

# Persidangan Kebangsaan Teknologi Hijau

9-10 June 2014



## Green Initiatives in Sewerage Sector - *Sharing on IWK's Experience*



(A) Green Resources in the Sewerage Sector

(B) Bio-Effluent Recovery

(C) Bio-Solids Recovery

(D) Bio-Energy Recovery

(E) Future Green Technology Applications and Benefits

# **(A) GREEN RESOURCES IN THE SEWERAGE SECTOR**

# IWK's Services and Resources

**Indah Water Konsortium Sdn Bhd (IWK)**, a national sewerage company, owned by the Government of Malaysia. It is responsible for providing sewerage services to more than **21 million population** nationwide and covering almost **54,000 km<sup>2</sup> of area**.



**6,086 Public Sewage Treatment Plants**



**943 Network Pump Stations**



**16,573 km Pipelines**



- 1. No. of State/Unit Office: 21**
- 2. No. of Reporting Center: 64**
- 3. No. of Laboratory Facility: 3**
- 4. No. of Certification Office: 10**
- 5. No. of Regional Planning Office: 4**
- 6. No. of Staff: 3,278**
- 7. No. of Vehicle Owned: 612**
- 8. No. of Local Authorities Served: 87**

# Sewage Treatment - The Present Scenario



## By-products

### BIO-SOLIDS

N – 3%; P – 1%, K - <0.1%  
Organic Matter – 40-50%  
CV – 2000-3500 kCal/kg DS

### BIO-EFFLUENT

BOD < 5 mg/l  
COD < 15 mg/l  
SS < 5 mg/l

### BIOGAS

Methane – 65%  
CV – 5000 kcal/m<sup>3</sup>



**DISPOSE**



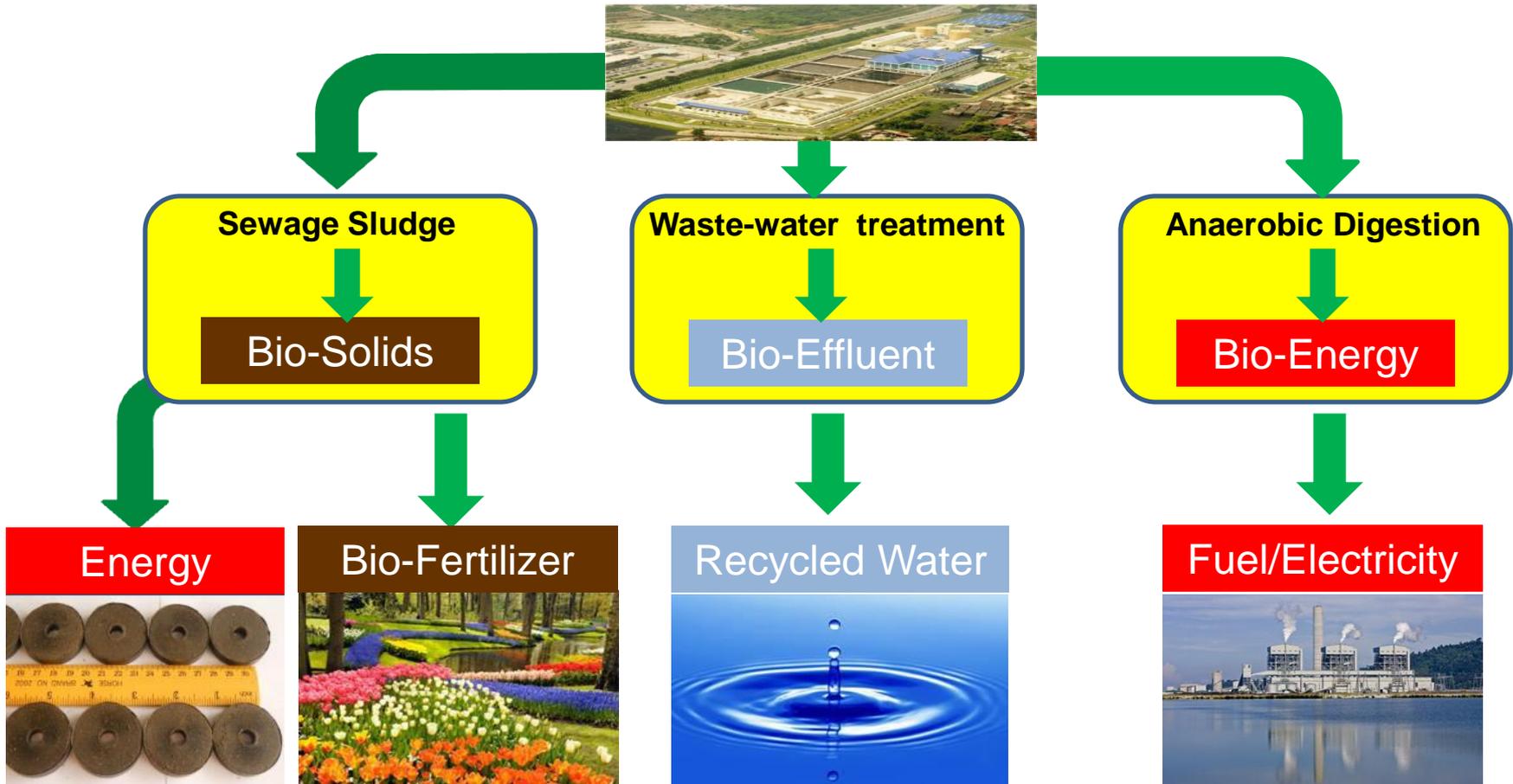
**DISCHARGE**



**FLARE**

**GREENHOUSE GAS EMISSION  
LOSS in RESOURCES**

# Sewage Treatment – The Future Scenario



**Towards Sustainable Development and Environment**

# **(B) BIO-EFFLUENT RECOVERY**



# Bio-Effluent Reuse for Non-Potable Water Application



*Application of Continuous Submerged MF (CMF-S) followed by Reverse Osmosis (RO) membrane for waste water reclamation.*



*Effluent water reclamation for non-potable and industrial purposes*



*Bio-effluent reuse - Pilot project for landscape purpose at MPPD*

*Study on alternative lower cost water reclamation technologies*

*Treated effluent application for landscaping, irrigation and pond recharge*



**Benefits of bio-effluent reuse:**

- Reduce stress/demand on raw water resources, lower water footprint i.e. reduce water abuse by recycling (fit for purpose).
- Reduced demand on potable water contributes to lower energy consumption to treat and transfer potable water for non-potable use.
- Minimize contribution to carbon dioxide (CO<sub>2</sub>) emission.

# Bio-Effluent Reuse

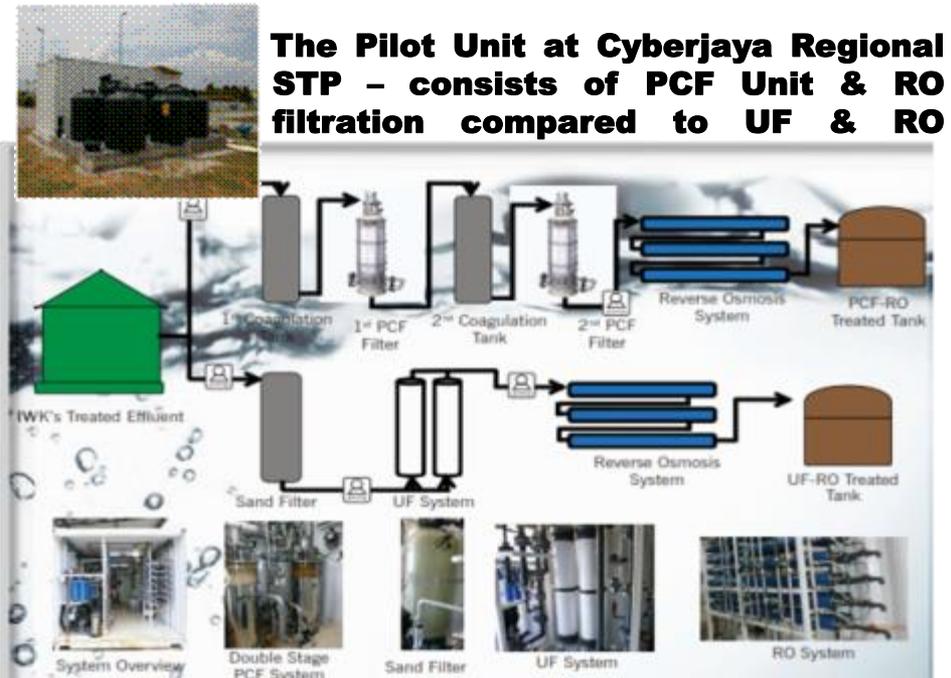
- IWK-UKM- SSENG at Cyberjaya (April 2012 Dec 2014)

Parameter	Unit	Test Results	WHO Std	MoH Std
Colour	Hazen	<5	15	15
Turbidity	NTU	<0.1	5	5
Ammonia	mg/l	<1.5	1.5	1.5
NO3-N	mg/l	0.7	10	10
NO2-N	mg/l	0.1	NA	NA
TDS	mg/l	4.6	1000	1000
Alkalinity	mg/l	10	500	500
*Conductivity	uS/cm	<100	NA	NA
E.Coli	CFU/100mL	Absent	Absent	Absent
Total Estrogen	ug/l	<2.5	NA	NA
*Silica	mg/l	4.6	NA	NA

Note: the above data is based on average values of the RO product (reclaimed water quality) compiled from the on-going study at Cyberjaya STP; NA refers to Not Applicable/Available. \*Conductivity and Silica are monitored to assess the performance in % rejection achieved.

WHO – World Health Organisation  
MoH – Ministry of Health, Malaysia

- Pilot Project – to study the potential of SSENG’s Pore Controlled Fiber Filter (PCF) technology for water reclamation from STPs.
- Proof of concept of PCF as a lower cost water reclamation technology.
- The output quality after reverse osmosis (RO) meets Ministry of Health (MoH) standards. Further improvements to optimize the system is currently being investigated.



# Bio-Effluent Reuse For Landscape Plants



## Joint Research: IWK-UTM (2006)

Before

After



Rate of leave growth increased by 5 fold.

Rate of plant growth increased by 9 fold.

Levels of pathogen in the bio-effluent can be reduced by use of UV or chlorination techniques.

## Pilot Project with MPPD (2012)



Advantages of using water from bio-effluent on landscape plants :

- i. Reduce dependency on potable water.
- ii. Contain nutrients for plant growth.
- iii. Cheaper source of water.

# Bio-Effluent Reuse



## - Reuse of Bio-effluent at IWK Regional STPs

- Regional STPs (RSTPs) plants equipped with polishing of bio-effluent using filter media.
- Approximately 10% (41,689 m<sup>3</sup>/day) of the bio-effluent will be recycled.
- Some applications of the recycled bio-effluent:
  - Compound cleaning,
  - Landscaping,
  - Polymer preparation,
  - Service water in plant operation, (equipment cleaning, etc).
- Green Technology application in sewage treatment plants.
- Reduce dependency on potable water.



Bio-Effluent



Compound cleaning



Filter Tank



Landscaping

# (C) BIO-SOLIDS RECOVERY



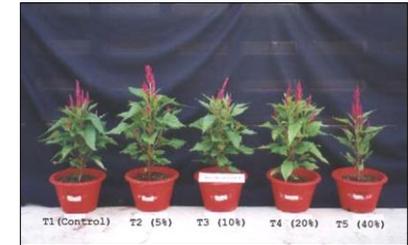
# Bio-Solids as Nutrient Source

- Joint Research: IWK-UPM, IWK-MARDI & IWK-RRIM



*Vermicompost of sewage sludge*

*Co-composting sewage sludge and municipal solid waste*



*The use of sewage sludge as a soil conditioner*



*The use of sewage sludge as fertilizer for different crops*



**BIOSOLIDS**



*Biosolid as a fertilizer for non-food crop: application in rubber farm*



*Sewage sludge in the conservation and regeneration of forests*

## The advantages of Biosolids as fertilizer

- i. Reducing the use of chemical fertilizer
- ii. Contains essential nutrients such as organic matter and minerals in addition to N, P and K
- iii. There is no smell; resources and reliable quantity
- iv. Low capital cost, installation, simple maintenance operations &
- v. Lower price compared to organic fertilizer

# Bio-Solids as Nutrient Source

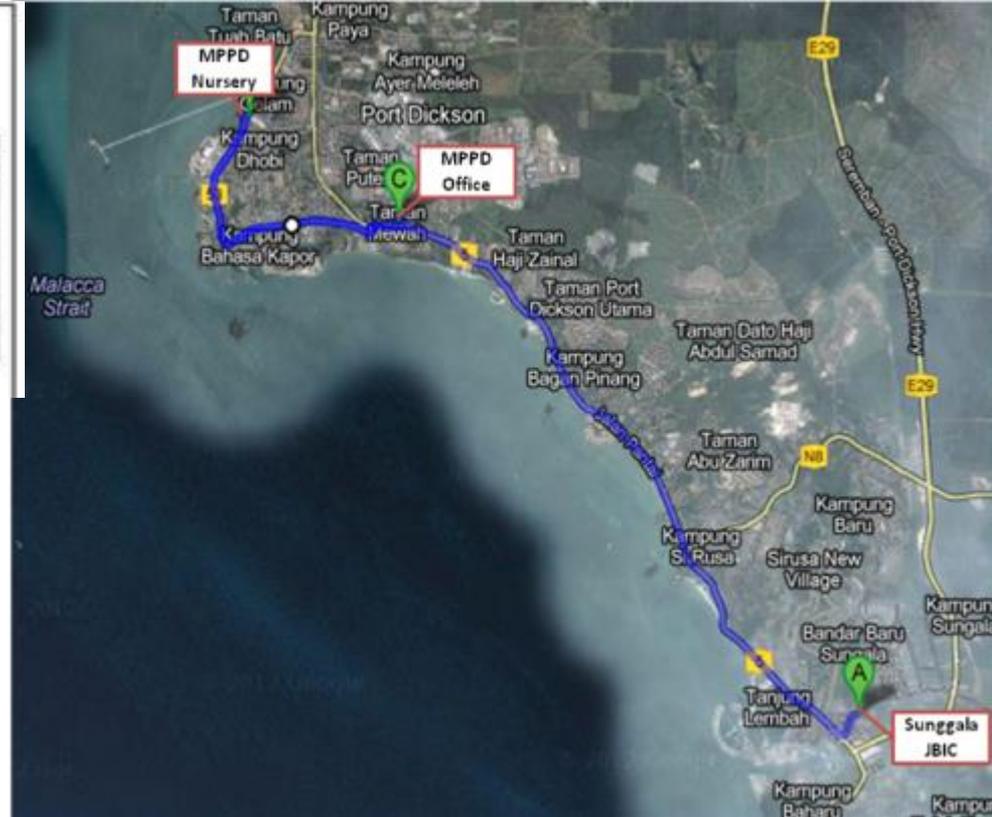
## - Pilot Project at Majlis Perbandaran Port Dickson (MPPD)



Indah Water supports green technology, helps reduce usage of precious potable water



Indah Water is proud to announce that it has been selected as the preferred provider of water treatment services for the healthy plants that will grow using IWK's green products.



- Collaboration between IWK and MPPD
- Objective: To demonstrate the effectiveness of bio-solids and bio-effluent application on landscape plant compared to commercial fertilizers.

Trial Location:

- MPPD Nursery
- Field trial at Landscape area



# Bio-Solids as Nutrient Source

## - Pilot Project at MPPD – Outcome & Results

- Positive effects of biosolids were observed, e.g. greener & glossier leaves and more flowering.
- Biosolids and bioeffluent was beneficial for landscape plants and adopted for greening landscape area in MPPD areas.



Comparison between *Turnera Ulmifolio* using IWK biosolid and soil and sand mixture treatment



# Bio-Solids as Nutrient Source

## Replication Initiatives – 1 State 1 Local Municipality Project



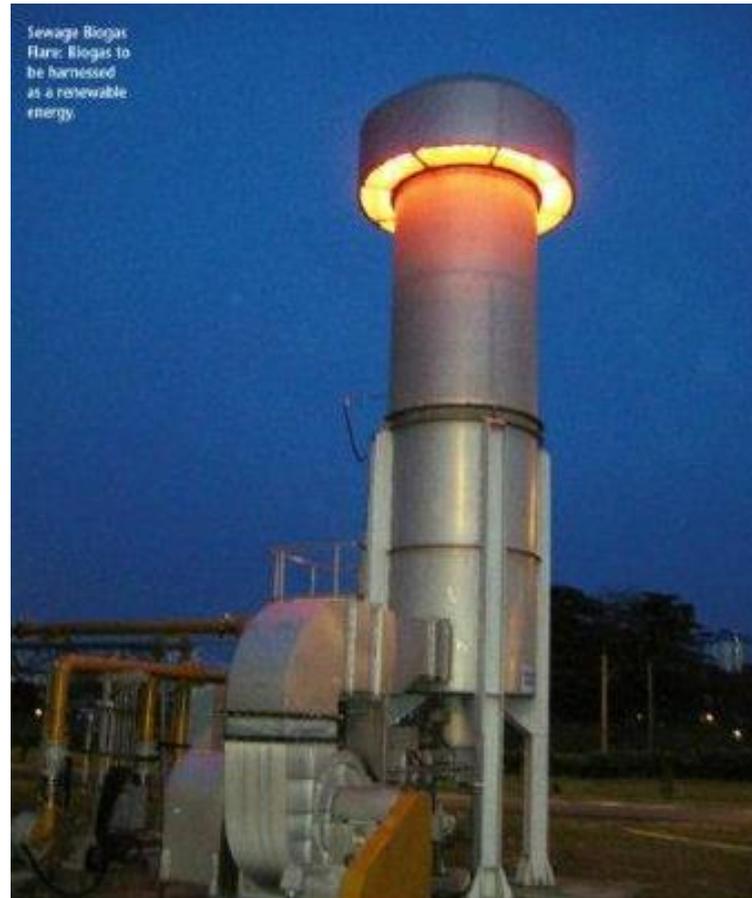
- The Proposal was presented to the National Green Technology and Climate Change Council.
- A total of 14 Local Municipalities have been identified to be involved in this green pilot project initiatives nationwide.



### The Positive Impact Nationwide

1	2	3
<ul style="list-style-type: none"> <li>• Greening of Landscape areas with Renewable and Sustainable Nutrient rich resources</li> </ul>	<ul style="list-style-type: none"> <li>• Contribute towards Resource Recovery and Sustainable Sewerage Services</li> </ul>	<ul style="list-style-type: none"> <li>• Realization of Green Technology Initiatives through Recycling of sewage by-products i.e. Biosolids and Bioeffluent</li> </ul>

# (D) BIO-ENERGY RECOVERY



# Present RE Initiatives at STPs



**Jelutong STP**



The first sewage biogas to electricity demonstration project in Malaysia at Jelutong STP, Penang. Installed capacity of 180kW Gas Engine to generate electricity for internal consumption.



**Pantai STP**



Harnessing RE from hydraulic energy of treated effluent discharge via micro hydro.



Producing RE from Biogas to Electricity (500kW)

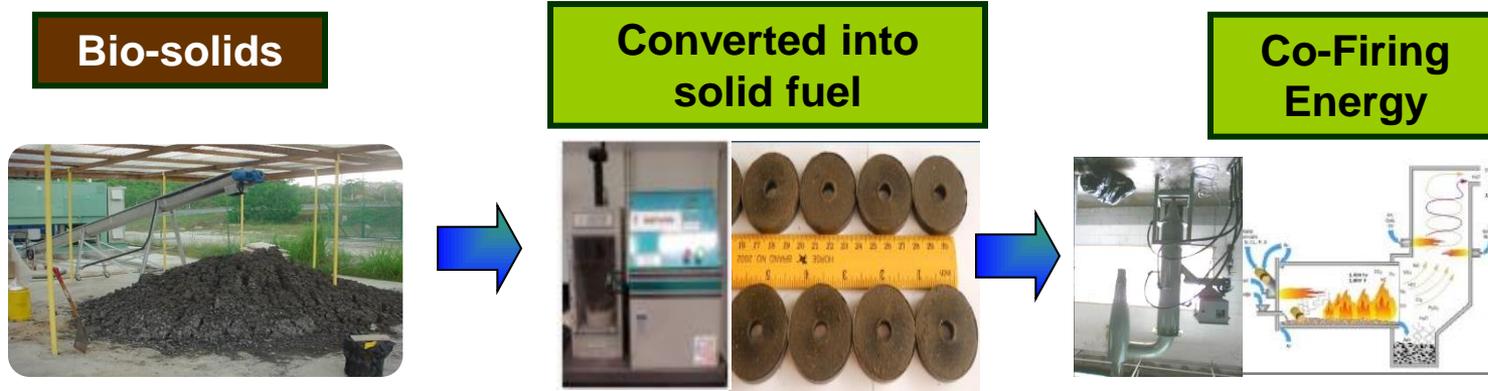
# Energy Management & Recovery Potentials



ENERGY EFFICIENCIES & SAVING DEVICES		
VARIABLE SPEED DRIVE	TURBO BLOWER	LED LIGHT

# Energy Recovery Potential from Bio-Solids

## Bio-Solids into Fuel for Co-firing



- Energy content available in the IWK bio-solids is comparable to other fuel materials.
- Reasonably low sulfur content indicate manageable emission.
- Recovering energy resources in biosolids.
- Generate renewable energy and minimize greenhouse gas emission.

**(E) FUTURE GREEN  
TECHNOLOGY  
APPLICATIONS AND  
BENEFITS**

# Future GT Applications : Role of Bio-Technology



**Regional Mechanized Treatment Facility**

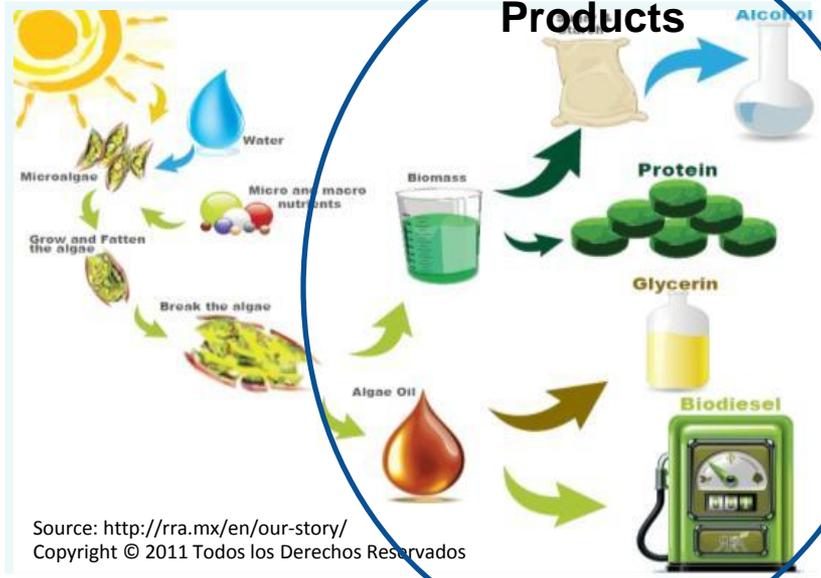
Current process generates 3 by-products:

- Bio-Solids
- Bio-Energy
- Bio-Effluent

**Greenhouse Gas Emission.  
Loss of Resources**

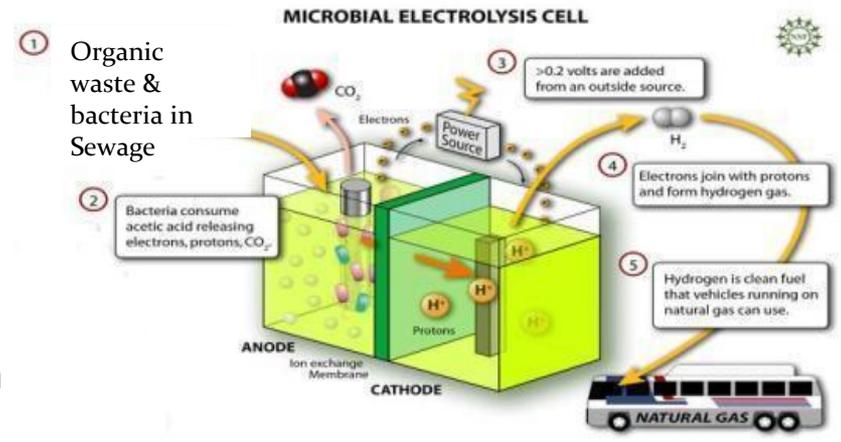
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**Algae Cultivation & Harvesting for Bio-Products**



New green technology applications in and along sewage treatment process.

**Microbial Fuel Cells Generating Power from Sewage**



Credit: Zina Deretsky, National Science Foundation Source: [http://peswiki.com/index.php/Directory:Penn\\_State\\_Microbial\\_Fuel\\_Cells\\_Produce\\_Hydrogen\\_from\\_Waste\\_Water](http://peswiki.com/index.php/Directory:Penn_State_Microbial_Fuel_Cells_Produce_Hydrogen_from_Waste_Water)

# Future GT Applications : Nanotechnology

Nanotechnology

Output

Applications

IWK's Treated Effluent



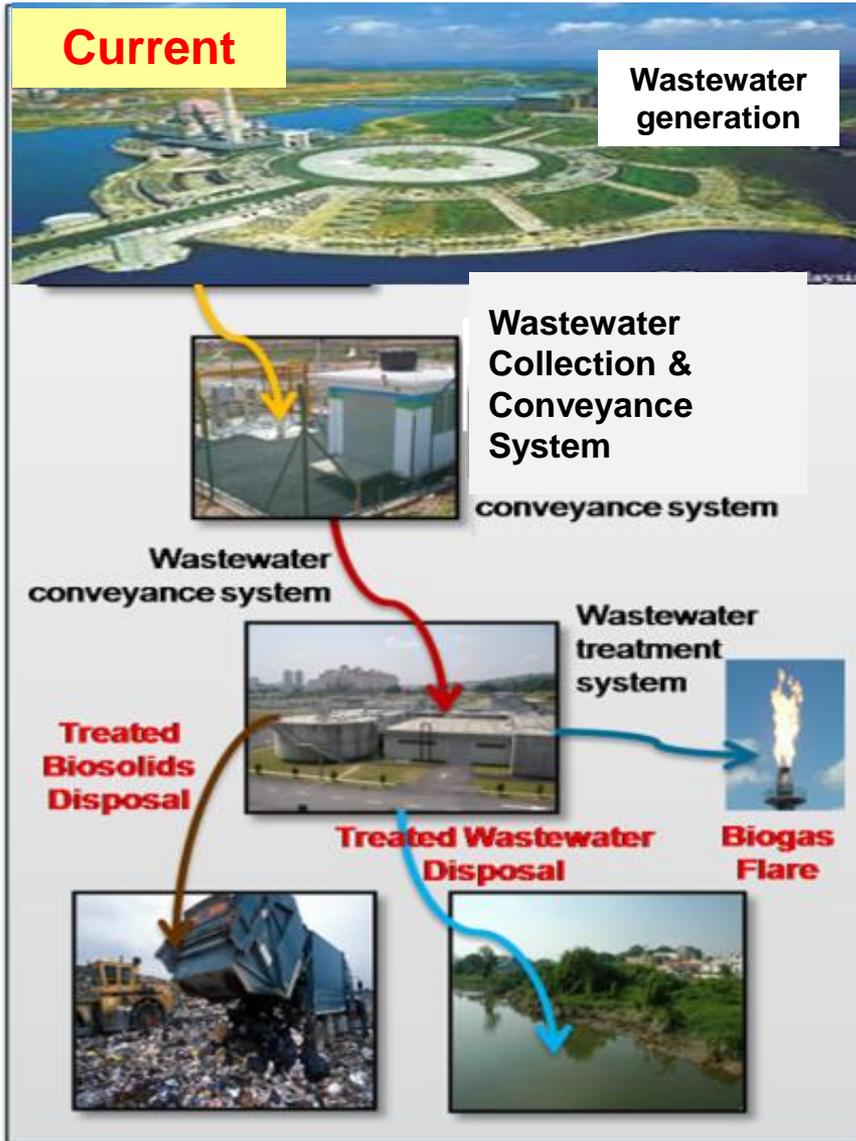
- **Increase effective area for treatment.**
- **Increase bio-activity.**
- **Highly effective.**
- **Small foot-print treatment.**

In future, nanotechnology can be applied for effective treatment and disinfection of treated water from STPs.

The treated water can then be used for landscaping or non-food crop agricultural irrigation.

Current treatment process may contain deficiencies.

# Present Scenario



- Present approach to sewage treatment protects our public health and environment.
- However, present approach generates by-products which are either flared (bio-gas), discharged (bio-effluent) or disposed off (bio-solids).
- The process by which by-products are generated and disposed is decidedly high carbon footprint in addition to releasing greenhouse gasses into the atmosphere.
- The current approach results in loss of resources and is not sustainable in the long term.

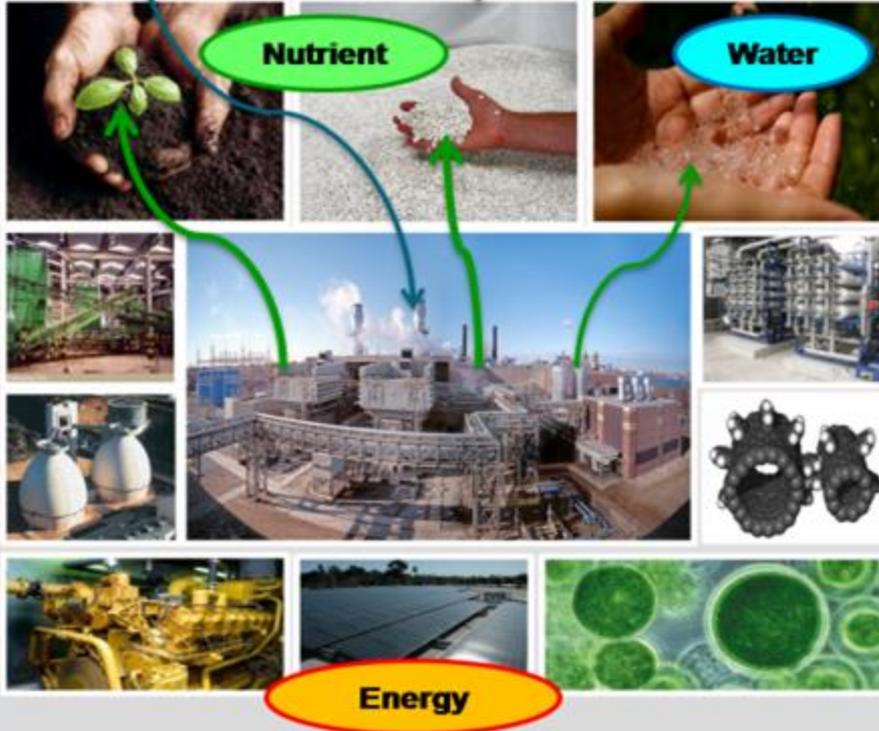
# Future Scenario

**Future**

Wastewater generation



STPs as green resource centers



- Green technology and resource recovery approach are integrated into the operational aspects of STPs.
- STPs are transformed from utility based model to one centered on green resources.
- STPs as green resource centers play a crucial role supplying raw materials/energy/resources to key industries and communities whilst providing essential services to the public at large.
- The sewerage industry and STPs are looked upon as pioneers and early adopters of green technology in efforts that contribute to sustainable development and holistic environmental management.

**SUSTAINABLE ENVIRONMENT**

# Benefits of Adopting GT for Resource Recovery in Sewerage Sector

- Development of new source of economy and income
- Development of technology
- Job opportunities
- Lower commodity prices



- Reduced stress on raw water sources
- Sustainable waste management practices
- Conserve landfill space
- Minimize contribution to GHG
- Decrease in pollution

- Affordable water tariff; waste disposal cost; electricity tariff
- Reduced taxes
- Availability of water improved
- Improves public sanitation



# THANK YOU

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