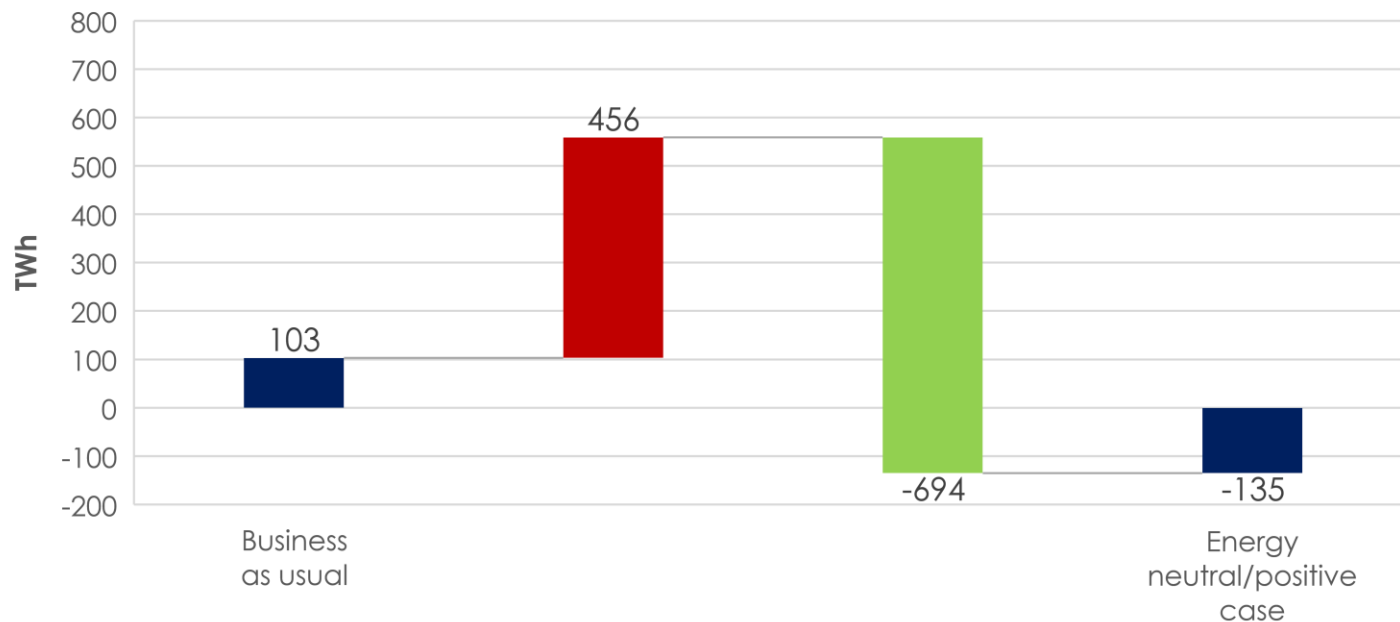
C. Utilities: Sewage – efficiency and then energy recovery



Maximising efficiency in sewage treatment leads to 10% reduction in electricity use by 2030 (IEA SDS).

2. What is the potential of energy efficiency in municipal services?

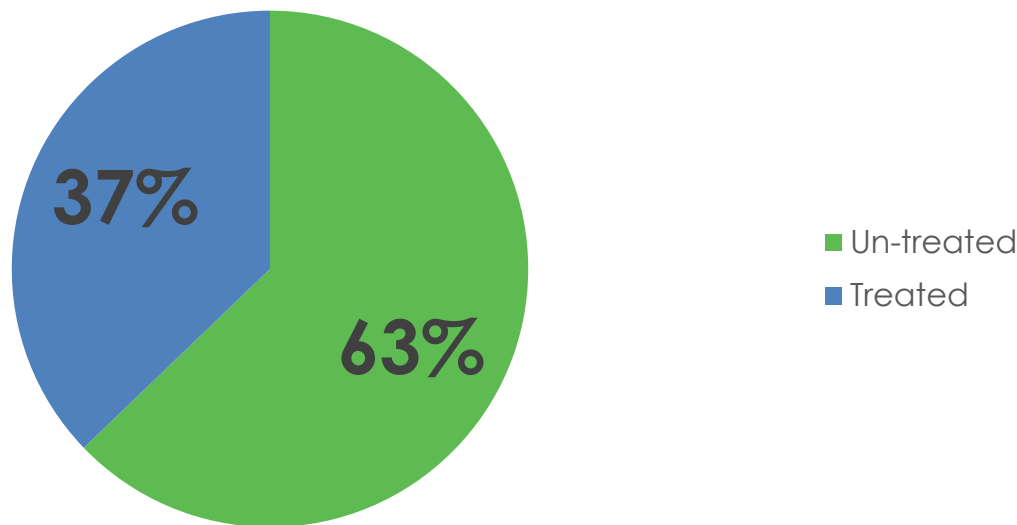
C. Utilities: Sewage – efficiency and then energy recovery



But ramping up energy recovery helps achieve SDG 6.2 (sanitation for all) and SDG 6.3 (halving the percentage of untreated water) by 2030.

2. What is the potential of energy efficiency in municipal services?

C. Utilities: Sewage – current status of India

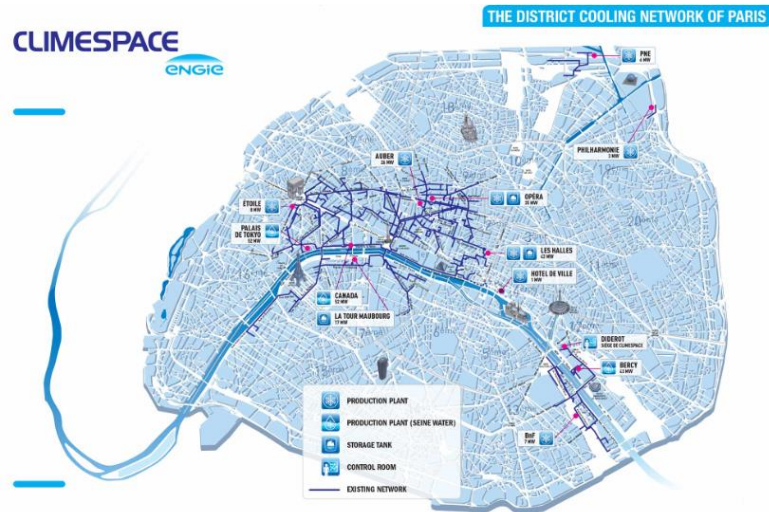


Sewage generation in India in 2016 averaged at 61 754 million liters per day, 63% of which are untreated.

2. What is the potential of energy efficiency in municipal services?

D. Utilities: Energy

- In Paris, district cooling led to:
 - **35% lower electricity** consumption
 - **50% reduction** in CO2 emissions
- In India, a reduction from 240 MW to 135 MW (**44% lower**) in electricity consumption is expected from the GIFT City



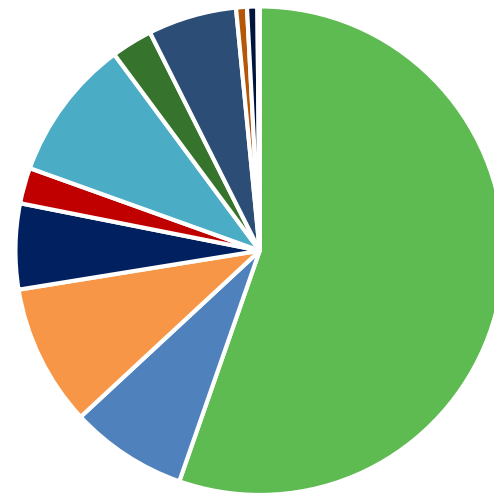
2. What is the potential of energy efficiency in municipal services?

D. Waste

2. What is the potential of energy efficiency in municipal services?

D. Waste

- Sample of solid waste energy recovery potential by combustion in Andhra Pradesh
 - **210 MT** of MSW transported per day
 - Energy recovery potential of **260 000 kWh**
 - Power generation potential of **10.8 MW**

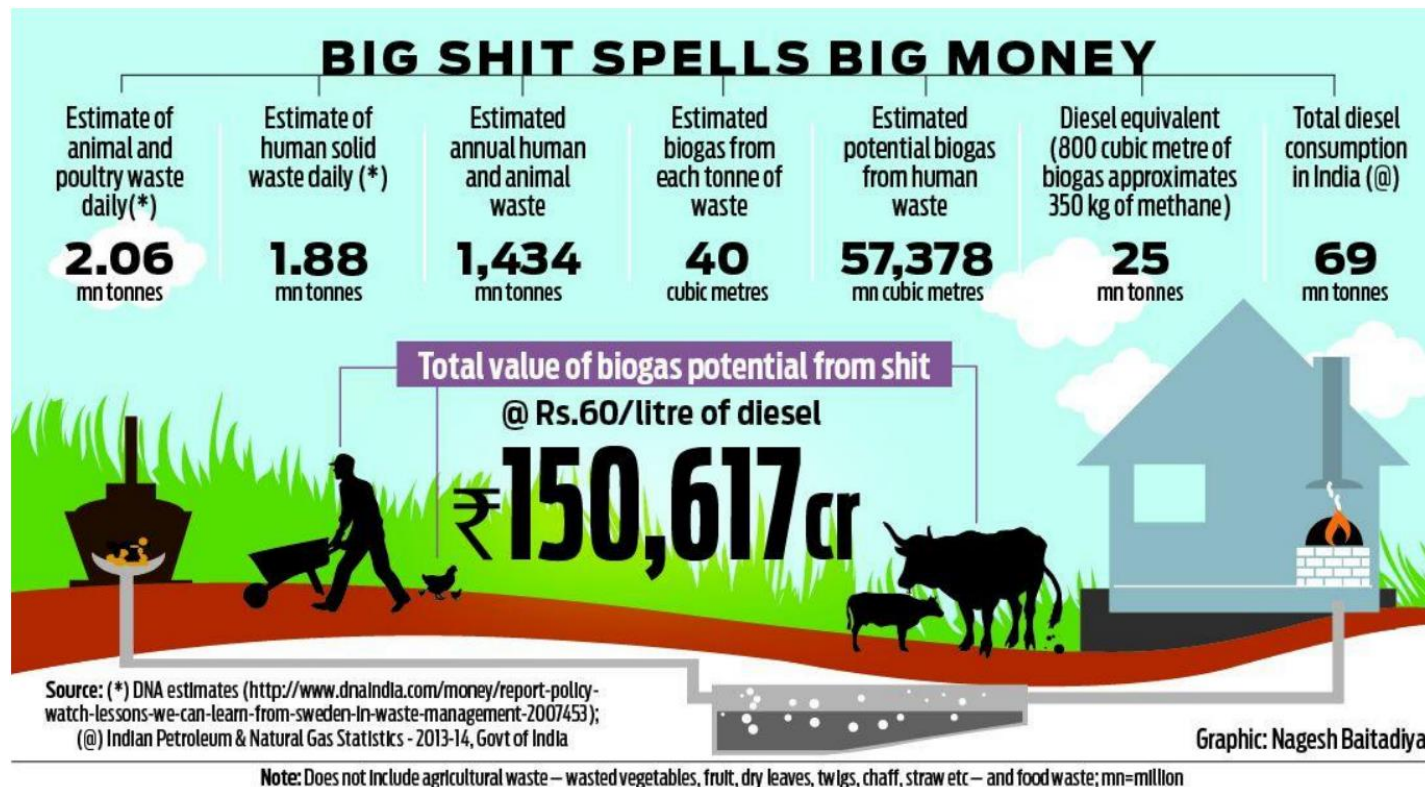


- | | |
|-----------------------|------------------|
| ■ Food waste | ■ Paper |
| ■ Plastics, packaging | ■ Yard trimmings |
| ■ Textiles | ■ Coconut |
| ■ Coconut shells | ■ Dust & mud |
| ■ Diapers | ■ Glass |
| ■ Metals | |

2. What is the potential of energy efficiency in municipal services?

D. Waste

- Value of recovered energy from organic waste turned to biogas



3. How do I calculate the potential?

Available tools for calculating potential

3. How do I calculate potential?

Sector-specific tools

- EnergyPlus (Buildings)
- FEPIT (Fuel Economy Policies Implementation Tool)



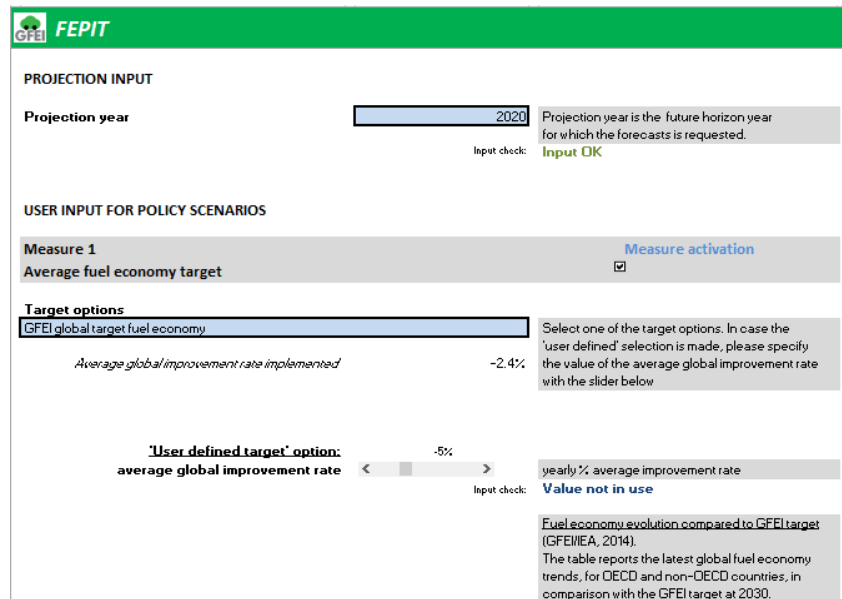
EnergyPlus

EnergyPlus is DOE's whole-building energy simulation engine.

Whole-building Energy Simulation | HVAC System Selection and Sizing | Code Compliance

Last Software Update: 30 September 2015 | Last Entry Update: 12 December 2015

Ratings ★★★★★ | Reviews 0 | [Add to compare](#)



FEPIT

PROJECTION INPUT

Projection year: 2020
Input check: Input OK

USER INPUT FOR POLICY SCENARIOS

Measure 1
Average fuel economy target
Measure activation: ☒

Target options
GFEI global target fuel economy
Average global improvement rate implemented: -2.4%

'User defined target' option:
average global improvement rate: -5%

Fuel economy evolution compared to GFEI target (GFEI/IEA, 2014)
The table reports the latest global fuel economy trends, for OECD and non-OECD countries, in comparison with the GFEI target at 2030.

3. How do I calculate potential?

Sector-specific tools

- EDGE (Buildings)

Creating Markets, Creating Opportunities

Homes

Hospitality

Retail

RESULTS

Final Energy Use

413,048 kWh/Month

Operational CO₂ Savings

0.00 tCO₂/Year

Final Water Use

3,031 m³/Month

Embodied Energy Savings

0.00 MJ/m²

Save

Version 2.1.5

Design

Energy: 0.00%

Water: 0.00%

Materials: 0.00%



Project Details

Project Name*

Number of Distinct Buildings*

Number of EDGE Subproject(s) associated

Total Project Floor Area

0

m²

Project Owner Name*

Project Owner Email*

Project Owner Phone*

Office

eg 0001

Upload project-level documents.

Download project audit documents.

Subproject Details

Subproject Name*

Property Name*

Subproject Multiplier for the Project*

1

Certification Stage*

Select Stage

Status

Auditor

Certifier

Area Details

	Default	User Entry
Bedroom	20	<input type="text"/> m ²
Kitchen	8	<input type="text"/> m ²
Living/Dining	32	<input type="text"/> m ²
Bathroom	6	<input type="text"/> m ²
Utility, Balcony, Service Shaft**		13.60 m ²
Gross Internal Area	80	<input type="text"/> m ²
External Wall Length m/Unit	17	<input type="text"/> m
Roof Area/Unit	8	<input type="text"/> m ²
Window to Floor Ratio	19.8%	
Common Area/Unit	20	<input type="text"/> m ²

3. How do I calculate potential?

Multi-sector tools

• Curb

Municipal Buildings and Public Lighting Data

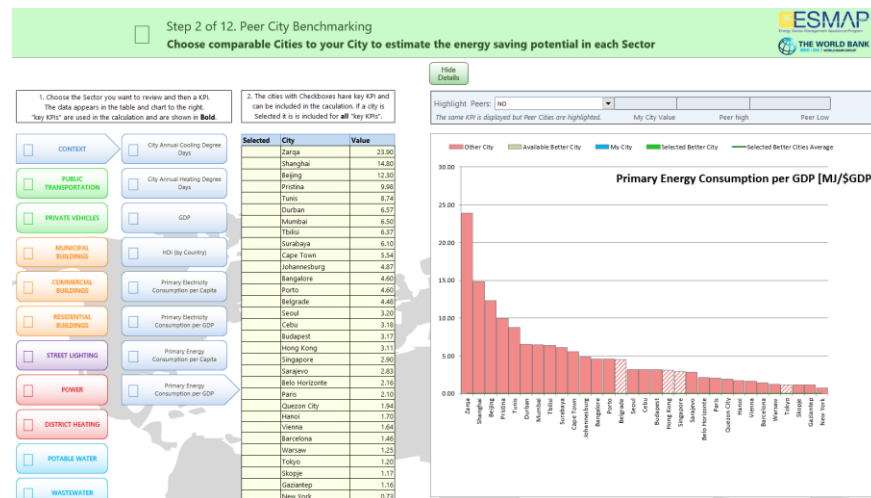
This section asks for information on energy consumption by municipal buildings, streetlights, traffic lights and other types of Baseline Year. This will be used to model energy use and emissions in this sector.

Total Floor Area	Value	Units	Explanation
Office		Square Meters (m ²)	Please estimate the total floorspace (m ²) for municipal buildings

Municipal Building Energy Consumption by Fuel Type	Value	Units	Explanation
Electricity		MWh	Please estimate the amount of annual energy consumed within municipal (i.e. city-owned) buildings for the Baseline year. If other types of energy are consumed please write in the appropriate fuel type in the left column and provide the value of energy consumption in the appropriate cell.
Natural Gas		GJ	
Other		GJ	
Other		GJ	
Other		GJ	

Streetlight Data	Value	Units	Explanation
Total Streetlight Electricity Consumption		MWh	Please state how much energy is consumed by all streetlights in the Baseline Year. Please select units. If alternative units are used, please state in the column to the right.
Average Hours of Streetlight Operation per Day		Average hours/day	Please state, on average, how many hours each day your streetlights run for. The number of hours that streetlights are operated for each day will naturally change throughout the year and from season to season; please provide an annual average for the Baseline Year.
Total Traffic Light Electricity Consumption		MWh	Please state how much energy is consumed by all traffic lights in the Baseline Year. Please select units. If alternative units are used, please state in the column to the right.

Trace



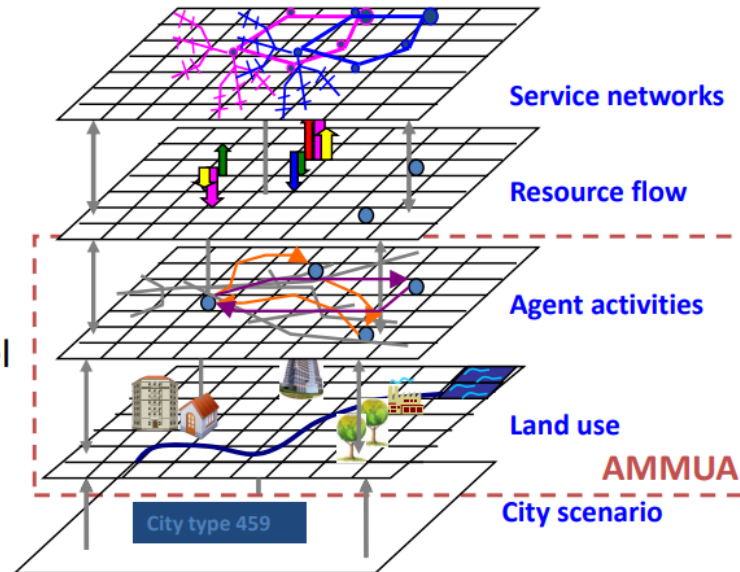
3. How do I calculate potential?

More advanced tools

- SynCity

4 sub-systems

- Layout Model
- Agent-based Micro-simulation Model of Urban Activities (AMMUA)
- Resource-Technology Network (RTN) Model
- Service Networks Design Model



Activity

Back-of-envelop calculations of efficiency potential

Back-of-envelope calculations: Lighting

- **LIGHTING SYSTEM**

- No. of lights: **30 posts, covering 10 m² each**
- Total required lighting output: **60 lumens / m²**
- Operating hours: **12 hrs per day for 365 days (4380 hrs)**
- *Lighting E = $\frac{\text{total lighting output} \times \text{operating hours}}{\text{lamp luminous efficacy}}$*

- **LAMP**

- Current technology: **high pressure mercury vapour, 50 lumens / W**
- Best available technology: **LED, 130 lumens / W**

**How much energy saving in kWhr can you get
in a year if you switched to LED?**

Back-of-envelope calculations: Water

- **PUMPING SYSTEM**

- No. of pumps: **4 pumps @ 400 kPa differential pressure (dP), 0.01 m³/s each**
- Volumetric efficiency: **90% (inherent in pump design)**
- Operating hours: **24 hrs per day for 360 days (8640 hrs)**
- $Pump\ E = \frac{no.\ of\ pumps \times dP \times flow \times operating\ hours}{vol\ eff \times motor\ eff}$

- **MOTOR**

- Current technology: **efficiency 80% @ 40m³/hr**
- Best available technology: **efficiency 90% @ 40m³/hr**

**How much energy saving in MWhr can you get
in a year if you switched to the best available technology?**



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