IAWD DANUBE WATER PROGRAM

es, strong utilities, sustainable services

DWP KNOWNOW

WEBINAR

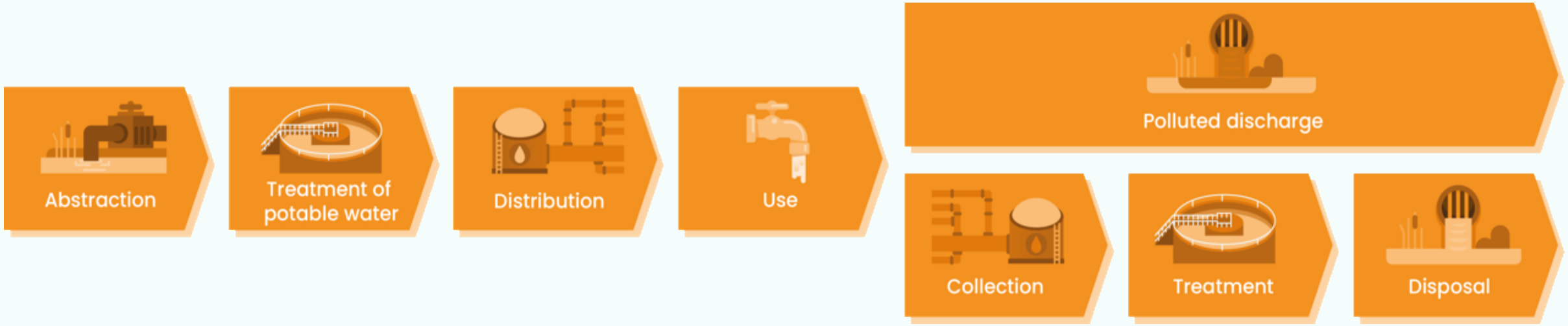
FROM WASTE TO VALUE

HOW THE WASTEWATER TREATMENT SECTOR CAN CONTRIBUTE TO MITIGATING HE ENERGY CRISIS IN THE DANUBE REGION

Sludge: A pollutant or a potential resource?

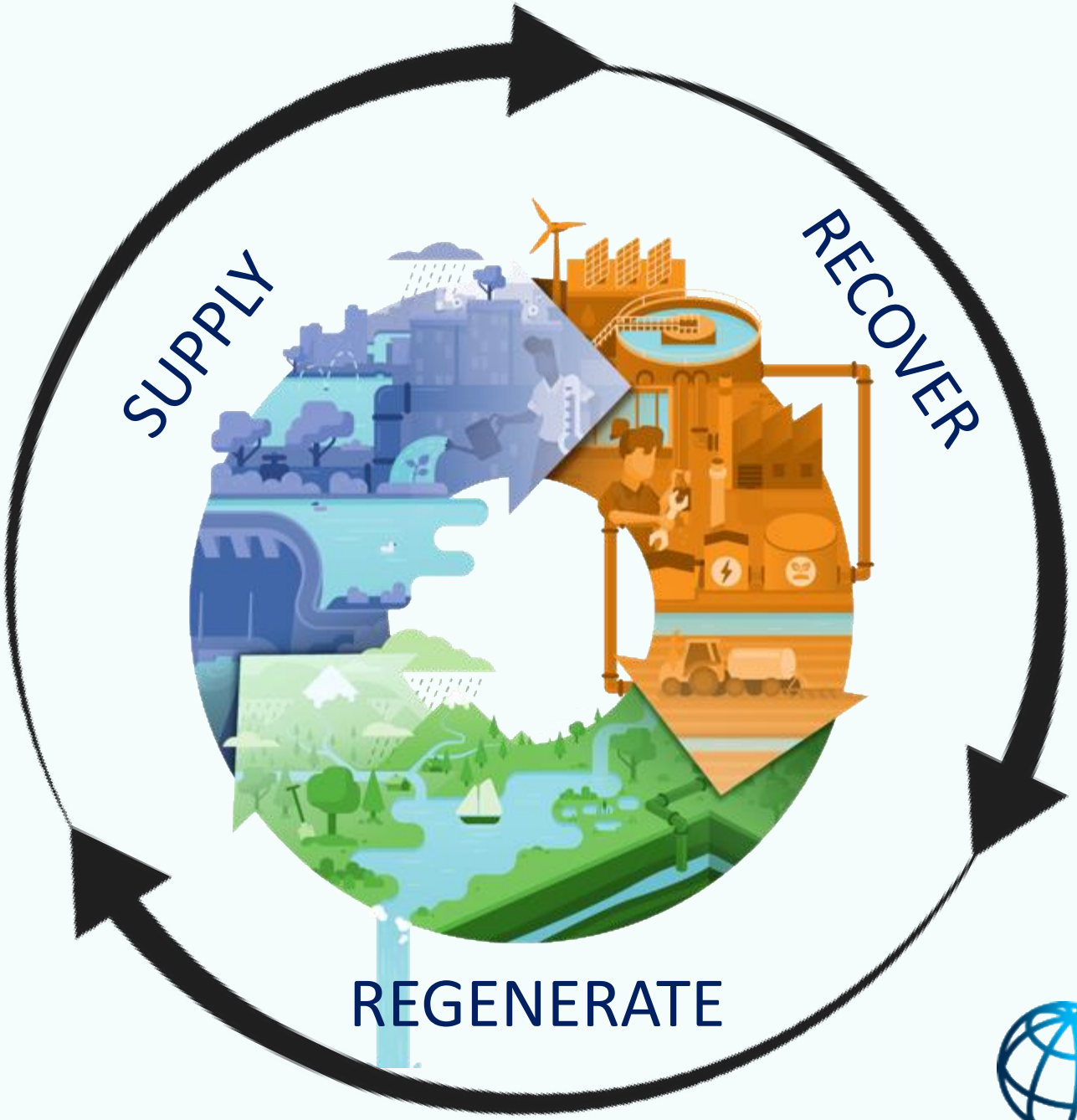
We need to shift from

A LINEAR SYSTEM …

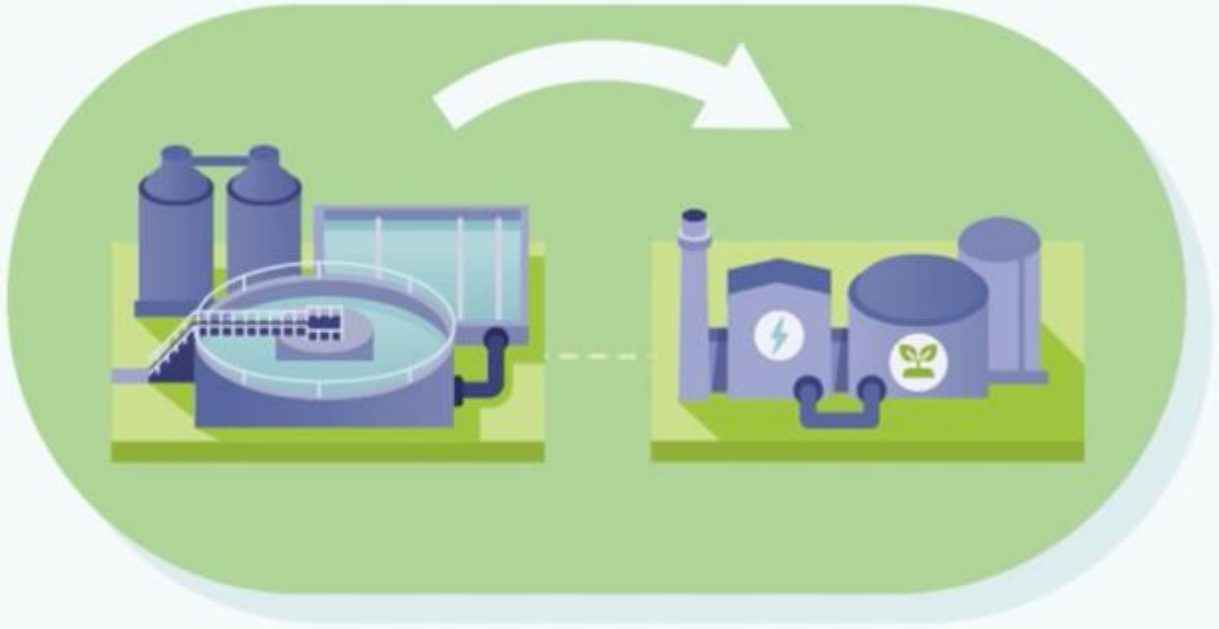


To a circular system,

to capture the full value of water and wastewater



Maximize the use of existing infrastructure



Be energy efficient and use renewable energy

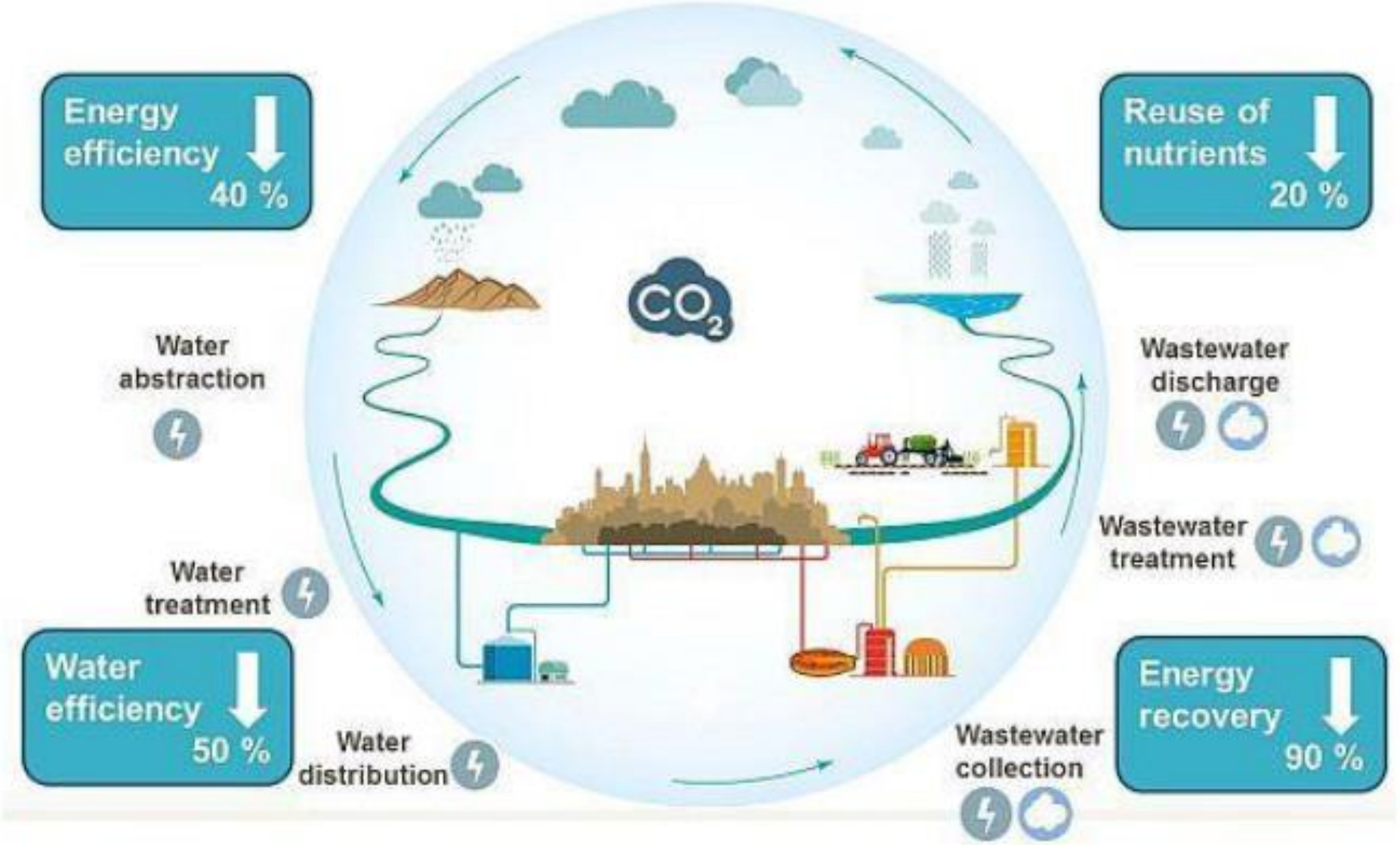
Self-generating renewable energy can reduce energy costs and increase system resiliency

Recover resources from water and wastewater

Energy

Water

Nutrients



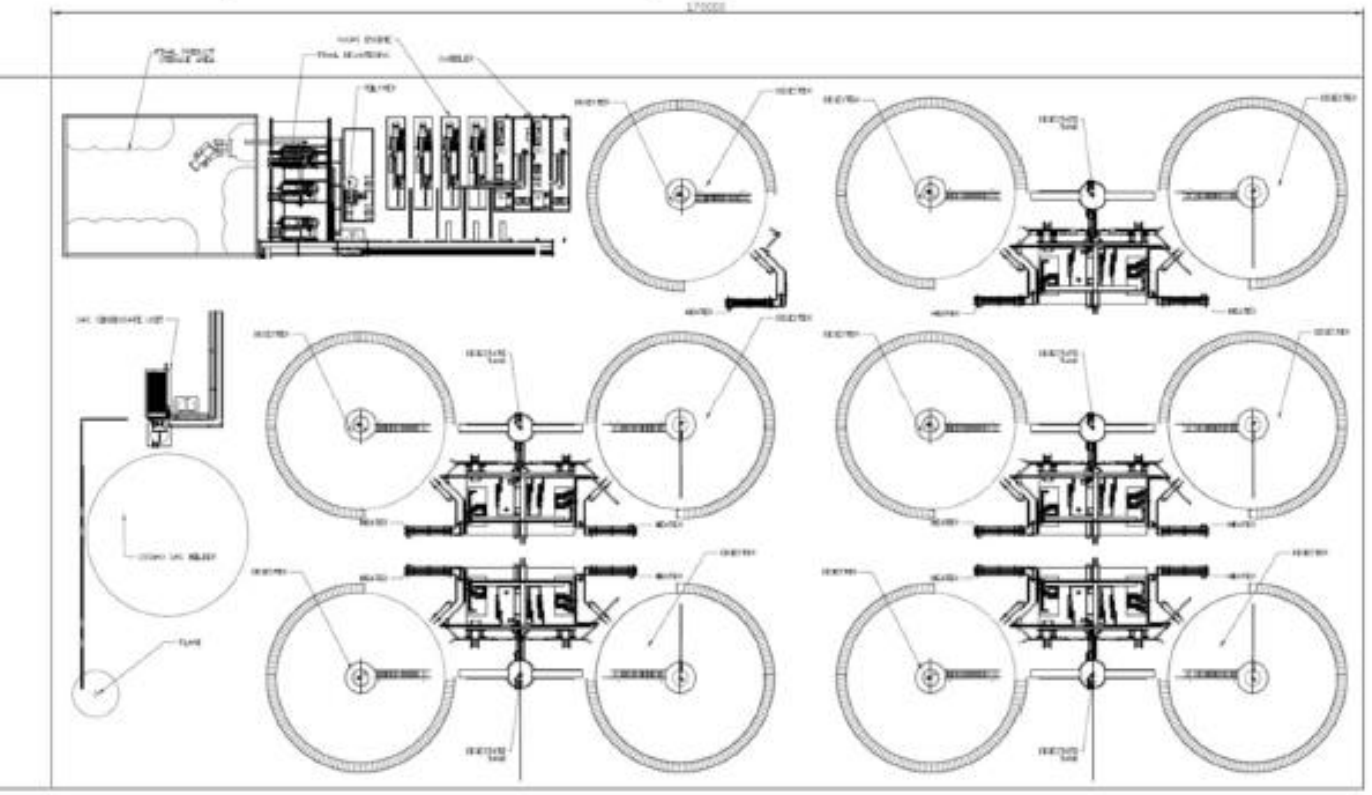
Goal: Carbon neutral water utilities

Advanced Wastewater Treatment

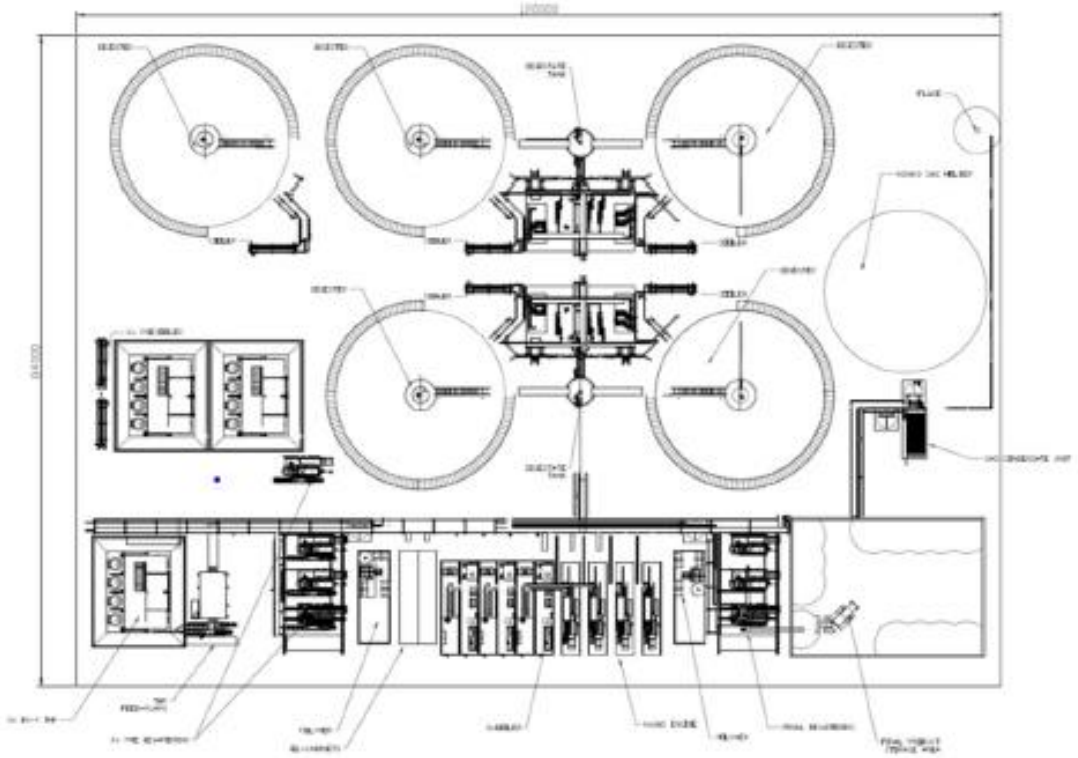
Picture: DC Water, USA

Benefits: Requires less space

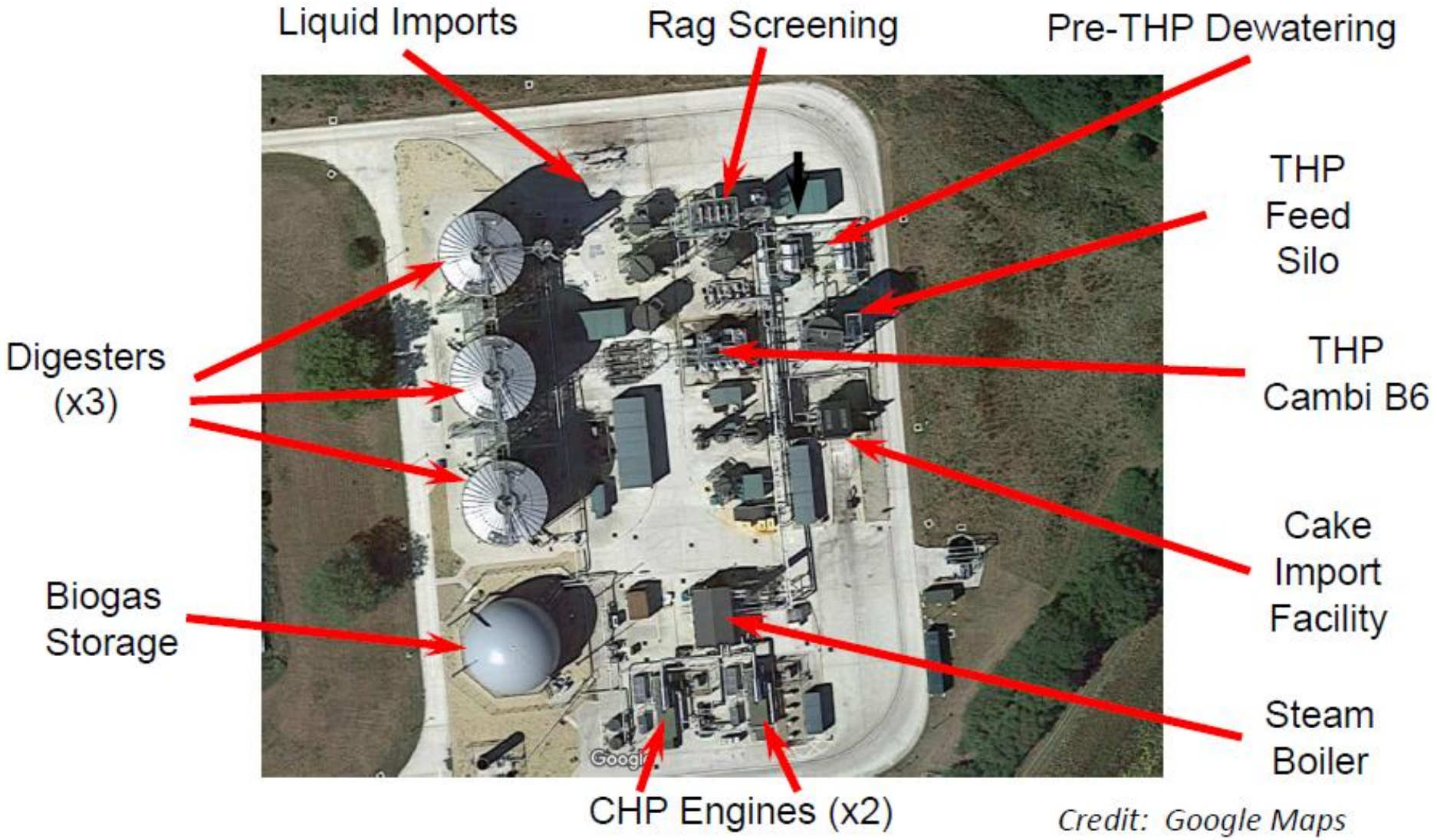
Layout conventional AD, 15,640 m2



Layout with THP, 10,080 m2

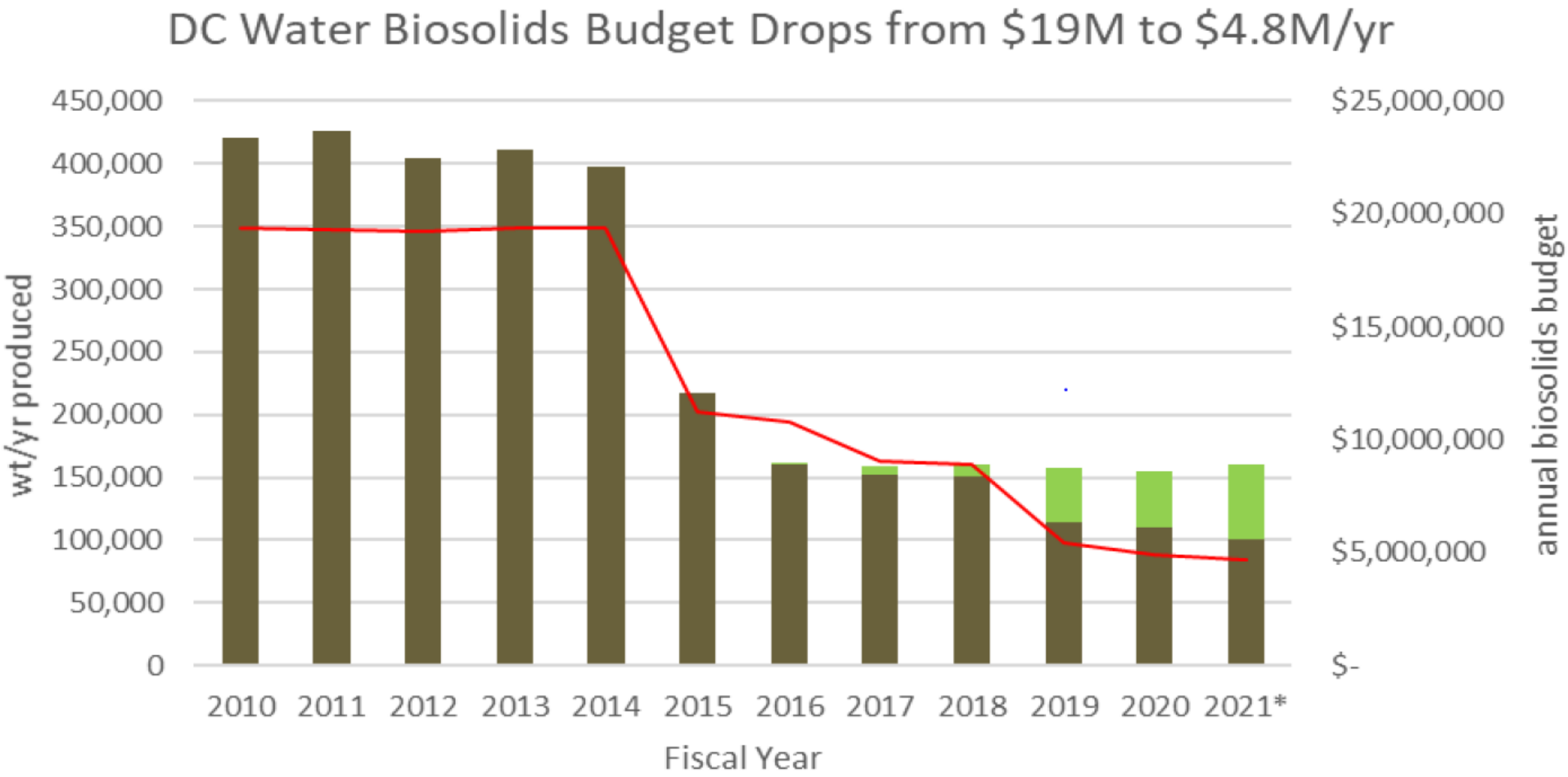


Thermal hydrolysis process ensures the sustainable and safe disposal of sludge - free of pathogens and promoting a circular economy.



Key benefits:

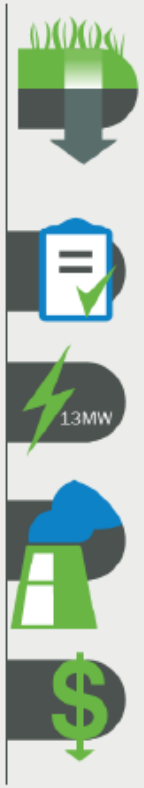
- **Methane capture** reduces GHGs
- **Biogas** provides a local source of energy
- **Reduced sludge retention time** in the anaerobic digesters and enables more than twice the solids loading
- **Reduces odor**
- **Biosolids:** Converts a waste product into a revenue source - biosolids/fertilizer


DC Water Biosolids Budget Drops from $19M to $4.8M/yr
wt/yr produced
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
$25,000,000
$20,000,000
$15,000,000
$10,000,000
$5,000,000
$-
annual biosolids budget
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021*
Fiscal Year

BLOOM GOOD SOIL,® BETTER EARTH.

Program Benefits

Resource Recovery



Reduce biosolids quantities by more than 50%

Improve product quality (Class A and more)

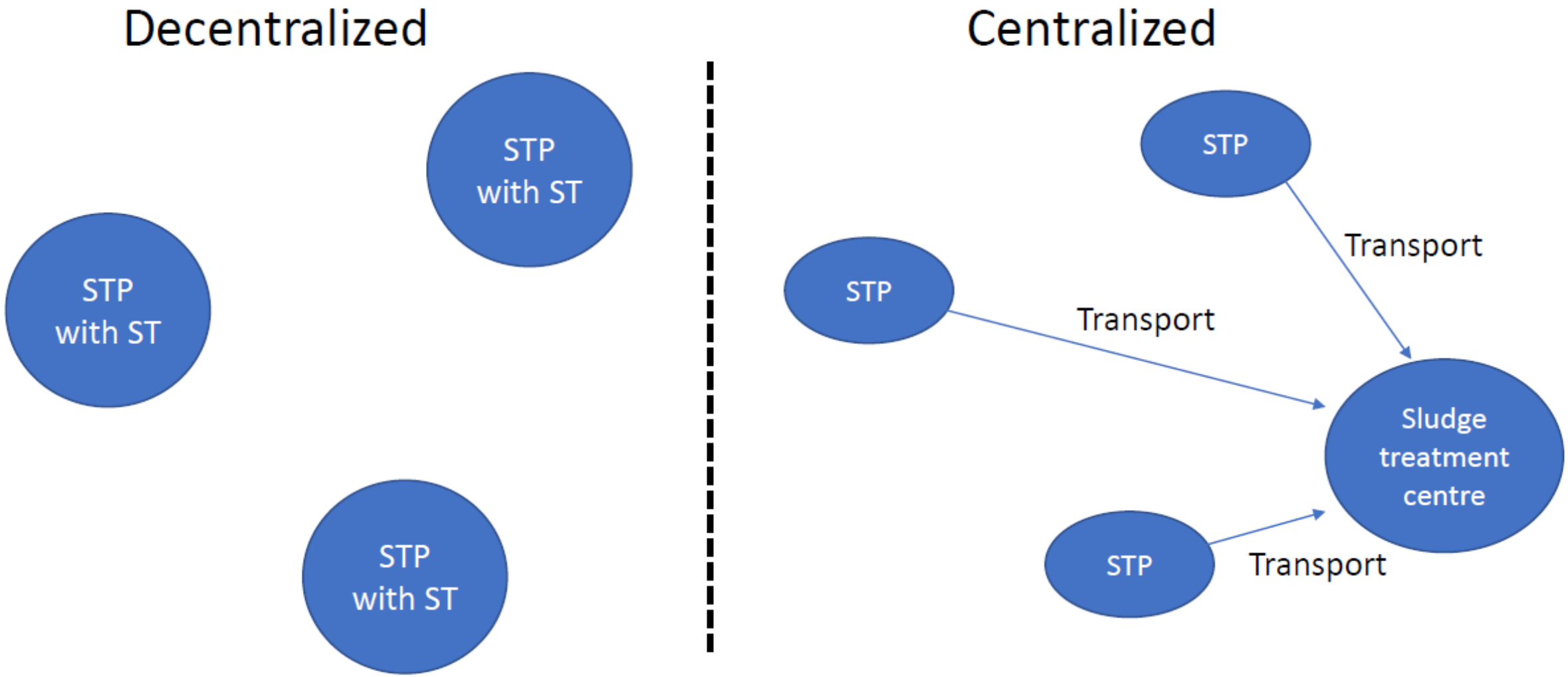
Generate 8 MW of clean, renewable power

Cut GHG emissions dramatically - by 1/3 or 50,000 MT CO2e annually

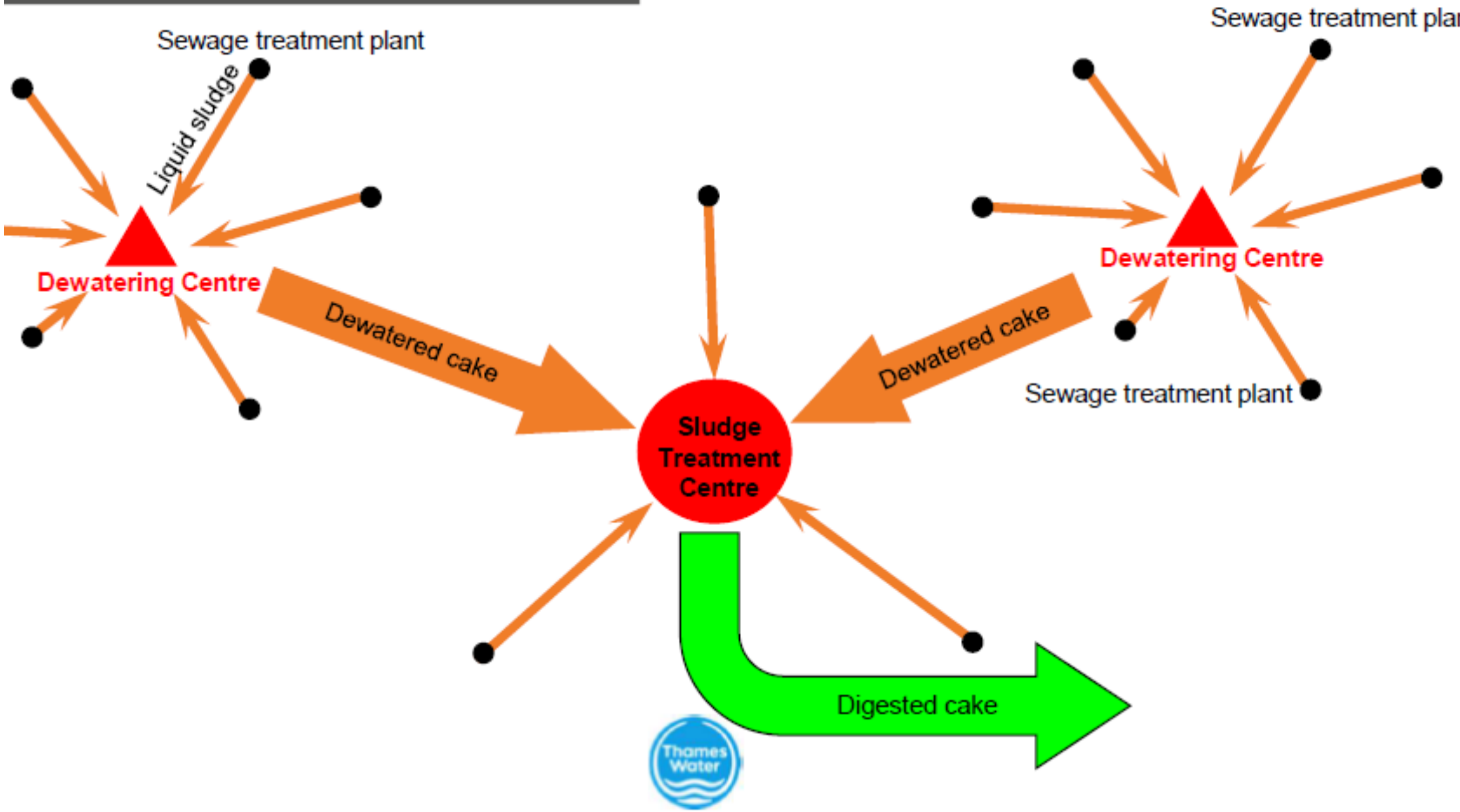
Save millions of dollars annually

DC Water, USA

Sludge management



. Sludge Centre Concept



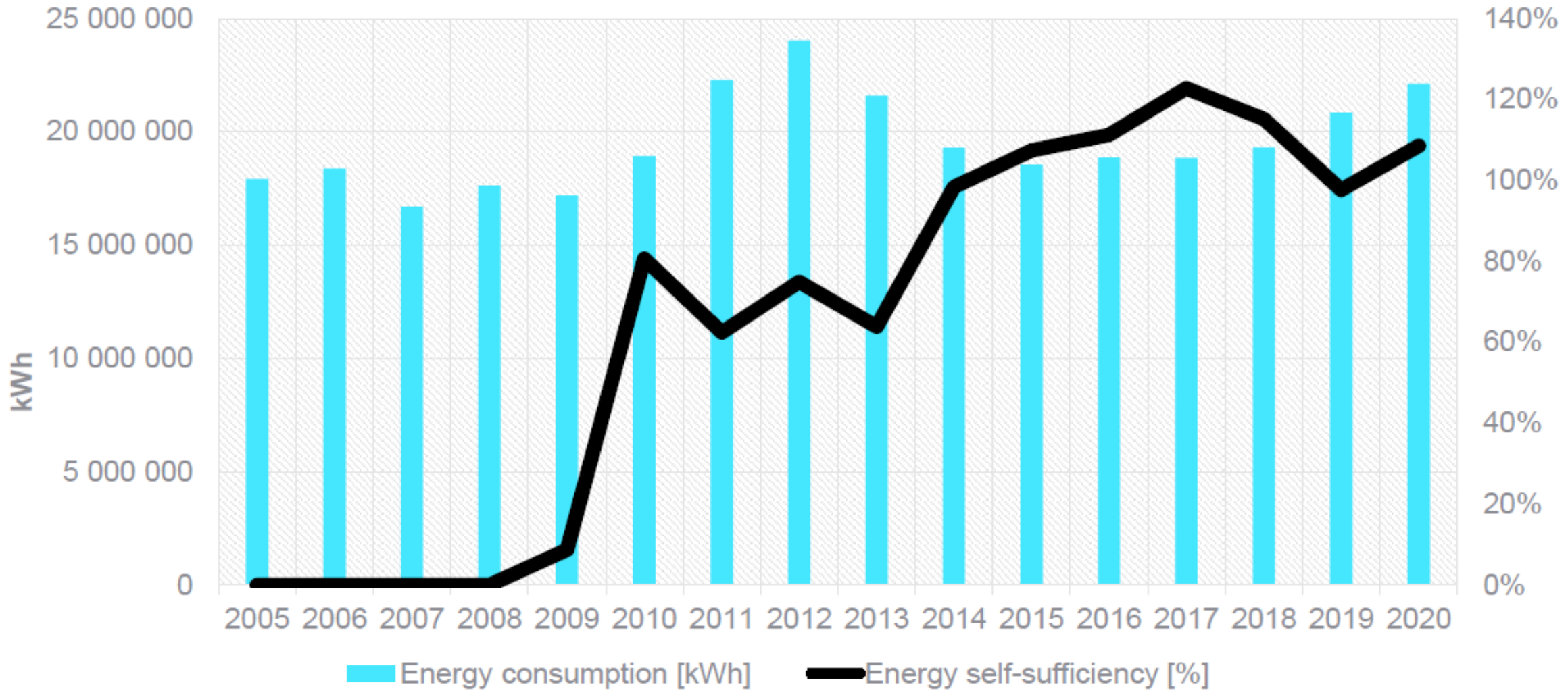
Bulgaria – Sofia UWWTP

A total of 12.6 M€ has been invested in producing renewable energy over the period 2004 - 2020

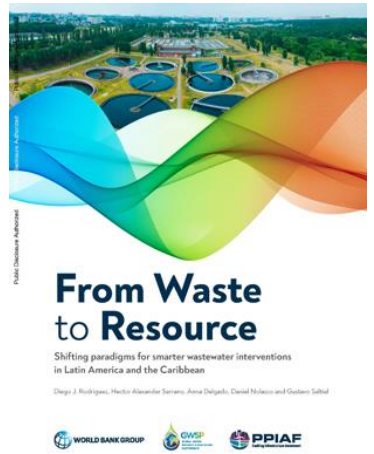
2007	2009	2016	2021
Restart of anaerobic digesters	Commissioning of co-generation units	Commissioning of an additional gasholder	Commissioning of an additional anaerobic digester
4.8 M€	**2.6 M€**	**0.3 M€**	**2.6 M€**

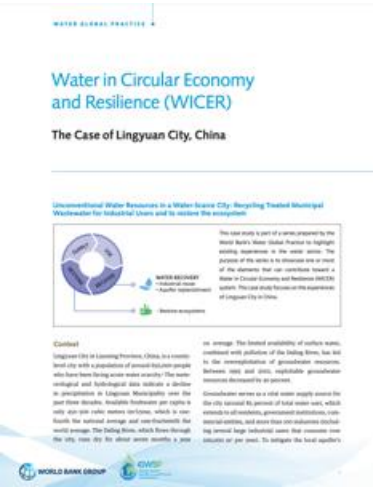
Bulgaria – Sofia UWWTP

TREND OF ENERGY CONSUPMTION AND SELF-SUFFICIENCY



Documenting relevant case studies



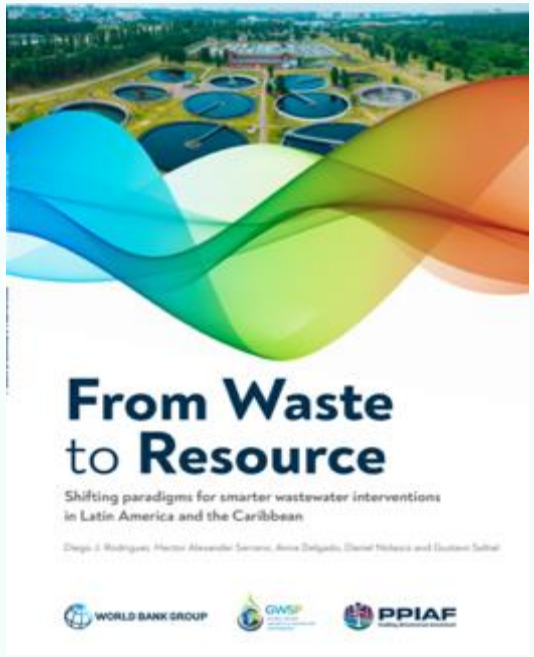


www.worldbank.org/wicer

www.worldbank.org/wastetoresource

To learn more:

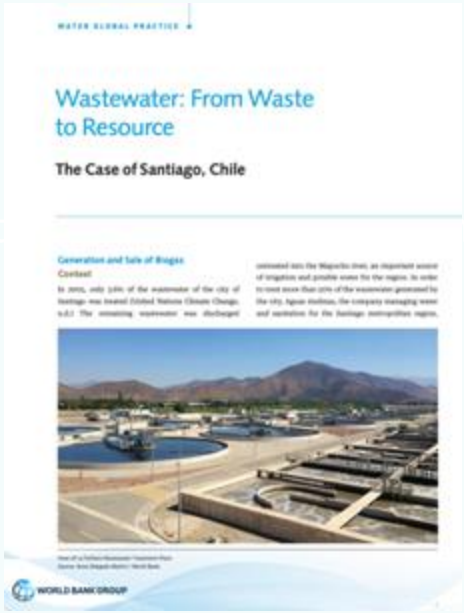
Reports with examples and guidelines to implement the concepts in the water sector



www.worldbank.org/wicer

www.worldbank.org/wastetoresource

Several case Studies



WORLD BANK GROUP

THE WORLD BANK IBRD • IDA | IFC International Finance Corporation | MIGA Multilateral Investment Guarantee Agency

Scaling ReWater

A Programmatic Approach to Developing Sustainable Wastewater Treatment and Water Reuse Infrastructure for Water Security and Climate Change Resilience

A World Bank Group initiative to scale-up sustainable wastewater treatment and water reuse infrastructure in emerging economies through unlocking public and private finance using blended financing models

Challenges scaling up investment in sustainably managed wastewater

- **Policy:** Establishing effective policy, institutional and regulatory incentives
- **Feasibility:** Carrying out adequate planning and feasibility assessments
- **Capacity:** Ensuring long-term technical and financial sustainability
- **Financing:** Addressing revenue constraints, and mobilizing financing

Short-term actions

1. Energy audit
2. System optimization (up to 30% energy savings)
3. Pump replacement, power correction, etc.
4. Continued monitoring and optimalization

Medium-Term - World Bank Proposal for The Daube Region

Identify - Invest

Nationwide Master Plan of Waste to Value opportunities. To allow high-level authorities to think in holistically and plan the best strategies for sludge and waste treatment.

Study:

1. Centralization with dewatering (economies of scale)
2. High volume advanced wastewater treatment
3. Co-digestion: Food and agricultural waste
4. Biogas optimization including public transportation etc.

Thank you!

Kristoffer Welsien, Senior Water Specialist
Contact: kwelsien@worldbank.org

www.worldbank.org/wicer

WORLD BANK GROUP
Water Global Practice

GWSP
GLOBAL WATER SECURITY & SANITATION PARTNERSHIP

CASE STUDY -
Energy Neutrality, retrofitting an existing WWTP

Ridgewood Village, USA

CONTEXT

- Energy is one of the highest costs for WWTPs
- Electricity costs are usually between 5 to 30 percent of total operating costs (in developing countries it can go up to 40 percent or more).
- Energy efficiency and energy recovery can reduce operation costs and reduce the carbon footprint of WWTPs.
- Biogas generated in WWTPs can be used to produce electricity onsite and therefore reduce electricity costs (especially in places where the price of electricity is high)
- If co-digestion is implemented, energy neutrality in WWTPs can be reached

WWTP in Ridgewood, NJ, USA

Opportunity: methane gas from digesters was previously burned and released into the atmosphere

Goal: Improve the anaerobic digesters and use the biogas to produce enough electricity (renewable energy) to satisfy the power demand of the plant.

Outcome: Improve affordability, resiliency and sustainability of wastewater treatment plant

Solution: retrofit of existing infrastructure through a PPP

The village made a "request for proposal" to design and implement a project that would convert excess methane into usable electricity. Ridgewood Green was chosen.

Ridgewood Green financed and installed liquid waste holding tanks and a biogas generator, and retrofitted the plant's two anaerobic digesters

The methane is collected, cleaned, compressed and pumped into a biogas engine to produce electricity. The excess heat from the engine is used in the anaerobic digester, increasing the plant's efficiency.

Village of Ridgewood

Operates and owns WWTP

Sends sludge to the co-digestion system operated by Ridgewood Green

Buys electricity from Ridgewood Green cheaper than market rates

Ridgewood Green

Operates co-digestion and electricity generation system

Financed and installed liquid waste holding tanks and a biogas generator, and retrofitted the plant's two anaerobic digesters

Collects additional material for the co-digestion system

Gets revenue from electricity sales and tipping fees

Financial and Contractual Agreements

Financed through a PPP between the village of Ridgewood and Ridgewood Green

- Ridgewood Green made the up-front capital investment to retrofit the plant (cost zero and minimum risk for the village of Ridgewood)
- 20 year agreement between RGRME and the village of Ridgewood:
  - The power purchase agreement set a fixed increase rate, establishing the village's price and Ridgewood Green's revenue for the duration of the contract.
  - Ridgewood Green owns the new equipment from investment and the village of Ridgewood owns and operates the plant with technical support from Ridgewood Green
- Revenue model for RGRME (expects to recover investment + reasonable ROI):
  - Selling electricity to the Village of Ridgewood
  - Selling all the renewable energy certificates (RECs) to 3Degrees, a leader in the renewable energy marketplace under an agreement of several years
  - Tipping fees assessed when haulers deliver vegetable and animal fats, oil and grease (FOG) to feed the anaerobic digesters. Proximity incentivizes haulers to dump FOG at Ridgewood's water plant rather than the traditional destinations

Benefits

For the Village of Ridgewood:

- Renewed infrastructure (state-of-the-art)
- No capital Cost to taxpayers
- Savings: Lower operating costs for the WWTP
  - Lower sludge hauling costs
  - Lower electricity costs
- More resilient – not affected by electricity price surges (locked price for 20 years)
- Lowers the Village carbon footprint

For Ridgewood Green:

- Showcase solution as an example of sustainability in WWTP (won the Biogas Project of the Year by the American Biogas Council and Environmental Achievement Award)
- Risk mitigation: The power purchase agreement set a fixed increase rate, ensuring Ridgewood Green's revenue for the duration of the contract.

For the environment:

- reduction of GHG emissions

Success – Key Factors

Stakeholder engagement

- 20-year partnership: lowering risks and ensuring revenue for the capital investor (Ridgewood Green)
- Ridgewood Green was formed to leverage each organization's respective financial capacities and technical expertise: Natural Systems Utilities (NSU), Middlesex Water Co. (MSU), and American Refining and Biochemical

Technical innovation:

- Re-use of existing infrastructure
- optimization of the anaerobic digestion process with the addition of an enzyme product which increases biogas production
- Co-digestion: the production of electricity is enhanced when food wastes such as fats, oils and grease are introduced into the process.
- Use of solar panels to achieve 100% renewable energy use in the plant

Creative and diversified new revenue streams:

- Revenue from: electricity sales to WWTP, fees from haulers and renewable energy certificates (RECs) to 3Degrees

CASE STUDY - Generation and sale of biogas

La Farfana, Chile

Context: La Farfana, Santiago de Chile

Challenge in early 2000s

- Only 3.6% of the wastewater of the city of Santiago was treated
- Released untreated water polluted Mapocho river, an important source of irrigation and potable water for the region

LA FARFANA

- Largest WWTP in Latin America at that time
- Served Population: equivalent of 3.3 million people
- Capacity: 8.8 m^3/s
- Operated by: Aguas Andinas
- Treatment Type: Conventional activated sludge
- 8 anaerobic digesters

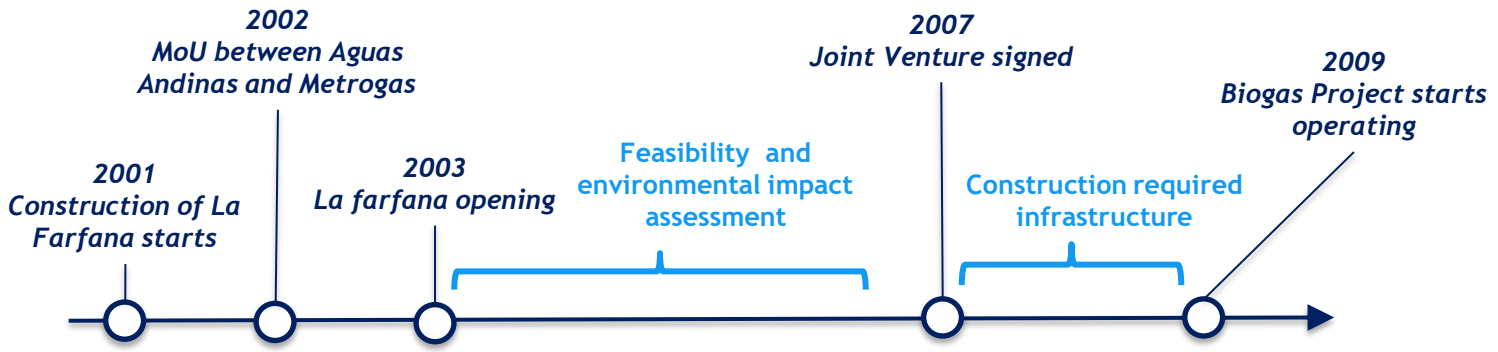
Background: La Farfana, Santiago de Chile

Generation of 25 million m³/year of biogas

Biogas burned: 19 million m³/year

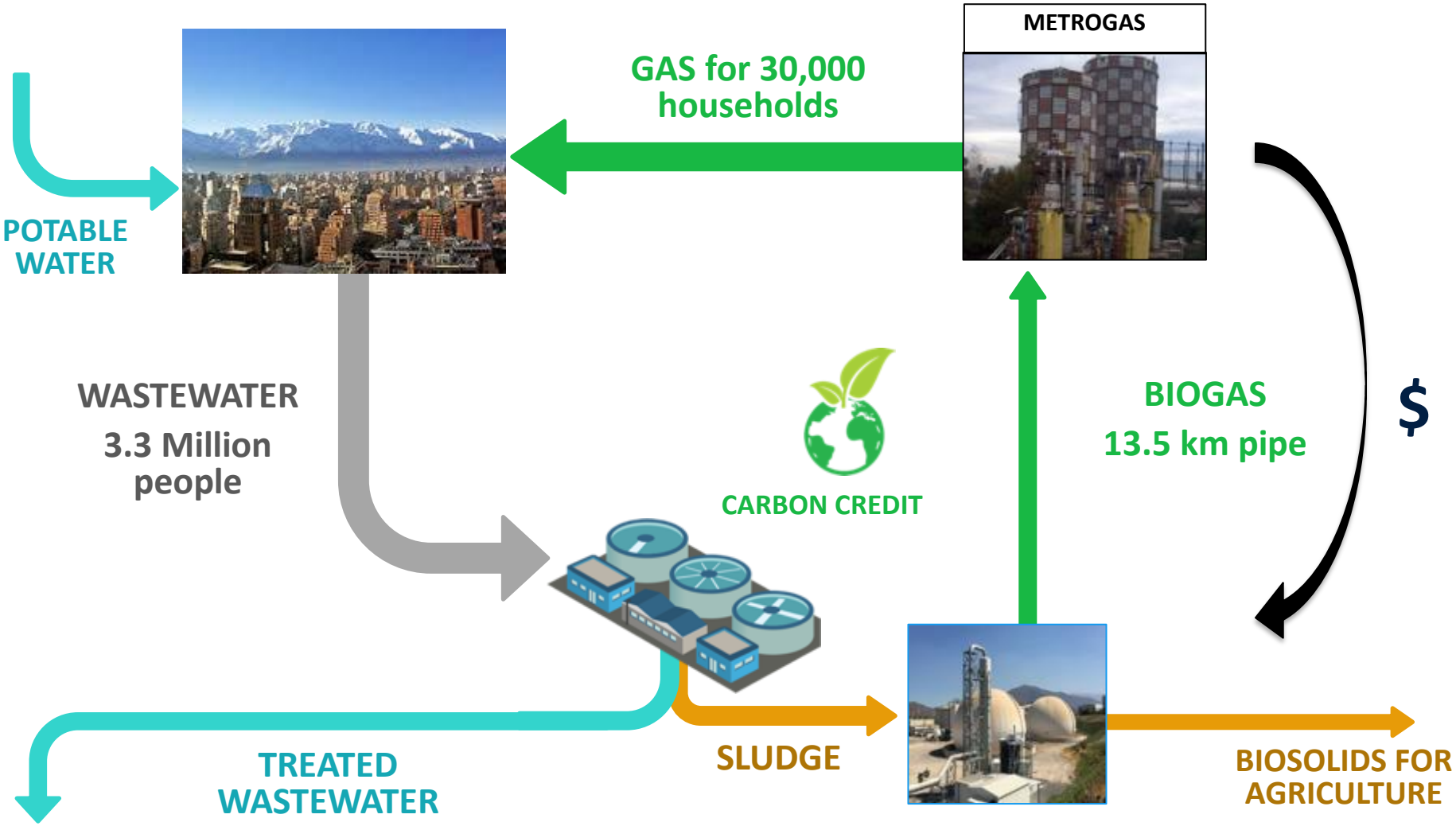
OPPORTUNITY! Available Biogas

Used biogas in the WWTP for boiler: 6 million m³/year



WORLD BANK GROUP
Water

Solution: Project Biogas



WORLD BANK GROUP
Water

Financial and Contractual Agreements of the Project

Investment: total cost 6M USD, divided equally

- Grupo Aguas: investment to improve biogas catchment and treatment (treat sulphites and modify pressure, humidity and temperature)
- Metrogas: investment for the gas pipeline (13.5 Km) and biogas final treatment (to remove siloxanes)

Conditions of the Joint Venture Sale/Purchase Agreement in 2007 :

- Fixed price for the biogas, indexed to the price of oil
- The energy value of the biogas is measured in situ, to ensure its quality
- A minimum volume of biogas is guaranteed per trimester (take or pay contract)
- Agreement for 6 years, renewable

Fuente: SUEZ Environnement

Benefits

Economical:

- *For the WWTP*: additional revenue from biogas and carbon credits (investment recovered in less than 4 years), and allows it to access the green bond market
- *For the gas distributor:* biogas is cheaper and more sustainable and reduces the dependency on imports
- *For the farmers: using b*iosolids has reduced the use of fertilizers by around 50%, reducing fertilizer costs.

Environmental and Social:

- Reduction of local pollutants (MP, NOx, COV, Az)
- Reduction of global pollutants: Reducing GHGs emissions by burning biogas, given that it replaces gas (with its transportation costs)
- Energy Sustainability
- Harnessing local resources
- Creation of “know-how”

Lessons Learned

- The Biogas Business Model Can Be Profitable for All Parties If Designed Correctly
- Water sector regulation can foster innovation
- Long-term agreement among stakeholders
- The Spill-Over Effect: The Biofactoria Concept

BIOFACTORIA

100% treated wastewater

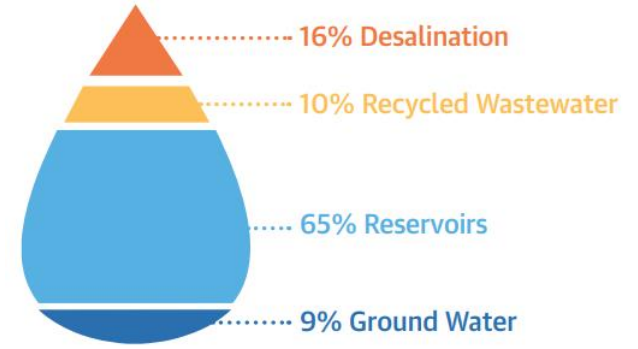
0 waste

0 GHG emissions

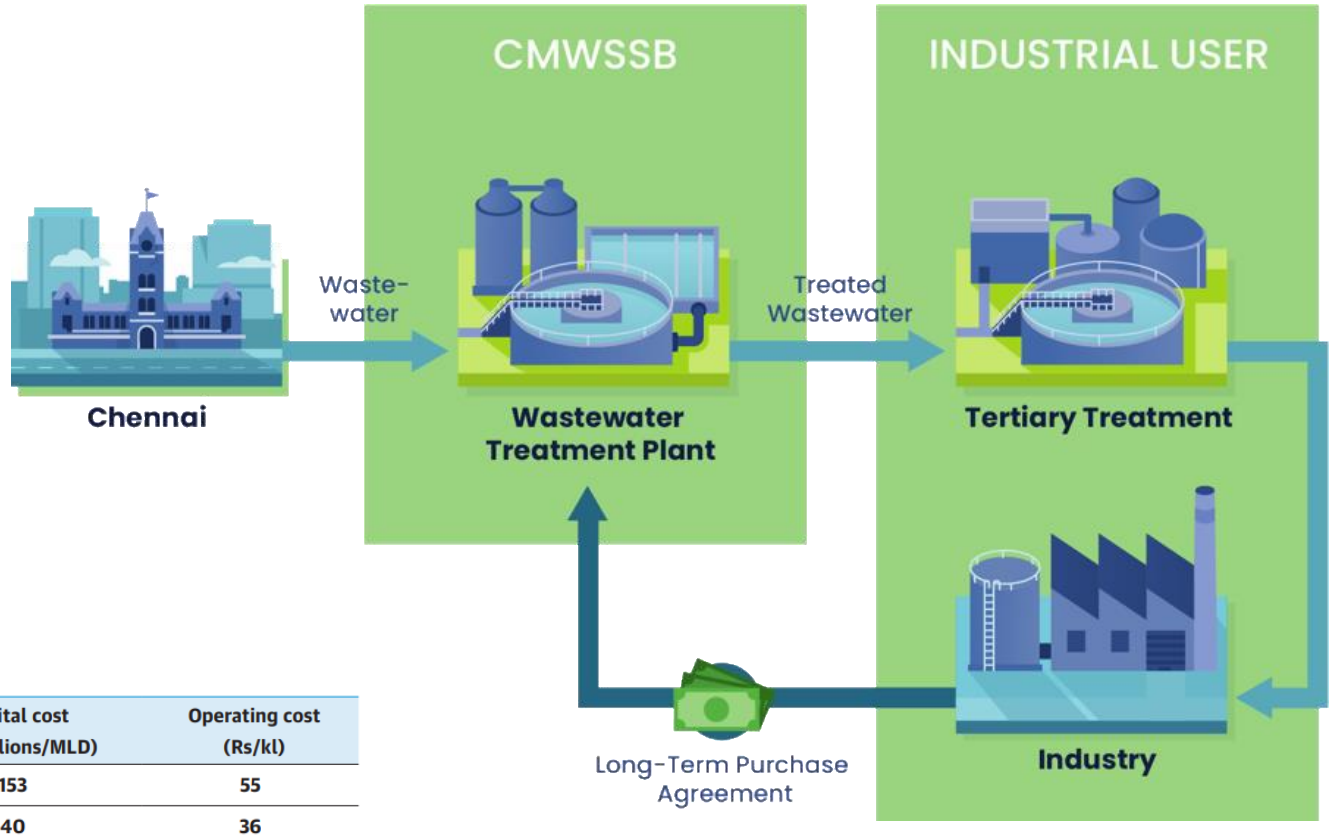
0 environmental impact

Applying circular economy principles in Chennai, India

Tamil Nadu Sustainable Urban Development Project



Source: CMWSSB, 2020.



Cost comparison by source

S. No.	Source	Capital cost (Rs millions/MLD)	Operating cost (Rs/kl)
1.	Desalination	153	55
2.	Tertiary treatment + reverse osmosis (supply of treated wastewater to industries)	40	36
3.	Tertiary treatment + ultrafiltration + water treatment plant	35	18
4.	Distance surface-water source (~250 km from the city)	77	23

Source: CMWSSB 2019.

CMWSSB: Chennai Metropolitan Water Supply and Sewerage Board