An Overview of the IWMF
Broad Objectives of IWMF

An integral part of NEA’s long-term plan to meet Singapore’s future solid waste disposal needs.

As a state-of-the-art flagship facility, it will be developed to achieve greater environmental sustainability and provide Singapore with an affordable waste management system when completed.
IWMF as a Solid Waste Treatment Facility

IWMF will provide several key solid waste treatment processes in an integrated facility to effectively handle various waste streams such as incinerable waste, household recyclables collected under the National Recycling Programme (NRP), source-segregated food waste and dewatered sludge from Tuas WRP.

Design objectives include:

• Maximisation of energy and resource recovery
• Minimisation of environmental impact
• Optimisation of land use
• Optimisation of synergies through co-location with TWRP
Project Innovations – Improve Power Production

- IWMF will be able to achieve high overall plant thermal efficiency (~ 28%) through:
  - Optimised combustion process and boiler designs
  - Increased steam parameters 370°C/35 bar → 440°C/50-60 bar
  - Use of external biogas superheaters to boost steam parameters from 440 °C/50-60 bar → 480 °C/50-60 bar
  - Use of Wet Cooling Towers

- Annual power production of IWMF will be ~1,980,000 MWh
- Annual export to grid and TWRP will be 1,797,000 MWh
- Can power more than 400,000 apartments (4-room apartments)
Project Innovations – Minimise Environmental Impact

- IWMF will be designed with a Wet FGT system to produce clean air emissions

- Achieves clean air emissions
- Requires lower chemical dosage and therefore produces less residue for disposal

**Wet Flue Gas Treatment (FGT)**

- Scrubber tower (height ≈ 30 metres)
- Acidic gases neutralised in wet scrubbers before safe discharge
- Fly ash captured separately upstream

**IWMF Performance**

100% = Emission limits in ‘EU Directive 2010/75/EC’
Preliminary Design Layout

- Preliminary design layout has adopted innovative use of space to house all facilities while optimising land use.

Facilities located below tipping floor:
- Materials Recovery Facility
- Food Waste Treatment Facility
- Workshop

- Achieve land use savings of about 2 ha
INTEGRATED WASTE MANAGEMENT FACILITY (IWMF)

DESIGN CONCEPT & TECHNOLOGIES
Key Facilities of the IWMF

- Phase 2 (WTE + Food Waste Treatment Facility)
- Phase 1 (WTE + Material Recovery Facility)
- Sludge Incineration Facility
- Ramp up to Bunker
- Weigh Bridges
Waste-To-Energy Facility: Incinerable Waste

- Facility to treat Incinerable Waste with Advanced Moving Grate Technology
  - Goal: To ensure high volume reduction in waste and maximise energy and resource recovery
  - Key Criteria for Technology Selection
    - Commercially available
    - Offered by reputable manufacturers
    - Reliable: Reference plants with substantial track records
    - Volume reduction: Min 90%

- Reliable capacity = 5800 t/d (8 units)

- Key design features:
  - Innovative energy system → High power production
  - Wet flue gas treatment system → Clean air emissions
  - Advanced metal recovery → Facilitate metal reuse
Material Recovery Facility: Household Recyclables

- **Materials Recovery Facility (MRF)**
  - Goal: Improve sorting efficiency, product quality and reduce land-take
  - Technology based on advanced automatic systems to sort metals, paper, cardboard and plastics

- **2 units x 125 t/d** (equipped with trommels, magnetic separators, eddy current, near-infrared (NIR) etc.)
Food Waste Treatment Facility

- Facility to treat source-segregated food waste to high quality bio-pulp for co-digestion with sludge at Tuas WRP
  - Goal: To recover more energy from food waste via co-digestion with used water sludge
  - Well-proven technology based on screw press → High quality bio-pulp
  - 2 units x 200 t/d based on screw-press technology
Sludge Incineration Facility

- **Goal**: Treatment of Tuas WRP sludge and energy recovery
- Fluidised bed technology is selected due to good track record and ability to ‘open-up’ the structure of the wet cake
- 2 units x 400 t/d for treatment of dewatered sludge
- Back-up, co-incineration of sludge (capped at 5%) with MSW
## IWMF – Technical Overview

<table>
<thead>
<tr>
<th>Waste Streams</th>
<th>Treatment Capacity</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incinerable Waste</strong></td>
<td>• 5,800 t/d (reliable)</td>
<td>• 8 units at 725 t/d each</td>
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<tr>
<td></td>
<td>• Phase 1 – 2,900 t/d</td>
<td>• Advanced Moving Grate at medium pressure</td>
</tr>
<tr>
<td></td>
<td>• Phase 2A – 1,450 t/d</td>
<td>• 55 barG and 440/480 °C</td>
</tr>
<tr>
<td></td>
<td>• Phase 2B – 1,450 t/d</td>
<td>• Wet Cooling Towers</td>
</tr>
<tr>
<td></td>
<td>• Design NCV : 10 MJ/kg</td>
<td>• Wet Flue Gas Treatment (FGT)</td>
</tr>
<tr>
<td></td>
<td>• NCV envelope: 7-13 MJ/kg</td>
<td></td>
</tr>
<tr>
<td><strong>Household Recyclables (NRP)</strong></td>
<td>• 250 t/d</td>
<td>• 2 units at 125 t/d each</td>
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<tr>
<td></td>
<td></td>
<td>• Magnetic Separators</td>
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<tr>
<td></td>
<td></td>
<td>• Trommels</td>
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<tr>
<td></td>
<td></td>
<td>• Eddy Current Separators</td>
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<tr>
<td></td>
<td></td>
<td>• Ballistic Separators</td>
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<tr>
<td></td>
<td></td>
<td>• Near-Infrared Sorting</td>
</tr>
<tr>
<td><strong>Food Waste</strong></td>
<td>• 400 t/d</td>
<td>• 2 units at 200 t/d each</td>
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<tr>
<td></td>
<td></td>
<td>• Shredders/Crushers</td>
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<tr>
<td></td>
<td></td>
<td>• Mixers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Screw-press</td>
</tr>
<tr>
<td><strong>Dewatered Sludge from Tuas WRP</strong></td>
<td>• 800 t/d</td>
<td>• 2 units at 400 t/d each + back-up by co-incineration with MSW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sludge Dryers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fluidised Bed Incinerators</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Bag Filters</td>
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<tr>
<td></td>
<td></td>
<td>• Wet FGT</td>
</tr>
</tbody>
</table>
CO-LOCATION SYNERGIES
Co-location Synergies between Tuas WRP and IWMF

IWMF

- Household Recyclables
- Incinerable Waste
- Source-Segregated Food Waste
- Recyclables
- Clean Air Emissions
- Bottom Ash Treatment
  - Metal Recovery
  - Incineration Bottom Ash Recycling
  - Washed Incineration Fly Ash for Disposal

Tuas WRP

- Domestic
  - Inlet Pumping Station
  - Domestic Liquid Treatment Module
  - Domestic Inlet Pumping Station
- Industrial
  - Inlet Pumping Station
  - Industrial Liquid Treatment Module

- Used Water Collection via Link Sewers & Tunnels

- Food Waste Treatment
- Sludge Incineration
- Anaerobic co-digestion
- Thermal hydrolysis plant
- Sludge
- Biogas
- Steam Turbine Generators
- Steam
- Excess effluent (water)
- Electricity supply to Tuas WRP

- Recycled Water
  - NEWater Plant
  - Industrial Water Plant
  - NEWater
  - RO-brine
- Marine Disposal

- Domestic Liquid
- Industrial Liquid

- Fly Ash for Disposal
- Marine Disposal
- Surplus Electricity to Grid
- Dewatered sludge
- Treated effluents
Co-location Synergies between Tuas WRP and IWMF

Synergy: Food Waste from IWMF to Tuas WRP

Base Case

Food Waste → Incineration

Synergy Case

Food Waste → Food Waste Treatment → Rejects → Incineration

Food Waste Treatment → Bio-pulp

Food Waste Treatment → Pre-drying

Used Water Sludge → Solid Waste Treatment

Solid Waste Treatment → Biogas
Co-location Synergies between Tuas WRP and IWMF

Synergy: Food Waste from IWMF to Tuas WRP

Food Waste Treatment Facility at IWMF:
- Screw-press technology → high quality bio-pulp to Tuas WRP
- 400 t/d food waste + 280 t/d of water → 600 t/d bio-pulp + 80 t/d of rejects

An additional digester required + ancillaries at Tuas WRP:
- Plans to mix 1:1 with sludge (2 x 10,000 m³) in the initial phase
- Lab-scale study indicated 1:1 mixing increases biogas yield by 10%
Co-location Synergies between Tuas WRP and IWMF

Synergy: Power Supply from IWMF to Tuas WRP

**Base Case**

IWMF Turbine-generator → Power Grid → Tuas WRP

**Synergy Case**

IWMF Turbine-generator → Power Grid → Tuas WRP

Backup Gen Set & Ancillaries

Tuas WRP → Electricity sale → Power Grid → IWMF Turbine-generator

Tuas WRP → Electricity export → Power Grid → IWMF Turbine-generator
Synergy: Power Supply from IWMF to Tuas WRP

Direct power connection from IWMF to Tuas WRP:
- Tuas WRP is an auxiliary load of IWMF
- Singapore Power PowerGrid (SPPG) grid serves as back-up supply → No requirement for back-up generator set and ancillaries at Tuas WRP.
- Improved resilience due to dual power sources for Tuas WRP.
Co-location Synergies between Tuas WRP and IWMF

Synergy: Dewatered Sludge from Tuas WRP to IWMF

Base Case

Tuas WRP Dewatered Sludge → Stand-alone Incineration / Outsource Incineration

Synergy Case

Pre-drying → Fluidised Bed Incineration → Steam to Turbine-generator
Synergy: Dewatered Sludge from Tuas WRP to IWMF

Co-located plant configuration:
- Incorporates co-incineration of sludge from Tuas WRP
  - Base Case: 3 x 400 t/d
  - Synergy Case: 2 x 400 t/d + back-up with co-incineration (subject to a cap of 5-7% sludge)

Potential for increased electricity production:
- **5 MW** steam produced from sludge incineration is channeled by 50 bar system to IWMF turbines → Additional **2.5 MW** electricity produced
Co-location Synergies between Tuas WRP and IWMF

**Synergy: Biogas from Tuas WRP to IWMF**

**Base Case**

- Thickened Sludge → THP → Digester → Dewatering → Fluidised Bed Incineration
- Biogas from THP to Digester
- Heat from Digester to THP

**Synergy Case**

- Thickened Sludge → THP → Digester → IWMF Turbine
- Biogas from Digester to THP
- Fluidised Bed Incineration
- Steam Bleed from IWMF Turbine to Biogas superheater and Drying
- Biogas to Dewatering
Co-location Synergies between Tuas WRP and IWMF

Synergy: Biogas from Tuas WRP to IWMF

Biogas combusted in IWMF produces power:

• **Advantages:**
  • Innovative usage in external biogas superheaters at IWMF to increase overall plant thermal efficiency
  • Reduced land-take – as no need for biogas engines, biogas cleaning, large gas holders, etc. at Tuas WRP
  • Reduced CAPEX for Tuas WRP
  • Reduced technical complexity & operational costs
  • Reduced air emissions of NOx, Total Organic Content (TOC) and methane.
Co-location Synergies between Tuas WRP and IWMF

Physical Synergies include the Administration Building and Site-wide infrastructure on site

IWMF

- Food waste
- Power supply
- Steam supply
- Sludge drier condensate

Tuas WRP

- Dewatered Sludge
- Grit
- Biogas
- Water supply
- Odour Air

SYNERGIES BETWEEN TUAS WRP & IWMF
THE DTSS PHASE 2 & IWMF PROJECT

AIMS TO BE:

• SUSTAINABLE
• RESILIENT
• COST EFFECTIVE

HARNESSES SYNERGIES OF THE WATER-ENERGY-WASTE NEXUS TO ACHIEVE DESIGNS WHICH ARE:

• COMPACT
• RESOURCE EFFICIENT
• FIRST OF ITS KIND FROM THE GROUND UP

In association with
CONTRACT PACKAGING & IMPLEMENTATION TIMELINE
## DTSS Phase 2 & IWMF Overall Timeline

<table>
<thead>
<tr>
<th>Year</th>
<th>Link Sewers</th>
<th>Tunnels</th>
<th>Tuas WRP</th>
<th>IWMF</th>
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<tbody>
<tr>
<td>2016</td>
<td>Consultant Tender</td>
<td>D&amp;B Tender</td>
<td>Consultant Tender</td>
<td>Pre-Q, Owner's Engineer</td>
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<td>Design &amp; Construction</td>
<td>Detailed Design</td>
<td>Pre-Q, EPC</td>
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<td>Construction</td>
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<td>Construction</td>
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<td>&amp; call EPC</td>
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**DTSS Phase 2 Project | July 2016**
# CONTACT DETAILS

## DTSS Phase 2 Project

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Email</th>
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<tbody>
<tr>
<td>Mr Yong Wei Hin</td>
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<td>Project Director (B&amp;V+AECOM JV)</td>
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## Tunnels & Link Sewers

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ms Woo Lai Lynn</td>
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<td><a href="mailto:woo_lai_lynn@pub.gov.sg">woo_lai_lynn@pub.gov.sg</a></td>
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</tbody>
</table>

## Tuas Water Reclamation Plant

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Email</th>
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</thead>
<tbody>
<tr>
<td>Mr Ravi Chandran</td>
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## Integrated Waste Management Facility (IWMF)

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Email</th>
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<tbody>
<tr>
<td>Mr Joseph Boey</td>
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</tr>
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<td>Mr Lok Horng Ming</td>
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