Singapore's Waste Management System

Efforts Towards Achieving a Zero Waste Nation

Lim Siak Heng, Principal Engineer

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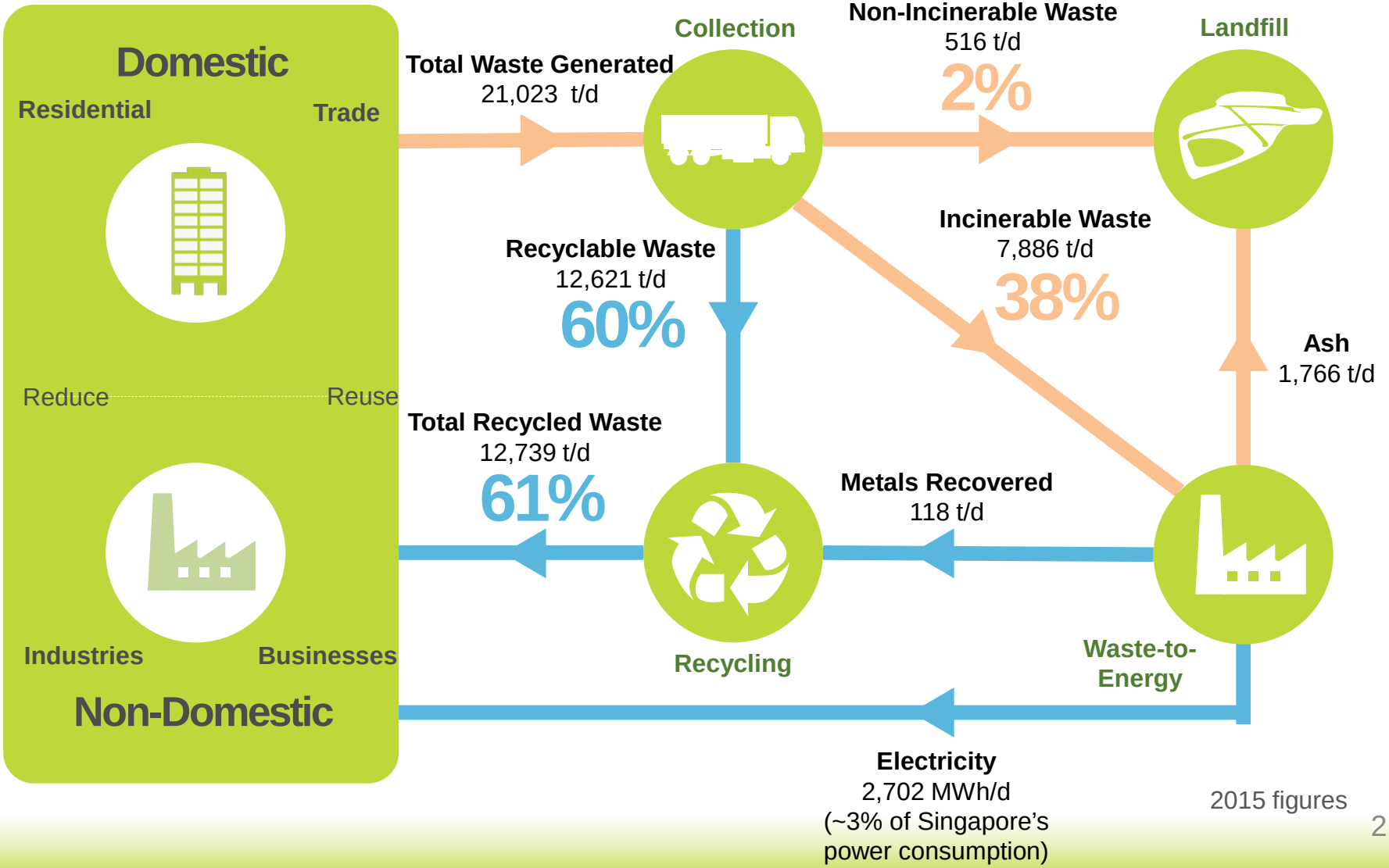
National Environment Agency

Safeguard · Nurture · Cherish

Singapore's Solid Waste Management System

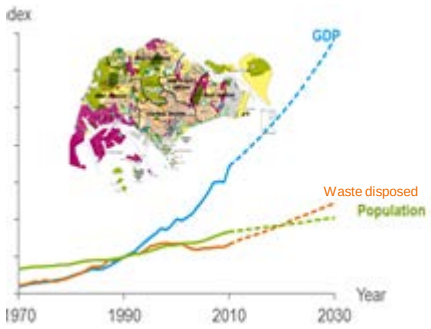


2015 figures

Waste Management Challenges

Land Scarcity

- Prolonging lifespan of Semakau Landfill
- Minimising footprint for waste treatment facilities



Increase Waste Generation

- Meeting treatment capacity demands
- Achieving higher plant efficiency

Reliance on Manpower

- Increasing manpower productivity

Climate Change

- Minimising carbon emissions / environmental impacts

High Public Expectation

- Meeting high public hygiene and cleanliness expectations

Operational Challenges

- Collecting waste daily (putrescible waste due to tropical climate)
- Highrise setting make waste recycling challenging

Waste Management Strategies

To meet the vision of a Zero Waste Nation, emphasis is placed on waste minimisation and recycling

Minimisation / Prevention

- Promote efficient use of resources in production processes
- Avoid waste through product re-design and reuse

Recycling

- Maximise resource recovery from waste
- Adopt better recycling methods
- Promote waste segregation at source in homes & businesses

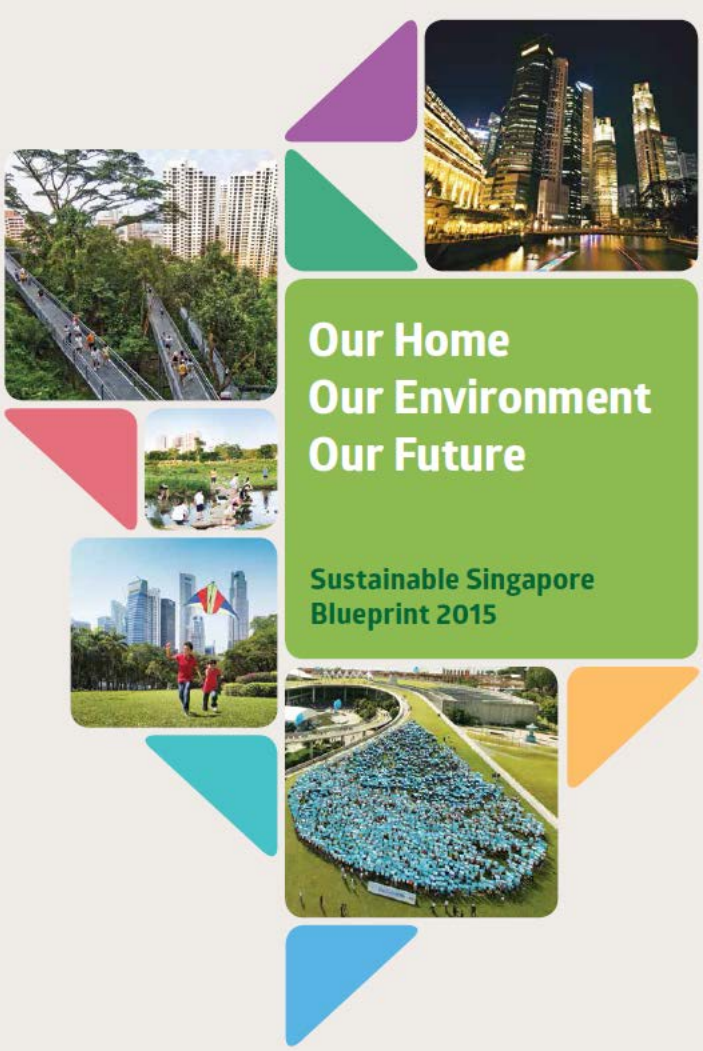
Waste-to-Energy / Volume Reduction

- Adopt innovative technology to maximise energy recovery, minimise ash & land use

Landfill

- Minimise waste to landfill

Sustainable Singapore Blueprint



Towards a Zero Waste Nation

We will work towards becoming a Zero Waste Nation by reducing our consumption of, as well as reusing and recycling all materials to give them a second lease of life. The Government, the community and businesses will come together to put in place infrastructure and programmes that make this our way of life. We will keep Singapore clean and healthy, conserve precious resources, and free up land that would otherwise have been used for landfills, for our future generations to enjoy.

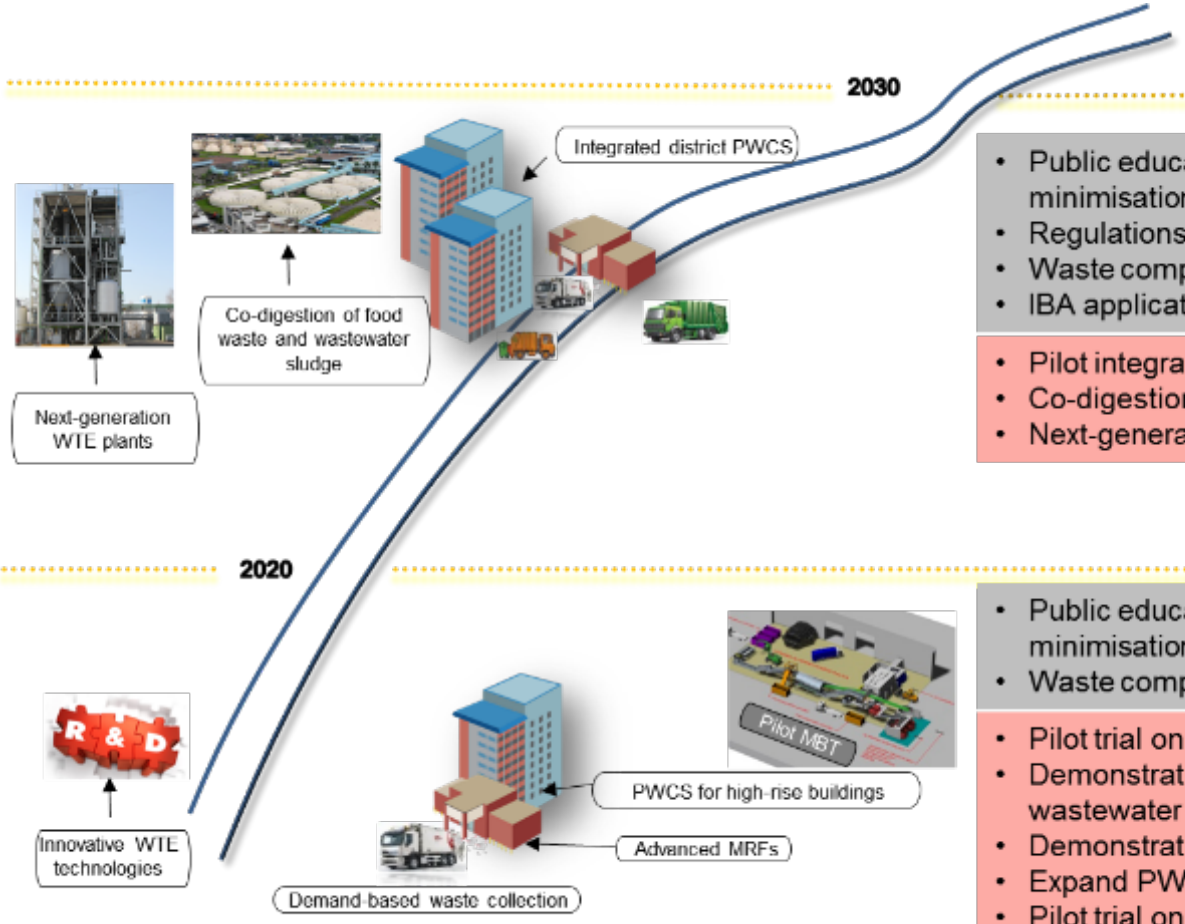
Achieve resource sustainability - overall national recycling target of 70% by 2030

Solid Waste Management Technology Roadmap

Proposed pathways on RDD&D to achieve 2030 waste management vision goals

- Maximise cost effectiveness and affordability while maintaining high levels of public health
- Maximise recycling and achieve recycling target of 70% by 2030
- Maximise resource and energy recovery from residual waste
- Minimise emissions and land footprint

Proposed Solid Waste Technology Roadmap



- Public education and community promotion of waste minimisation, source segregation and recycling
- Regulations on the use of autonomous vehicles
- Waste composition study
- IBA applications

- Pilot integrated district PWCS
- Co-digestion of food waste and wastewater sludge
- Next-generation WTE plants

- Public education and community promotion of waste minimisation, source segregation and recycling
- Waste composition study

- Pilot trial on source segregated food waste
- Demonstration of co-digestion of food waste and wastewater sludge
- Demonstration of MBT
- Expand PWCS for waste collection
- Pilot trial on demand-based waste collection
- R&D in innovative WTE technologies

Waste Minimisation and Recycling Programmes

Businesses

Singapore Packaging Agreement

Voluntary industry-govt platform to reduce packaging waste

3R Packaging Awards in recognition of SPA signatories towards the 3R of packaging waste

Commercial Premises

Mandatory Reporting Requirement

Large commercial premises to report waste data and waste reduction plans

3R Guidebook for Shopping Malls

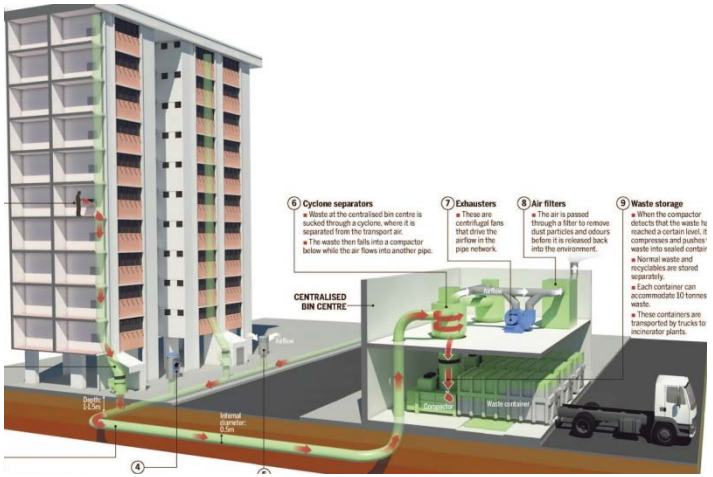
3R Fund

Homes, Schools, Public Places

Enhancements to National Recycling Programme

Examples of Innovative Waste Solutions

Solar-powered smart compactor bin



Pneumatic waste-conveyance system

On-site food waste recycling machine at food centre

Tender for food waste recycling machines in schools

New Waste-to-Energy Plant & Integrated Waste Management Facility

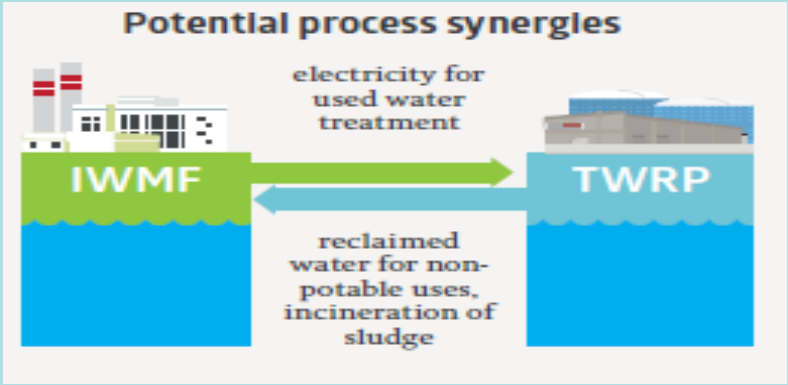
Capacity: 3,600 tonnes/day

TuasOne Waste-to-Energy Plant

Expected completion in 2019

Co-located with PUB's Tuas Water Reclamation Plant

Integrated Waste Management Facility



Expected completion in phases from 2022 and beyond

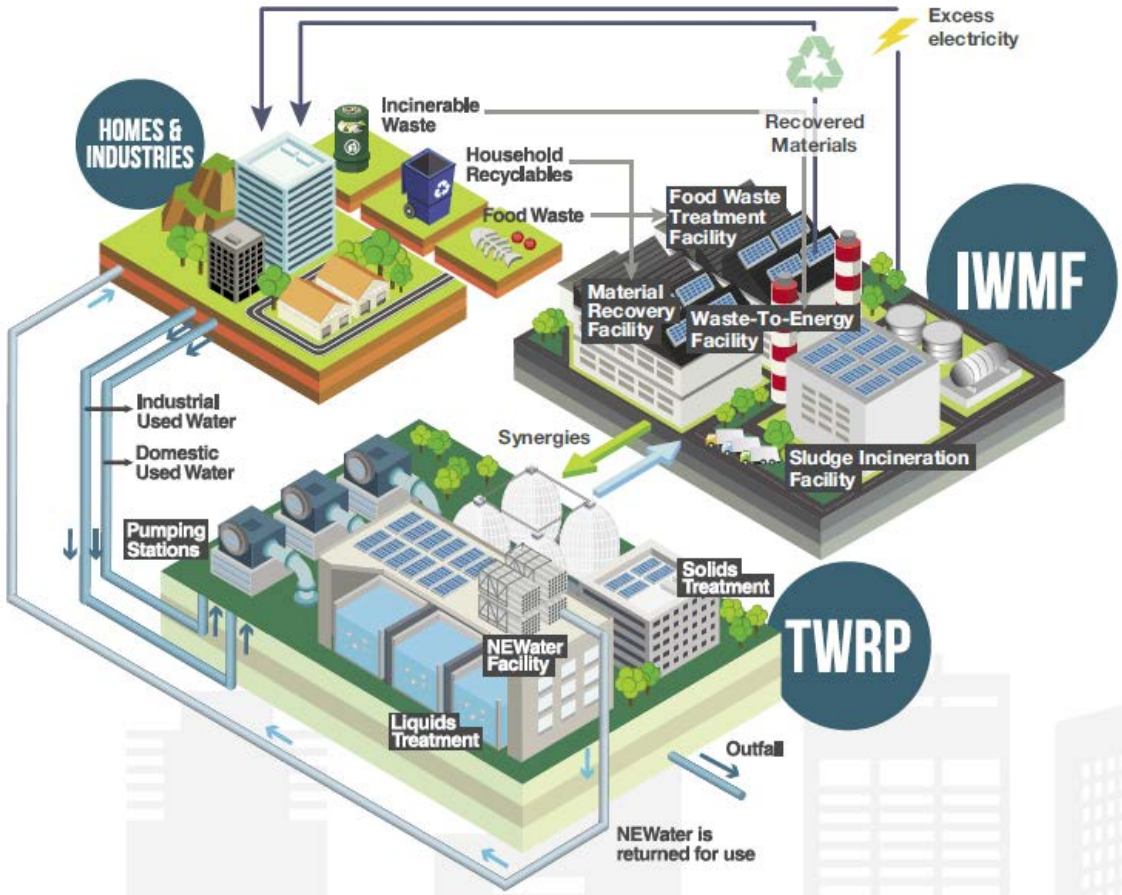
TuasOne WTE Plant

Tuasone WTE Plant

Facts & Figures

- Develop under a Design-Build-Own-Operate scheme
- Provide waste treatment services agreement for a 25-year period
- Estimated project value: SGD750 million
- Incineration technology: Reverse-acting stoker system
- Capacity: 3,600 tonnes of waste per day
- Land Area: 4.8 hectare
- Best land utilisation factor (750 t/d per hectare)
- Generate 120 MW of electricity per day
- One of the most efficient in terms of energy recovery per unit waste incinerated

Integrated Waste Management Facility (IWMF)

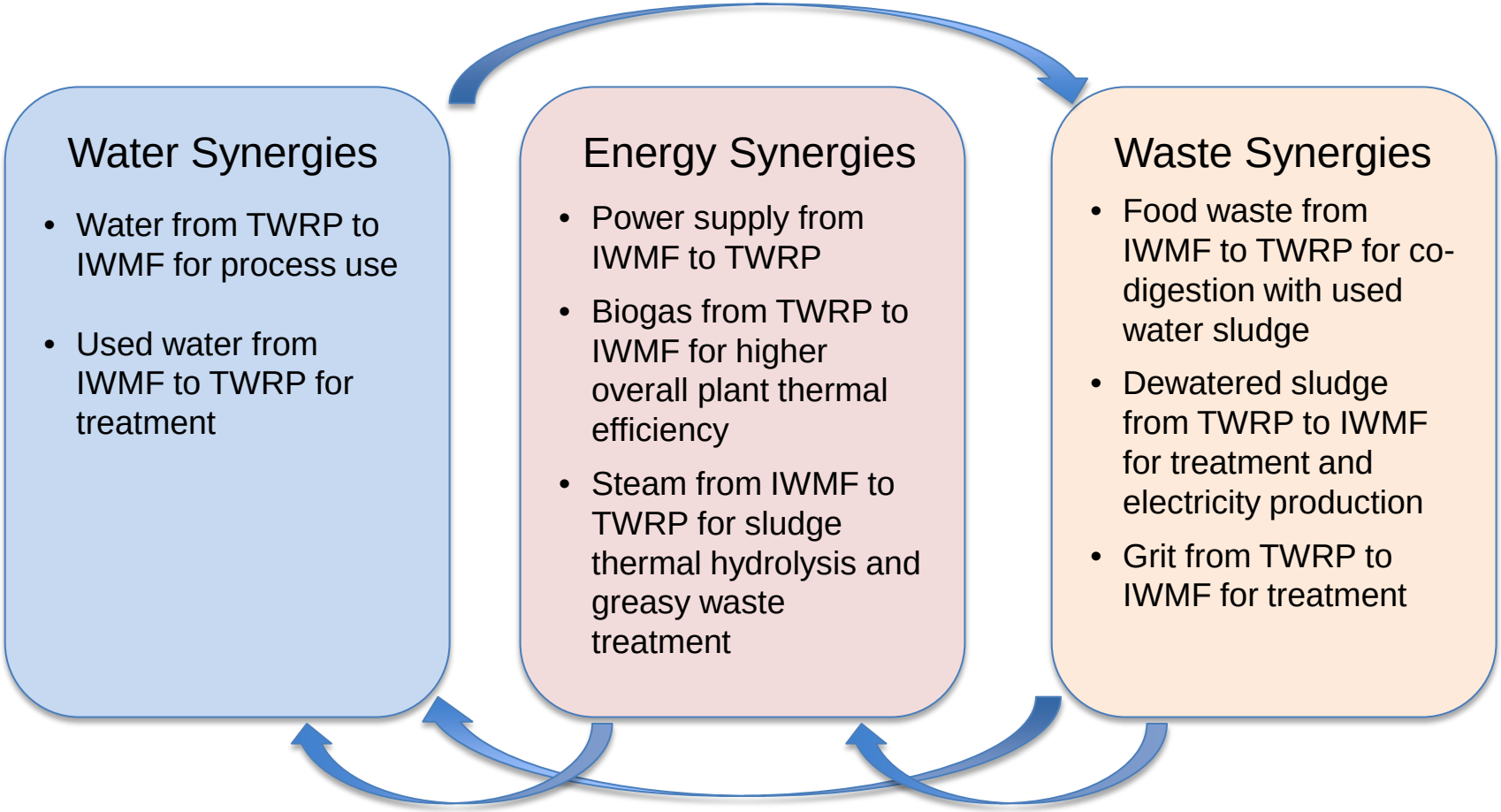


Design objectives

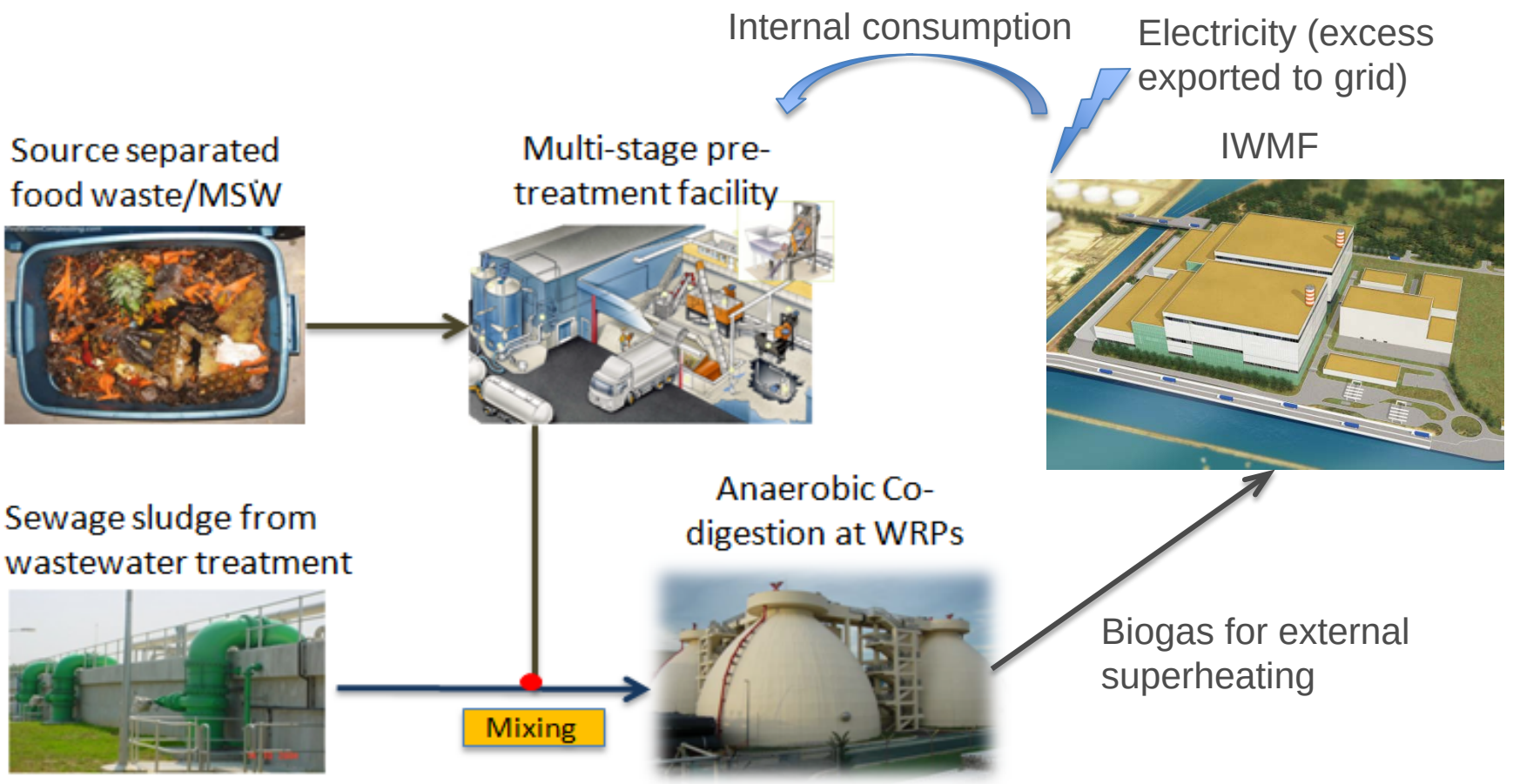
- Maximise energy recovery
- Maximise resource recovery
- Minimise environmental impacts
- Maximise system resilience
- Optimise land use
- Optimise synergies over water-energy-waste nexus

IWMF – Water-Energy-Waste Nexus

Synergies reap from the co-location of IWMF and TWRP



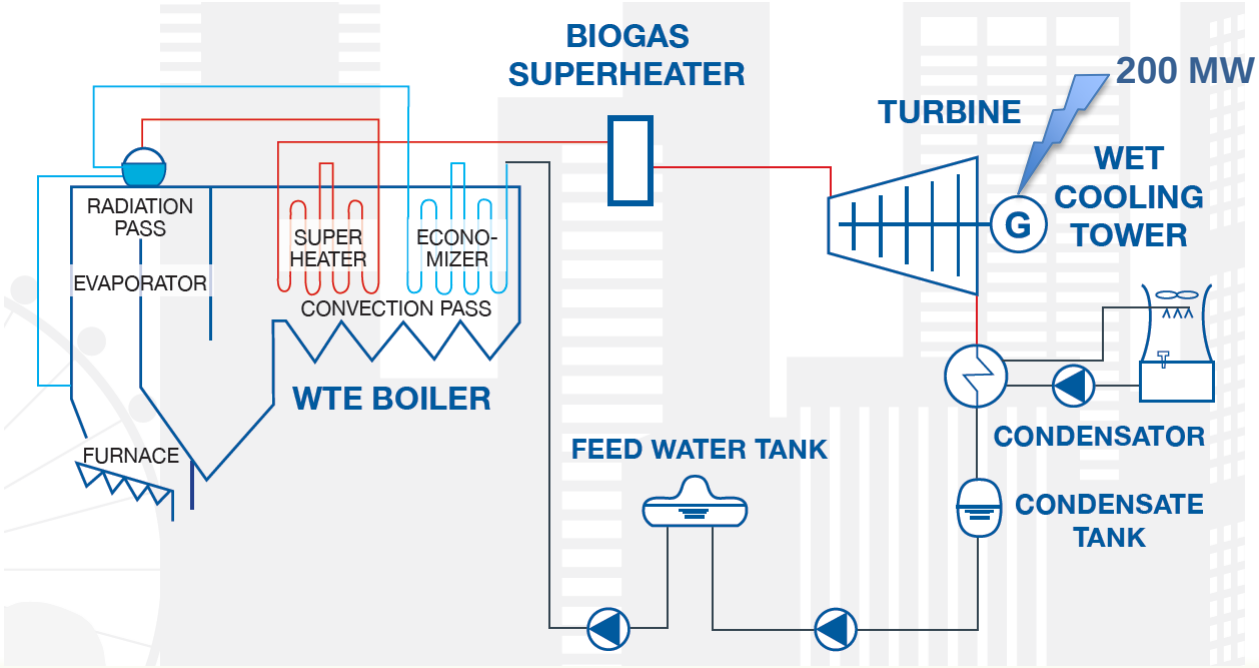
IWMF Energy-Waste Synergy - Co-digestion of Food Waste and Used Water Sludge



IWMF – Enhancing Energy Recovery

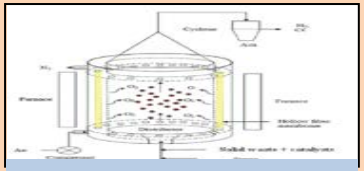
Achieve high overall plant thermal efficiency through:

- Optimised combustion process and boiler designs
- Increased steam parameters of 440˚C/50-60 bar
- External biogas superheater to boost steam parameters to 480˚C/50-60 bar
- Use of Wet Cooling Towers



NEA's Efforts in Waste Management Research

Energy Recovery

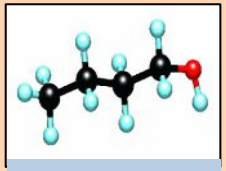


Catalytic membrane gas reactor-water gas shift system to produce hydrogen

Novel dual function capsule catalysts for gasification

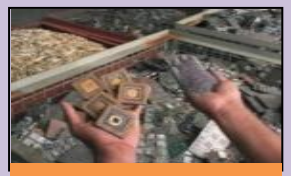
Fuel oil from mixed plastic waste

Ethanol biorefinery from food waste



Food waste into 1-Butanol

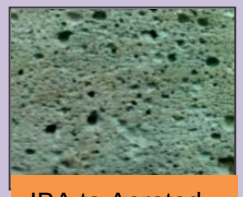
Resource Recovery



Precious and heavy metals recovery from e-waste

Paper waste to aerogels

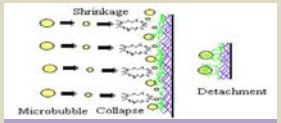
Plastic waste to biodegradable material



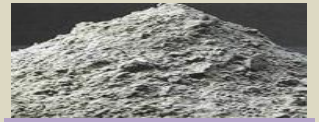
IBA to Aerated concrete

Special Waste Treatment

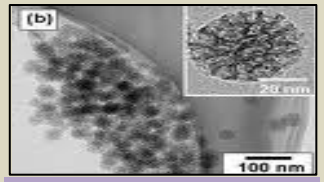
Metal oxides for selective catalytic reduction of NOx



Mircrobubbles for oily waste



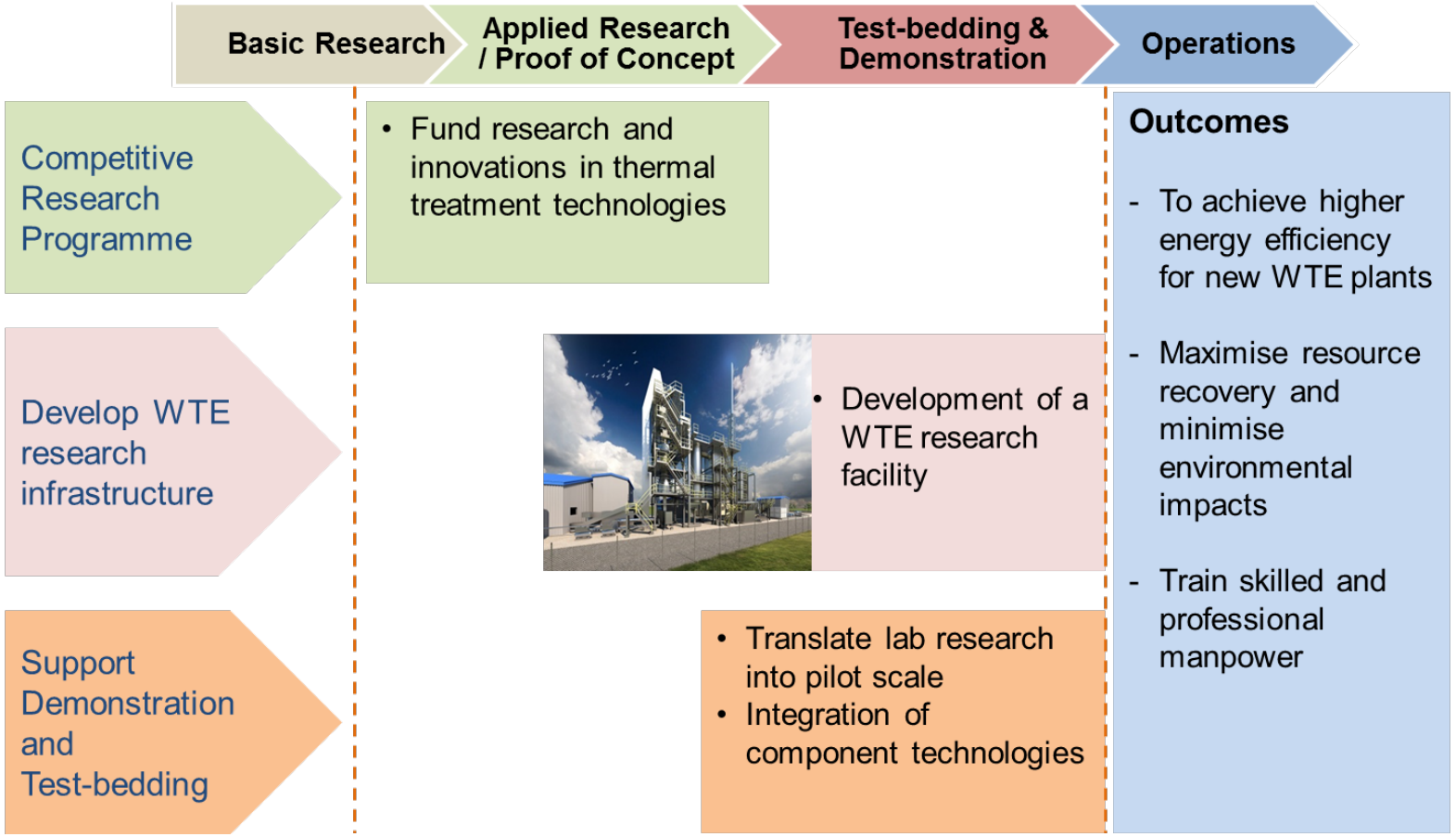
Physical and Chemical Recovery from IBA



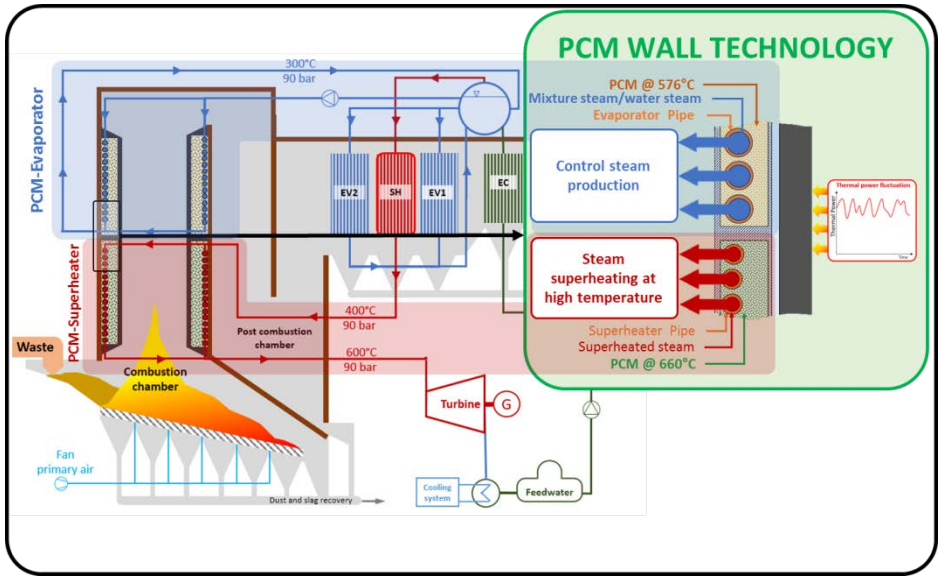
Chemical stabilisation of ash using mesoporous silica

NEA's Efforts in Waste Management Research

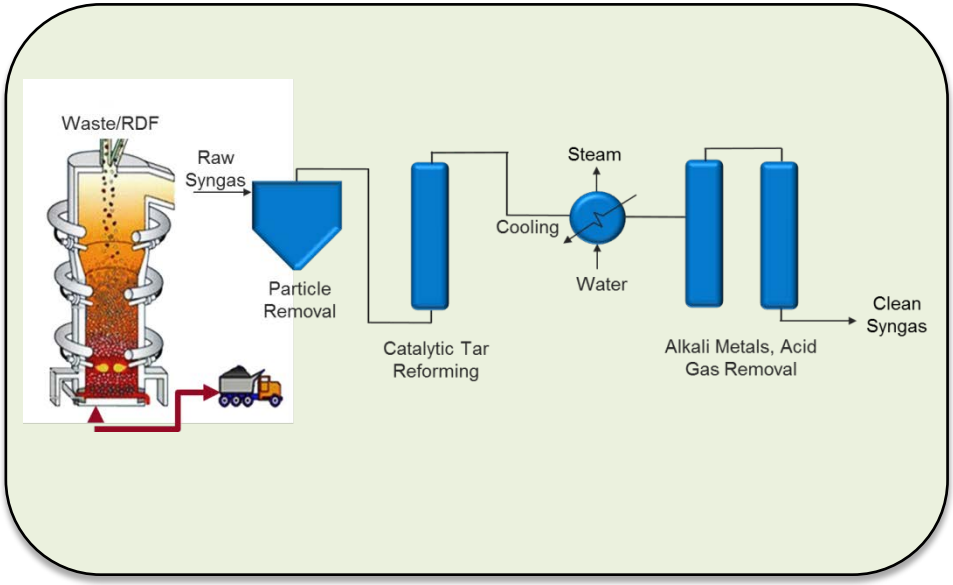
WTE R&D Programme funded by the National Research Foundation



WTE Competitive Research Programme – Awarded Project Examples



Application of Phase Change Materials (PCM) for improved energy efficiency in Waste to Energy (WtE) plants



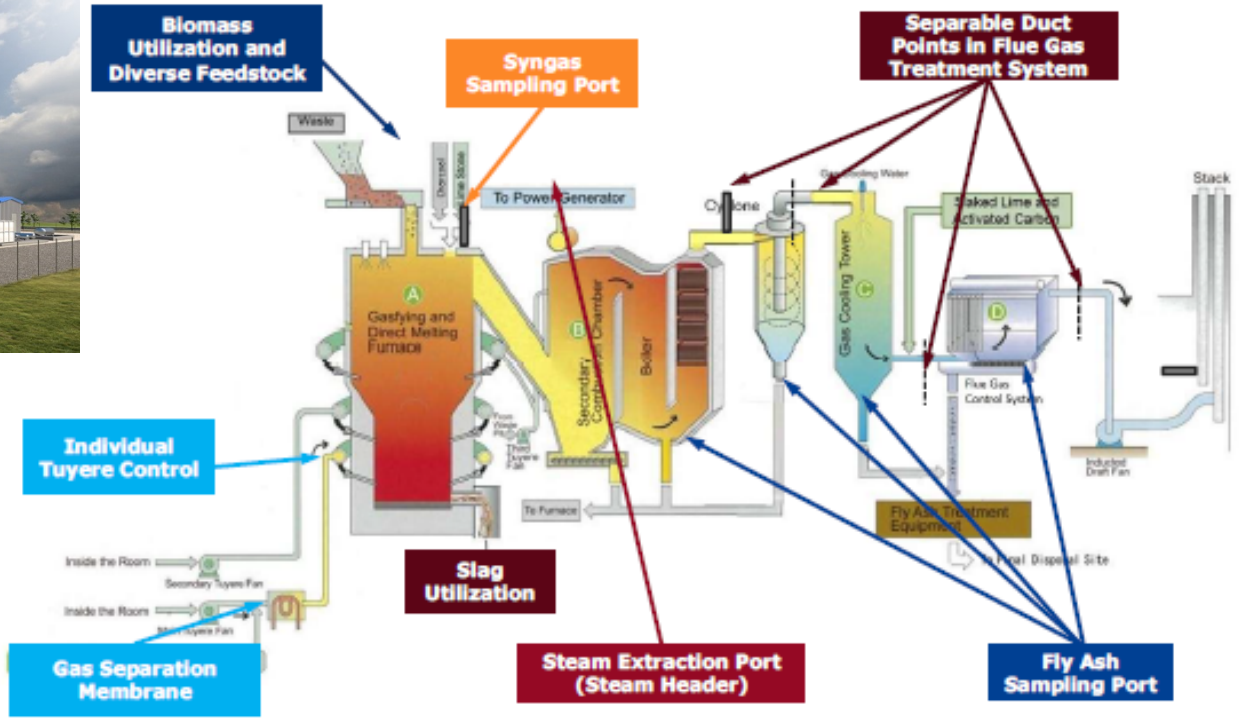
Gasification-based Syngas Upgrading and Purification System for Enhanced Power Generation

Proposed WTE Research Facility

A platform to support research, education, demonstration and test-bedding

Artist Impression

Plug and Play Features

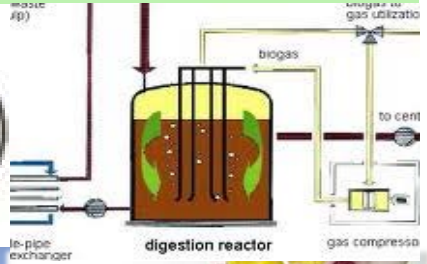


Waste Management Focus Areas

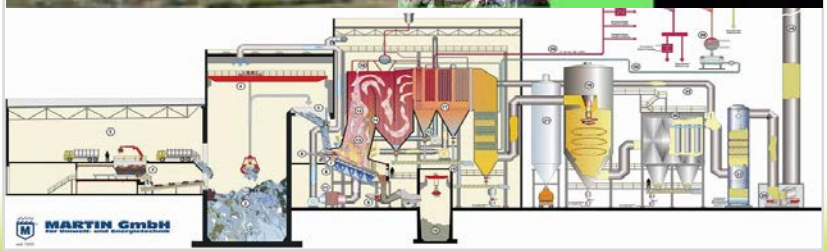
More Efficient Collection, Sorting and Pre-treatment *(e.g. MRFs, MBT)*




Organic Waste Separation & Treatment *(e.g. Co-digestion, high value products, etc)*


Thermal Treatment for Waste *(e.g. advanced mass-burn, gasification, etc)*

Ash Treatment and Utilisation *(e.g. metal recovery, land reclamation, etc.)*

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