THE REPORT

SAARC Second Webinar on “Promotion of Energy Conservation in Municipalities of SAARC”

25th July 2019, Islamabad
Organized by SAARC Energy Centre, Islamabad

July 25, 2019
SAARC Energy Centre
697, Street 43, Sector E-11/4 (NPF), Islamabad, Pakistan
www.saarcenergy.org
Introduction

SAARC Energy Centre, Islamabad under its approved program activity for the year 2019 successfully conducted second webinar on “Promotion of Energy Conservation in Municipalities of SAARC” on Thursday, 25th July 2019. Webinar Agenda is available at Annexure – I.

2. Main focus of the webinar was towards techniques and solution to enhance the culture of energy conservation in municipalities. Areas discussed were: Energy conservation opportunities in vehicle routing to collect Municipal Solid Waste (MSW), Waste-to-Energy Options in Municipal Solid Waste Management and Financing Municipal Energy Conservation/ Efficiency Projects. Proven techniques for effective implementation of energy conservation and efficiency in Municipalities were discussed.

Participation

3. The webinar was attended by a total of 25 professionals representing public sector organizations, Academia and private sector from within and outside SAARC region. The Resource Persons from India, Pakistan and Saudi Arabia shared their knowledge pertaining to government policies, existing practices, and international experience in the field of energy conservation in municipalities. The participants list is available at Annexure-II.

Description

4. The webinar was started with welcome remarks by Program Coordinator, Mr. Ihsanullah Marwat, from SAARC Energy Centre. The technical session comprised of presentations by the Resource Person. Each presentation was followed by a brief Q & A session. The program
coordinator read out conclusions, which were gathered during the webinar. Before closing the webinar, the Program Coordinator from SAARC Energy Centre offered remarks of appreciation to all the participants and Resource Persons.

**Technical Proceedings**

5. All the presentations delivered during the webinar are available at SEC’s website [www.saarcenergy.org](http://www.saarcenergy.org). Details of Resource Persons are available at Annexure-III and Presentations at Annexure IV. A brief information on the content of the delivered presentations is as follows:

### Presentation 1 – Vehicle routing to collect Municipal Solid Waste (MSW)

*Expert: Mr. Naveed Anwar, Sustainable Development Study Center, Government College University Lahore, Pakistan.*

6. Mr. Naveed Anwar, teaches Solid Waste management and has hands-on experience in a major solid waste management company in Lahore, Pakistan. He lectured on techniques of vehicle routing to conserve fuel that is wasted on daily basis during collection of municipal solid waste (MSW). In his lecture he covered functional elements, benefits of efficient vehicle routing, importance of transfer stations, and waste treatment techniques.

### Presentation 2 – Waste-to-Energy Options in Municipal Solid Waste Management

*Expert: Dr. Abdul Sattar Nizami, Head, Solid Waste Management Unit, Center of Excellence in Environmental Studies (CEES) of King Abdul Aziz University, Saudi Arabia*

7. Dr. Abdul Sattar Nizami has vast experience in designing and developing feasibility studies of waste to energy projects. He apprised the participants on various waste to energy technologies including both thermal technologies such as Incineration, Gasification, Pyrolysis, Plasma Arc Gasification etc. and Non-Thermal Technologies like Anaerobic Digestion, Fermentation, Transesterification, and Mechanical Biological Treatment (MBT). Dr. Nizami briefed the participants on selection of suitable waste to energy technologies. The expert introduced an interesting concept of Integrated Waste to Energy (WTE) under Waste-driven Factory. In the end he shared Saudi Arabia’s vision 2030 to deal with MSW, explaining the economics and environmental benefits of proposed plans.

### Presentation 3 – Financing Municipal Energy Efficiency Projects

*Mr. Sandeep Kumar Mohanty, PricewaterhouseCoopers Private Limited, India*

8. Mr. Sandeep Kumar is a financial expert in a leading consulting firm. He started his presentation with global investments in energy efficiency in municipal utilities. He discussed about sources of income and expenditures of municipalities and the smart city concept.

9. Mr. Kumar, briefly explained key challenges associated with energy efficiency projects in municipalities. He covered Financing Mechanism in Municipal Energy Efficiency Projects such as Public Funding, Public-Private Partnership and private lending. He emphasized that only through
appropriate selection of financing mechanism, energy efficiency projects can be implemented successfully. He supported the argument by giving examples from USA, Turkey and India.

**W**rap up and conclusion  
*Mr. Ihsanullah Marwat, Research Fellow (Energy Efficiency), SAARC Energy Centre*

10. Mr. Marwat thanked everyone for attending the event. He informed the participants that there is huge multi facet potential for energy saving in municipalities whether its day to day municipal operations or the consumption by the community. Following are main conclusions:

   a. Just by intelligently routing, waste collection vehicles, we can save huge chunk of energy. We can convert major part of municipal solid waste into useful energy. Similar is the case by producing of biogas from solid waste at dump sites, and so on so forth.

   b. The most difficult part in implementing energy conservation in municipalities is financing of investment-oriented projects, particularly in developing world. As proposed by our expert from India, we should prefer collaborative approach with focus on consumers and develop long-term market-based view.

   c. In order to develop the culture of energy conservation, municipalities need to develop, municipal energy conservation strategy to outline where and how key energy saving areas will be achieved in different sectors of the economy. The strategy should also highlight how, when, and by whom, these targets could be achieved. Once the strategy is in place, an internal coordinating energy committee should be established to track the implementation of the strategy.

**Closing of Webinar**  
*Mr. Ihsanullah Marwat, Research Fellow (Energy Efficiency), SAARC Energy Centre*

11. Mr. Ihsanullah Marwat, informed all the participants that the presentations will be available on SAARC Energy Centre’s website (www.saarcenergy.org). He requested the participants to submit suggestions and comments to SEC for any further improvement. They may also suggest and submit any topics of their interest to SEC for arranging future webinars. He closed the webinar with a thank you note to everyone attending the Webinar.
# Program Agenda

**SAARC Webinar-II on “Promotion of Energy Conservation in Municipalities of SAARC”**  
**Thursday, 25th July 2019**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100 – 1110</td>
<td>Introduction</td>
</tr>
</tbody>
</table>
| 1110 – 1140 | Vehicle routing to collect Municipal Solid Waste (MSW)  
Mr. Naveed Anwar, Sustainable Development Study Center, Government College University Lahore, Pakistan. |
| 1140 – 1150 | Q & A session                                                            |
| 1150 – 1220 | Waste-to-Energy Options in Municipal Solid Waste Management  
Dr. Abdul Sattar Nizami, Head, Solid Waste Management Unit, Center of Excellence in Environmental Studies (CEES) of King Abdul Aziz University, Saudi Arabia. |
| 1220 – 1230 | Q & A session                                                            |
| 1230 – 1300 | Financing Municipal Energy Efficiency Projects  
Mr. Sandeep Kumar Mohanty, PricewaterhouseCoopers Private Limited, India |
| 1300 – 1310 | Q & A session                                                            |
| 1310 – 1320 | Conclusions and Recommendations                                         |
| 1320 – 1330 | Closing of Webinar                                                      |

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**Information for the participants:**

1. All times mentioned in agenda are according to Pakistan Standard Time (PKT). The participants from other Member States may attend Webinar by following their own national time. The time conversion for all Member States is given below for reference:

<table>
<thead>
<tr>
<th>Country</th>
<th>Afghanistan</th>
<th>Bangladesh</th>
<th>Bhutan</th>
<th>India</th>
<th>Maldives</th>
<th>Nepal</th>
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<td>(PKT+00:45)</td>
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</table>

2. The participants can ask questions to presenters by typing questions or clicking to the raised hand option into the Attendees pane of the main window of GotoWebinar software. You may send in your questions at any time during the presentations; we will collect these and address them during the Q&A session at the end of each presentation.

3. All participants can also submit comments/views and/or observations on the webinar to SAARC Energy Centre through email to Mr. Ihsanullah Marwat, Research Fellow (EE) ([rfee@saarcenergy.org](mailto:rfee@saarcenergy.org)) before 30th July 2019.
# Annexure-II

## List of Participants

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>First Name</th>
<th>Last Name</th>
<th>Email address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<tr>
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</table>
### List of Experts

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<thead>
<tr>
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<th>Name</th>
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</table>
Presentations Delivered During the Webinar

1. “Vehicle routing to collect Municipal Solid Waste (MSW)” by Mr. Naveed Anwar
   Sustainable Development Study Center, Government College University Lahore, Pakistan

   **Role of Vehicle routing to collect MSW in energy conservation in municipalities**

   M. Naveed Anwar
   Sustainable Development Study Center
   Government College University, Lahore.

   **Major Problems of South Asian Region**

   - Waste Management
   - Energy Crisis
   - Air Pollution
   - Climate Change
   - Smog Episodes
   - Dependence on Fuel (mostly imported) for the energy mix
   - Traffic Congestion
Municipal Solid Waste Management

- Six Functional Elements
  - Generation
  - Collection
  - Storage
  - Transfer and Transfer Station
  - Treatment and Recovery
  - Disposal

- Importance of Efficient MSW Management to reduce Routing

Vehicle Routing – A brief Intro

- Importance of Vehicle Routing in context of
  - Energy Conservation
  - Air Quality Improvement
  - Coping up with Traffic Congestion
  - Cost Saving
Rules for Heuristic Routing

- Route should not be fragmented or overlapping. Each route should be compact, consisting of street segments clustered in the same geographical area.

- The collection route should be started as closed to garage or motor pool as possible.

- Heavily traveled streets should not be collected during rush hours.

- Services on dead end streets can be considered as services on the street segments that they intersect, since they can be collected only by passing down that street segment...
Rules for Heuristic Routing (Cont.)

- The dead end streets must be collected by walking down, backing down, or making a U-turn.

- When practical, steep hills should be collected on both sides of the street when the vehicle is moving downhill, for safety, ease, speed of collection, reduced wear on vehicle, and conservation of gas and oil.

- Higher elevations should be at the start of the route.

- Backing up should be avoided as much as possible. Streets where there is no garbage is to be collected should also be avoided.

Rules for Heuristic Routing (Cont.)

- The collection route should be ended as close to the waste final destinations as possible.

- Streets should be traveled only twice if only one side of a street is picked up a time. If both sides are collected at the same time, streets should be traveled only once.

- For certain block configurations within the route, and in the case of collection from one side of the street at a time, the specific routing patterns should be applied.
Figure 3-12  A sample routing for a collection truck.
Transfer Stations

- A transfer station is a facility situated locally to the collection area where collection vehicles can discharge their load so that it can be reloaded onto large vehicles for economic transportation to disposal site.

TRANSFER STATIONS

When the waste disposal unit is remote to the collection area, a transfer station is employed. At a transfer station, waste is transferred from smaller collection vehicles to larger transfer vehicles, such as a tractor and trailer, a barge, or a railroad car.

Transfer stations can be quite simple, or they can be complex facilities. The design of the facility is based on its intended use with small transfer stations typically relying...
Transfer Stations (Cont.)

Two main types

- Those that serve short range primary collection vehicles usually non-motorized and small capacity motorized vehicles including auto-rickshaw and dumper trucks. Sometimes called transfer points.

- Those that serve larger, usually motorized vehicles such as conventional waste collection trucks which may bring waste to the transfer station after secondary collection.
Need for Transfer Stations

A. General
Used when:

– Direct hauling to the processing center or disposal site is no long economically feasible.

– When the disposal site or processing center is in a remote location and cannot be reached directly by highway.

• According to WHO: depending upon the collection vehicle, a round trip of less than one hour from the collection round makes direct transport more economical. With larger trip times, transfer loading and bulk transport may be cheaper as well as releasing the collection crew

Economics of Transfer Station (Cont.)

• Costs Associated with Transfer Station Analysis.
  – Cost of haul in small vehicles
  – Cost of haul in large vehicles
  – Capital cost of transfer station
  – Operating cost of transfer station
  – Benefit from other activities e.g. recycling and recovery
Transfer Station Design Requirements and Location (Cont.)

- Location of Transfer Stations
  - Near as possible to the weighted center of the areas to be served. Locate as to minimize transportation cost.
  - Within easy access of major highway routes.
  - Where there will be minimum public environmental objections.
  - Where construction and operation will be most economical.

*Figure 3-17: Break-even point of transfer stations.*
Types of Transfer stations (for motorized vehicles)

- direct load
- storage-load
- combined direct-load and discharge load

Direct-Load Transfer System

- The wastes in the collection vehicles are emptied directly into:
  - The vehicle that will transport the wastes to the final disposal site
  - Into facilities to compact the wastes into transport vehicles or
  - Into waste bales.

- In some cases, the waste may be emptied onto an unloading platform and then pushed into the transfer vehicles, after-recyclable materials have been removed.
Storage-Load Transfer System

- Wastes are emptied into a pit or unloading area as opposed to the transfer vehicle. The pit is typically a larger area and thus facilitates unloading of collection vehicles and shortens waiting time. Auxiliary equipment such as pay loaders moves the material from the storage area into the transfer vehicle. The storage time is typically 1-3 days.

Combined Direct-Load and Discharge Load Trans. Stations

- Usually a multipurpose facility

Waste Treatment at Block Levels and Vehicle Routing

- Comparison of systems
  - transporting waste from each block of city to one disposal point with
  - Having efficient treatment and recovery systems at block level to yield
    - Biogas
    - RDF
    - Compost
    - Manure
    - Recycling material
    - Reusable Material
    - Energy through Incineration
Quotes about Climate Change


“The violence that exists in the human heart is also manifest in the symptoms of illness that we see in the Earth, the water, the air and in living things.”

Pope Francis on climate change
2. “Waste-to-Energy Options in Municipal Solid Waste Management” by Dr. Abdul Sattar Nizami, Head, Solid Waste Management Unit, Center of Excellence in Environmental Studies (CEES) of King Abdul Aziz University, Saudi Arabia.

Waste-to-Energy Options in Municipal Solid Waste Management

Dr. Abdul-Sattar Nizami
Head of Solid Waste Management Research Unit, Center of Excellence in Environmental Studies (CEES), King Abdulaziz University, Jeddah, Saudi Arabia

Associate Editor, Renewable & Sustainable Energy Reviews - Elsevier (IF 10.556) for Bioenergy, Waste to Energy, and Biomass

The current world population of 7.2 billion is projected to reach up to 8.2 billion in 2025 with current annual growth rate of 1%.

The Asia, Middle East, Africa and Latin America are the places, where most of this growth will occur due to rapidly growing industries and urbanization.

The energy demand will increase significantly in developing countries, especially in Asia with an increase of 46-58% at annual rate of 3.7% till 2025.

Fossil fuels are the most relied source at the moment to meet the world’s energy demands.

The intensive and solely utilization of fossil resources are not only depleting our natural reserves but also causing global climate change.
The generation rate of municipal solid waste (MSW) will increase from 1.2 to 1.5 kg per capita per day in next 15 years.

Globally, around 2.4 billion tons of MSW is generated every year that will reach up to 2.6 billion tons by 2025.

In cities of developing world, MSW is the city’s single largest budgetary item.

The sustainable disposal of MSW is still at infancy level in most of the developing countries.

The current waste management in developing world include waste collection and disposal of the collected waste to dumpsite or landfill sites without any treatment.

The actual collection of waste from the cities is only 60% of generated waste, while the remaining waste lies in the empty plots, street sides, along road, railway lines, drains, and low areas.

The infrastructure and maintenance facilities for MSW vary according to the economy of the area.

What to do with so much waste?

The MSW can be a cheap and valuable source of renewable energy, recycled materials, value-added products (VAP) and revenue, if properly and wisely managed.
Best Waste Management Practice

Integrated Solid Waste Management (ISWM) System

Concept of Waste-to-Energy (WTE)

- The concept of waste to energy is known as one of the several energy recovery technologies capable of benefitting a society that wants to cut its fossil fuel addiction.

- The possibilities for converting waste-to-energy (WTE) are plentiful and can include a wide range of waste sources, conversion technologies, and infrastructure and end-use applications.

- Several WTE technologies such as pyrolysis, anaerobic digestion (AD), incineration, transesterification, gasification, refused derived fuel (RDF) and plasma arc gasification.

- The integrating of waste with the generation of energy will provide a solution to the developing world’s challenge of waste disposal with energy supply.
Types of Waste to Energy Technologies

Thermal Technologies
- Incineration
- Gasification
- Pyrolysis
- Plasma Arc Gasification

Non Thermal Technologies
- Anaerobic Digestion
- Fermentation
- Transesterification
- Mechanical Biological Treatment (MBT)

Choice of WTE technology

- Waste type and amount
- Amounts of gas emissions from WTE technologies
- Local recycling and waste disposal practices
- Environmental and economic benefits
- Local weather and other factors
- Public awareness and behaviour
- Required form of energy
- Local energy market and labour skills
## Annexure - IV

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<th>Agricultural waste</th>
<th>Animal waste</th>
<th>Industrial waste</th>
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<td>Fats</td>
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<td>Tallow</td>
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<td>Pulping liquors</td>
<td>What and rice straw waste</td>
<td>Blood</td>
<td>Meat processing waste</td>
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<td>Wood chips</td>
<td>Manure</td>
<td>Wastewater from sugar or toffee industry</td>
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<td>Sawdust</td>
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<td>Construction and demolition waste</td>
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### Single Waste Factory

### Why Integration of WTE Technologies?

- **Can any of the Waste to Energy technology achieve the zero waste concept?**
  - Yes, biorefineries can achieve the zero waste concept.

- **Is any of these technologies capable enough to compete other renewable-energy sources such as wind, solar, etc.?**
  - Yes, biorefineries can compete with renewable-energy sources.

- **Is any of the conversion technology can replace the fossil fuel substantially and immediately?**
  - Yes, biorefineries can replace fossil fuels.

- **Intergradation of energy recovery technologies under a waste-driven factory.**
  - Yes, biorefineries can integrate with waste-driven factories.
Integrated WTE technologies under Waste-driven Factory

- There is no energy or recovery facility exits in KSA.
- Most of the collected municipal waste is disposed to landfill or dump sites untreated.
- The recycling of metals and cardboards is the only waste recycling practices, which is around 10-15% of the total MSW.
- The problems of GHG emissions, and groundwater and soil contamination along with public health issues are occurring in the waste-disposal vicinities.
- Every year, around 15 million tons of MSW is generated in KSA with an average rate of 1.4 kg per capita per day.
- The food and the plastic waste are the two largest waste streams that collectively add up to 70% of total MSW.
- My Solid Waste Research Unit has examined the appropriate WTE technologies for Saudi Arabia according to the local waste composition and energy contents.
VISION 2030 – Saudi Arabia

- Improving efficiency of waste management
- Recycling projects
- Reducing all types of pollution
- Utilizing treated and renewable water
- Localizing renewable energy
- We still lack a competitive renewable energy sector at present
- Initial target of generating 9.5 gigawatts (GW) of renewable energy
- Millions of SAR in funding for waste to energy projects

Waste-based Factory in Makkah
Economic and Environmental Benefits of Waste Recycling in Makkah

There are significant economic and environmental benefits for the Makkah city by recycling only 12.21% of Makkah’s municipal solid waste, including the recyclable materials such as:

- Cardboard (6.6%)
- Glass (2.9%)
- Metals (1.9%)
- Aluminium (0.81%)

It is theoretically estimated that up to 140.1 thousand Mt. CO2 eq. global warming potential (GWP) will be achieved with savings of 5.6 thousand tons emission of CH4.

A net revenue of 113 million SAR will be added to the national economy every year only from recycling practices in Makkah city.

A total net revenue of 758 million SAR can be generated from:
- landfill diversion (530.4 million SAR)
- electricity generation (181.6 million SAR)
- recycling (45.5 million SAR).

1.95 million barrels of oil and 11.2 million mcf of natural gas can be saved with a cost savings of 485.5 million SAR.

---

Pyrolysis Process (Plastic waste)

- High temperature (300-600 °C)
- No oxygen
- Liquid oil, char and gases products
- Different feedstocks can be used
- We can use different catalysts to improve process

Two-Stage Batch Pyrolyzer System
Benefits of Waste-Based Factory

Research and Development

Improving Public Health

Renewable Energy and Valuable Products

Solving Waste Problems

New Businesses and Job Creation

Minimizing Environmental Pollution

Conclusions and Recommendations

Increasing energy consumption has exerted great pressure on natural resources and results in significant GHG emissions in developing countries.

This has led to a move towards sustainable energy production, mainly from the non-food biomass, including forestry and agricultural residues and industrial and municipal organic waste.

The commercialization of WTE technologies are expected in near future due to continuous improvement in process technologies with reduced process costs, governmental subsidies and generation of multiple energy and valuable products.

The Life Cycle Assessment (LCA) based studies on the integrated waste-based biorefinery will provide a knowledge base platform for academics and industries about technical, economic and environmental benefits and limitations of the conversion technologies.

Recycling is considered to be a key component of modern waste reduction practices to reduce the GHG emissions and environmental impact of waste.

A case study of KSA showed potential economic and environmental benefits of developing integrated waste-based biorefinery in the country.
Specialised Training for GAMEP Environmental Inspectors (2017-2018)

- Gave in-depth trainings to prepare the graduated environmental inspectors for Masters degree course in UK.
- The training was given in lectures format with some basic laboratory skills.
- The group was around 30-40 male students and 10-15 female students.
- Both groups from 2017 and 2018 are in UK doing their masters degrees in environmental and renewable energy related topics.

Course Modules

1. Integrated Waste Management System
   - Solid waste Management
   - Municipal Waste Management
   - Industrial Waste Management
   - Waste to Energy Technologies
   - Waste Based Biorefineries
   - Landfilling
   - Reduce, Reuse and Recycling (3 R concept)
   - Construction and Demolition Waste Management
   - Hospital Waste Management
Course Modules

2. Sustainability

- Introduction to Sustainability
- Sustainable Construction Activities
- Sustainable Resource Management
- Smart Buildings
- Sustainable and Resilient Cities

Solid Waste Management in Jeddah and Dammam (P 143450)

World Bank, United States of America (USA)

- NATIONAL COMPREHENSIVE WASTE MANAGEMENT STUDY
- Solid Waste Management in Jeddah and Dammam
An Overview of the Waste Management Sector in the Kingdom of Saudi Arabia

White policy paper. Averda, United Kingdom (UK)

Closure and Post-Closure Plan for Waste Management Facilities in Abqaiq Area

Saudi Company for Environmental Works Ltd. (SEW), Saudi Arabia
West Asia Solid Waste Outlook Report

UNEP supported document
Centre for Environment and Development for the Arab Region and Europe (CEDARE)

Chapter 2: Waste Management – Regional Status

Chapter 3: Specific Regional Features (Hajj & Ramadan)
National and International Reviewer, and Auditor

King Abdulaziz City of Science and Technology (KACST)

National Research Agency (ANR) of France

Government Agency of National Science Centre, Poland

Freelance Writer in Electronic and Printed Media

**Newspapers**
- Arab News
- Saudi Gazette
- Makkah-Al-Mukarmmah

**Magazines**
- Forbes Magazine
- EnviroCities

**Blogs**
- EcoMENA
- BioEnergy Consult
Collaboration Established with National and International Institutions

Thank You So Much
3. Financing Municipal Energy Efficiency Projects by Mr. Sandeep Kumar Mohanty, PricewaterhouseCoopers Private Limited, India

Financing Municipal Energy Conservation/ Efficiency Projects

July 2019

Contents

Overview of Municipal Energy Efficiency 3
Key Challenges – Implementation of Energy Efficiency Projects 8
Financing Mechanism in Municipal Energy Efficiency Projects 10
Way Forward 18
Overview of Municipal Energy Efficiency

In 2017, global investments in Energy Efficiency grew by 3% to USD 236 billion

- **Indoor Lighting**: replacement of inefficient lighting system and fixtures with energy-saving and efficient lamps such as LEDs, CFLs, etc.
- **Public Lighting**: replacement of inefficient mercury vapour lamps with high quality LEDs and installation of lighting controllers
- **Building Retrofit**: installation of efficient boilers and chillers, insulations, and development of energy management system
- **Municipal Utilities**: reduce losses via adopting state-of-the-art technology to build a robust municipal infrastructure

- Due to low cost and shorter payback period, Indoor lighting projects are implemented by municipalities using budgets allocated by the state or central govt. or both.
- Utility infrastructure projects require heavy investments and hence rely on govt. budget, loans from banks and international development finance institution such as ADB, World Bank, IFC, etc.
- Weak credit and limited borrowing capacity of the municipal utilities limits the number of financing options to Budget Financing and Energy Efficiency Funds such as EEEF, NEFCO (Finland), VCFEE (India), etc.

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Assessment of Energy Efficiency Projects

- Rising energy prices
- Increase in population
- Increased water demand
- Increasing GHG emissions

End goal of EE Projects
- Reduced cost of energy
- Improve delivery of services
- Renovation of existing systems
- Increase in revenue

Project feasibility
- Cost of capital
- Cost efficiency
- Sensitivity analysis
- Best solution to the identified problem
- In-depth analysis of the market

Type of contracts
- Energy service: ESCO model (Guarantee and shared savings)
- Turnkey projects: Municipality borrows from financial institutions or self-financed

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Expenditure and Source of Income for Municipalities

Revenue streams
- **Assigned Revenue**: Profession tax, surcharge on stamp duty, entertainment tax, motor vehicles tax
- **Own Non-tax Revenue**: municipal fees, sale and hire charges, user charges, lease amounts
- **Own Tax Revenue**: property tax, vacant land tax, tax on animals, taxes on carriages and carts, advertisement tax
- **Borrowings**: Loans undertaken by the municipalities largely from state and central govt., banks, municipal bonds, pension funds and insurance firms.
- **Grants**: are available from govt. under various projects, programmes and schemes. Further, non-plan grants are made to compensate for loss incurred.
- **Other Income**: sale of scrap, city buildings, revenue other than taxes from sanitation works.

Expenditure
- **General Administration**: municipal administration, finance, election, etc.
- **Planning & Regulation**: city planning, developing regulations, trade license, encroachment removal
- **Health**: public health, hospital services, ambulance, prevention control, primary health care
- **Public Works**: construction of roads and pavements, bridges, flyovers, street lights, drainage system
- **Civic Amenities**: Water supply, sewerage, fire services.
- **Urban Forestry**: parks, gardens, development of lakes and ponds, environment conservation
- **Social Welfare**: welfare of women, slum improvement, construction of houses, urban poverty alleviation programs.
- **Other Services**: education, transportation services (road & water), facility for pilgrims
Smart Cities - Redefining Urban Energy

Key Challenges – Implementation of Energy Efficiency Projects
Challenges associated with Energy Efficiency projects

- Low realisation of revenue
- Poor credit rating
- Unable to attract private investments
- Lack of collateral and recourse
- Insufficient flow of hard cash
- Limited revenue raising powers
- Restrictions on deployment of available funds

- Constraints on the ability to identify, design and implement Energy Efficiency projects
- Limited technical capacity to execute large scale projects
- Limited knowledge on Energy Efficiency technology
- Limited coordination between municipalities
- Lengthy procurement process
- Lack of skilled manpower

- Limited awareness on potential of Energy Efficiency
- Inadequate information on baseline conditions
- Lack of incentive from the govt. to execute Energy Efficiency projects
- Uncertainty in regulatory framework
- Low priority attached to energy related issues
- Energy prices rarely reflect the true costs of environmental impacts

Financing Mechanism in Municipal Energy Efficiency Projects
## Financial mechanism (1/2)

<table>
<thead>
<tr>
<th>Type of Funding</th>
<th>Definition</th>
<th>Advantage</th>
<th>Limitation</th>
</tr>
</thead>
</table>
| Grants          | These are non-repayment funds provided by govt. or donors to municipalities | • Can be applied all municipalities  
• No financing costs | • Limited grant funding available  
• Neither scalable nor sustainable |
| General Budget  | EE project costs funded through revenue’s of municipal corporations | • No additional financing cost is required  
• Less restrictions on use of money | • Budget resource is limited  
• Sustainability not assured |
| Budget Capture  | Financing provided by MoF, with repayments done via savings from EE projects | • Makes viability dearer  
• Provides security to financiers | • Sustainability not assured  
• Can be difficult to ring-fence |

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## Financial mechanism (2/2)

<table>
<thead>
<tr>
<th>Type of Funding</th>
<th>Definition</th>
<th>Advantage</th>
<th>Limitation</th>
</tr>
</thead>
</table>
| EE funds        | It’s an independent, public owned Co that finances EE projects | • Municipalities with poor credit ratings can borrow money  
• Leverage funds by bundling EE projects and develop ESCO models | • Recovery of Operation cost is difficult initially  
• Reliance on good fund manager |
| Credit Lines    | Soft public loan to banks for lending to municipalities for EE projects | • Funds can revolve  
• Municipalities can execute large scale projects | • Funding to municipalities with good credit ratings |
| Credit Guarantee| Guarantee provided by PIDG or govt. | • Allows leverage from public funds  
• Mitigates risk perception of lenders | • Can be applicable to handful of municipalities and limited EE projects |
| Vendor Credit   | Vendors supply equipment with longer payment durations | • Little or no collaterals required  
• Help mobilize commercial funds | • Limited choice of equipment as handful of vendors can provide such facilities. |
| Lease an Asset  | Lease EE equipment with payments based on estimated energy savings | • Paying the costs of EE equipment on leasing terms may not be counted against borrowing limits | • Requires banks & leasing companies to assume reasonable financing and credit risks |
| Commercial loans| Financial institutions lends money towards EE projects directly or through ESCO | • Complete project is financed  
• With ESPC, risks is transferred to ESCO | • ESCOs to bear majority of the risks  
• High Due Diligence costs |
| Municipal bonds | Municipality issues bonds to raise funds from private investors to finance EE projects | • Mobilize funds with less restrictions  
• Scalable and sustainable model | • High transaction costs  
• Limited to large municipalities with good credit rating |

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Successful implementation of EE projects via appropriate use of financing mechanism

**Public Funding**

**Commercializing Sustainable Energy Finance Program (CSEF), Turkey**
- As Turkey’s GHG emissions grew from 188 to 422 mtoCO2, the Turkish Govt. made EE a key priority and has enacted new laws and policies.
- It launched CSEF that was setup by IFC in 2010, via funding from USD 21 million Clean Technology Fund (CTF) and USD 100 million by IFC itself.
- The aim of the program was to help local financial institution to develop the capacity to finance EE projects.
- In the first 4 years of the operations, leasing companies invested more than USD 100 million of CSEF funds in over 50 energy efficiency projects which helped mitigate 200,000 tonnes of CO2 per year.
- The program has helped to catalyze an increase in both supply and demand of EE equipment as well as to have increased awareness and expertise of Turkish commercial banks in the EE sector.

**Private Lending**

**Ann Arbor, Michigan, USA**
- The city issued energy bonds worth USD 1.4 million to Energy Efficiency measures at 30 city facilities. The bonds were fully repaid in 10 years via energy cost savings.
- After the repayment of bond amounts, the city continued to redirect the energy saving costs for the next five years and accumulated USD 500,000 as Energy Efficiency Revolving Fund.
- The city used the funds in public lighting and building retrofitting.
- Further, these funds were also used to finance a scheme ‘Azenergy loan fund for rental housing’ which aimed to implement EE measures in the rental housing in Washtenaw County of the city. The loan to landlords was capped at USD 8,000 at low interest rates and payable in 12-36 months.
- It is estimated that the projects resulted in cost savings of USD 860,000 energy saving of 10.7 GWh and CO2 emissions reduction of about 8,000 tonnes after from offering better comfort and modern city facilities.

Revolving Energy Efficiency Fund play a key role in providing long-term financing for municipal EE projects

**Public-Private-Partnership**

**Case Study: Bulgarian Energy Efficiency Fund (BEEF)**
- BEEF was established with the support of World Bank, Global Environment Facility, government of Austria and Bulgaria and private investors such as Eurobank EFG, Brunata Bulgaria, etc.
- BEEF aims to finance and provide guarantees to EE projects implemented by municipalities, corporates and individuals.

**Case Study: Energy Efficiency Revolving Fund (EERF), India**
- EERF aims to expand and sustain investments in the energy efficiency market in India, build market diversification, and scale up existing technologies.
- Energy Efficiency Service Limited and ADB signed an agreement for a global environment facility grand of USD 13 million to establish EERF.

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*Note: this model may change according to market required*
## Mapping of financing tools to mitigate challenges

<table>
<thead>
<tr>
<th>Key Challenges</th>
<th>Financing mechanism to mitigate challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Large Municipalities</td>
</tr>
<tr>
<td></td>
<td>Small Municipalities</td>
</tr>
<tr>
<td>Inadequate revenues</td>
<td>• Special project vehicle (SPV) approach</td>
</tr>
<tr>
<td></td>
<td>• Municipal funds (instead EE focused funds)</td>
</tr>
<tr>
<td></td>
<td>• Public Private Partnerships</td>
</tr>
<tr>
<td></td>
<td>• Dedicated EE funds</td>
</tr>
<tr>
<td></td>
<td>• Budget financing</td>
</tr>
<tr>
<td>Limited revenue raising powers</td>
<td>• Energy Saving Performance Contract (ESPC) model can be implemented ESCOs (Energy</td>
</tr>
<tr>
<td></td>
<td>Saving Companies or providers)</td>
</tr>
<tr>
<td>Restrictions on use of funds</td>
<td>• Aggregate small projects into one large project</td>
</tr>
<tr>
<td></td>
<td>• Govt. can provide guarantee to lenders</td>
</tr>
<tr>
<td>Less borrowing powers</td>
<td></td>
</tr>
<tr>
<td>Requirement of collaterals</td>
<td></td>
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<tr>
<td>Assessing creditworthiness</td>
<td></td>
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<tr>
<td>Lack of cash flows</td>
<td></td>
</tr>
<tr>
<td>High transaction costs</td>
<td></td>
</tr>
</tbody>
</table>

- Selection of different financial mechanism depends on municipality’s financial strength, capacity to execute large scale projects, nature of energy efficiency projects, policies and regulatory framework, etc.
- Small municipalities may have a greater need to reply on public funding mechanism

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### Mapping of financial mechanism available for municipal Energy Efficiency projects in SAARC nations (1/2)

<table>
<thead>
<tr>
<th></th>
<th>Grants</th>
<th>General Budget</th>
<th>Budget Capture</th>
<th>EE funds</th>
<th>Credit Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>✓</td>
<td>-</td>
<td>✓</td>
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<tr>
<td>Bangladesh</td>
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<tr>
<td>Bhutan</td>
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<tr>
<td>India</td>
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<td>Maldives</td>
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<td>Nepal</td>
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<td>Pakistan</td>
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<tr>
<td>Sri Lanka</td>
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</table>

<table>
<thead>
<tr>
<th>Note</th>
<th>Available for EE projects</th>
<th>Present in other sectors</th>
<th>NA</th>
</tr>
</thead>
</table>

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## Annexure-IV

### Mapping of financial mechanism available for municipal Energy Efficiency projects in SAARC nations (2/2)

<table>
<thead>
<tr>
<th></th>
<th>Credit Guarantee</th>
<th>Vendor Credit</th>
<th>Lease an Asset</th>
<th>Commercial Loans</th>
<th>Municipal Bonds</th>
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<tbody>
<tr>
<td>Afghanistan</td>
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<td>Bangladesh</td>
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<tr>
<td>Sri Lanka</td>
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</tbody>
</table>

**Note:**
- ✔️: Available for EE projects
- ☐: Present in other sectors
- NA: Not Applicable

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## Way Forward
Key recommendations

(1/2)

**Collaborative approach will have greatest impact**
- While incentives for energy efficiency, business models, and finance mechanism are key aspects for mobilization of funds, these should be complemented alongside with policies, regulations, awareness on EE, and initiatives leading to behaviour change.
- The integrated approach needs to be guided by a national strategy to ensure long-term transformation of EE products.
- To achieve investments at a scale needed to meet the targets, financing from both Private and Public investors can achieve a multiplying effect.

**Business models should adapt to local market conditions**
- As each of the SAARC nations poses different challenges, financial mechanism and business model should be tailored fit according to the local market.
- Mechanisms that work for different set of end users can also vary significantly depending on the sector such as residential, public or private.
- New mechanism are better suited as Energy Efficiency and financial market matures over a period of time.

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Key recommendations

(2/2)

**Business models and mechanisms are most effective when they are consumer-focused**
- Developing trust, and removing financial or administrative barriers, will create demand and unlock investments for the right products from the consumers.
- The benefits of the Energy Efficiency products as well as programs should be communicated and highlighted to the end users to create awareness.
- Business models to include risk mitigation instruments that can reduce the risks perception for consumers, lenders, technology providers and other stakeholders in the project.

**Focus on developing a long-term market-based view**
- As Grants or subsidies are used to develop a market while encouraging private investments, the investment strategy of Grants or subsidies should aim to catalyse future growth.
- Various steps can be taken to unlock new technologies and encourage significant investments in technology innovation.

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Thank you