LGAQ Future Cities – Smart Communities Summit

The Future Now: What we do, done differently

Waste to Energy

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SLR

CONTENTS

1. WHAT DOES ‘SMART’ WASTE MANAGEMENT MEAN?

2. ‘SMART’ CITIES - GLOBAL CASE STUDIES

3. THE ROLE OF WASTE TO ENERGY

4. PROJECT CASE STUDIES

5. CONCLUSIONS

CONTENTS

1. WHAT DOES ‘SMART’ WASTE MANAGEMENT MEAN?

2. ‘SMART’ CITIES - GLOBAL CASE STUDIES

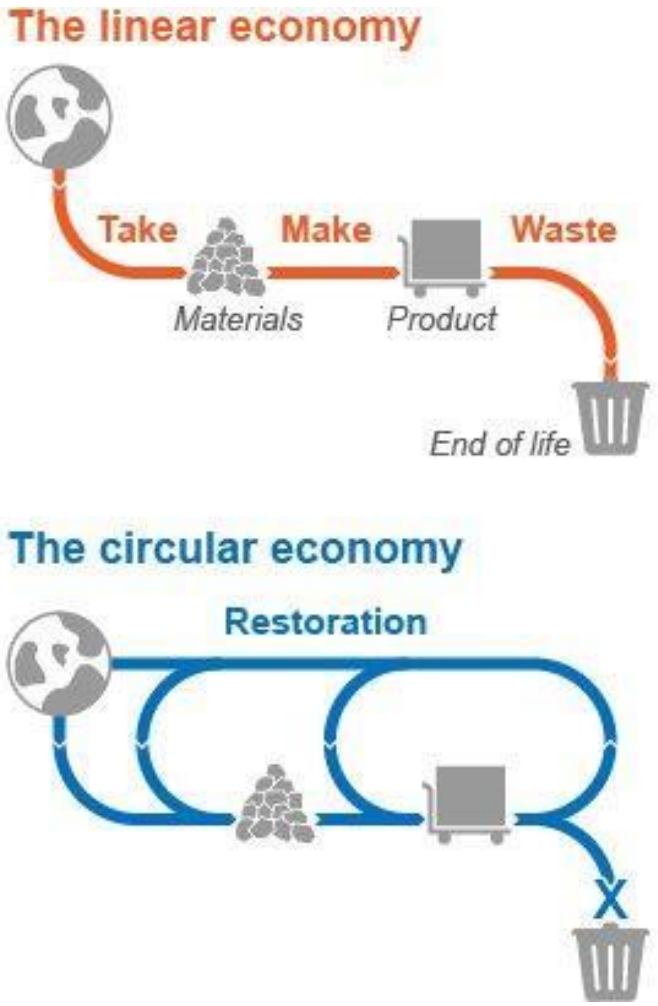
3. THE ROLE OF WASTE TO ENERGY

4. PROJECT CASE STUDIES

5. CONCLUSIONS

Being ‘Smart’ with waste

- Waste avoidance
- Designing waste out
- Waste refurbishment / reuse / recycling
- Minimising disposal (landfill)
- Changing the mindset – waste is a **resource**



Emergence of the Circular Economy

- The last 10-15 years has seen a dramatic change in the way we view and treat waste.
- The **'Circular Economy'** sees waste as a resource
  - **Materials reclaimed and reused or recycled** as secondary raw materials for new products
  - **Organic waste** a source of soil nutrients
  - Energy generated from any **residual waste** that cannot be recycled
- Reduces pressure on natural resources / supply chains
- Contributes to sustainable economic growth and employment

European Commission Circular Economy Package (2015)

- **BETTER PRODUCT DESIGN** – The Commission will support product requirements that makes **products more durable, and easier to repair and recycle**.

- **CREATING INCENTIVES** – The Commission will create a direct economic incentive for producers to **make products that can be easily recycled or reused** through extended producer responsibility schemes

- **IMPROVED PRODUCTION PROCESS** - To reduce resource use and waste generation in production processes, the Commission will **promote best practices in a range of industrial sectors** through Best Available Techniques Reference documents (BREFs) for various industrial sectors.

- **INNOVATIVE INDUSTRIAL PROCESSES** – The Commission will clarify rules on by-products and on end-of-waste status, which will help **support the development of industrial symbiosis** – a process by which the waste of one company can become the resource of another.

CONTENTS

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2. ‘SMART’ CITIES - GLOBAL CASE STUDIES

3. THE ROLE OF WASTE TO ENERGY

4. PROJECT CASE STUDIES

5. CONCLUSIONS

GLOBAL CITIES – Case Studies

- Global Cities
  - key drivers for change
  - lessons learned

GLOBAL CITIES – Case Studies

	Key Drivers	Lessons Learned
Vancouver **Stats** - **58% MSW diversion 2016** - **62% citywide diversion (MSW, C&I and C&D)** - **Pop (~0.6M for city and ~2.5M metro region)** - **Area ~2,900km^2**	• City plan for 50% reduction to landfill/EfW by 2020 (2008 baseline) • Regional waste plan targets 80% diversion rate by 2020 • New city strategy to reach Zero Waste by 2040	• Banning disposal of food waste • Complement food collections roll out • Transferring collection of recyclables to product stewardship schemes • Enforcing material bans by surcharging post collection
Stockholm **Stats** - **99% MSW diversion 2016** - **91% citywide diversion (MSW, C&I and C&D)** - **Pop ~0.9M for city and ~1.4M metro region** - **Area ~380km^2**	• EU legislation – recycling & organic waste diversion targets • National targets for AD • Local waste management plan • Landfill levy A$70/tonne (2018) • Material landfill bans • Cultural acceptance of EfW benefits • Widespread district heating in city	• Highest diversion EfW & recycling • Public acceptance of EfW reliability • Taxes & material bans are effective • EPR extended to dry recyclables • Optional food collections yield modest uptake

GLOBAL CITIES – Case Studies

	Key Drivers	Lessons Learned
Adelaide **Stats** - **58% residential diversion 2015/16 (MSW)** - **82% citywide diversion (MSW, C&I and C&D)** - **Pop ~1.3M for metro region** - **Area ~870km²**	• 2020 landfill diversion targets – 70% MSW, 80% C&I, 90% C&D • 2020 recycling target of 60% • Waste Levy – A$100/tonne	• Three bin system introduced • facilitated joint investment & economies of scale • Waste Levy created strong composting industry (competitive with landfill) • Absence of EfW investment so far
Seattle **Stats** - **53% MSW diversion 2016** - **64% citywide diversion (MSW, C&I and C&D)** - **Pop ~0.7M for city and ~3.8M metro region** - **Area ~217km²**	• 2007 Zero Waste Resolution • 2013 Waste Management Plan • 70% C&D recycling target 2020 • 70% MSW recycling target 2022	• Separate treatment & collection contracts • Innovative charging mechanism on bin volumes

GLOBAL CITIES – Case Studies

	Key Drivers	Lessons Learned
Copenhagen **Stats** - **99% residential diversion 2015 (MSW)** - **98% citywide diversion (MSW, C&I and C&D)** - **Population (~0.75M for city and ~0.9M metropolitan region)** - **Area ~3,200km²**	• EU legislation – diversion & CE targets • Copenhagen Waste Plan 2018 • Treatment taxes since 1987 (Incineration c. A$65/tonne, Landfill c. A$90/tonne) • Landfill ban since 1997 • Now looking to reduce waste to EfW	• EfW public ownership • Before ~80% of Danish hhd waste sent to EfWs • Now EfW caps in place • Voluntary food collections – now mandatory from Sep 2016 • Introducing surplus food supermarkets

- **Key Themes from Case Studies:**
  - Use of landfill levies / taxes or bans
  - Focus on organic waste diversion and processing
  - To achieve 95%+ diversion, thermal processing of residual waste required
  - Public ownership of assets preferred

GLOBAL CITIES – Lessons learned & key priorities

- **Lessons learned:**
  - **Legislative measures** consistent with waste hierarchy
  - **Fiscal re-structuring** consistent with waste hierarchy
  - **Strong commitment, accountability and ownership** of waste related issues
  - **Integration of waste streams** for treatment and disposal (MSW and CIW)
  - **Firm political commitment** and early decisive action
  - **Integrated plan development** (principally at regional level)

CONTENTS

1. WHAT DOES ‘SMART’ WASTE MANAGEMENT MEAN?

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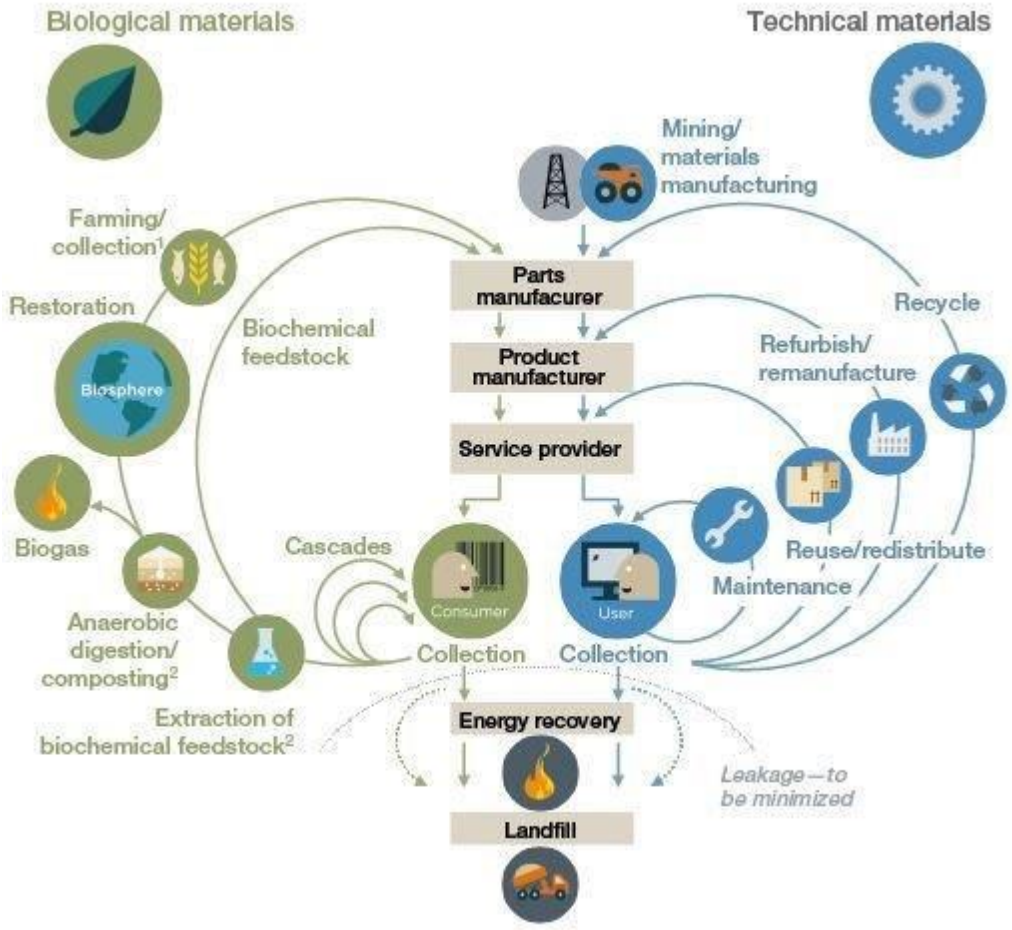
3. THE ROLE OF WASTE TO ENERGY

4. PROJECT CASE STUDIES

5. CONCLUSIONS

The role of waste treatment technology

- Focus often on the front end of product design and waste prevention / reuse – rightly so
- Provision for the treatment and reprocessing of segregated material streams, and the residual stream, is equally important if a move away from landfill reliance is to be achieved
- State & Local Government in Australia have the greatest ability to influence decisions on technology selection through policies, byelaws and contractual / procurement decisions.
- MRF's normally the first port of call: focussed on production of high quality recyclate streams for onward reprocessing.
- **Processing of other waste flows also critical**



Principal waste technology options

Non-thermal:

- Composting [**organic waste**]
- Anaerobic Digestion (AD) [**principally organic waste**]
- Mechanical Biological Treatment (MBT - **RDF / PEF production**)
- Mechanical Heat Treatment – Autoclaving [**residual waste**]

Thermal:

- Thermal treatment with energy recovery [**residual waste / RDF / PEF**]
- Advanced Thermal Treatment (ATT - gasification / pyrolysis / plasma arc) [**principally RDF / refined PEF**]

Key priorities for success

- Fully characterise and understand **waste flows** – quality and quantity
- Recognise that the **waste is variable** and will change significantly over time
- Vital to **match waste feedstock** (including variability) with technology
- Only select **technology that is proven** - and therefore **'bankable'**
- Secure sustainable and commercially viable **markets for all process outputs at the outset**
- Recognise that **market demands will change** over time

Anaerobic digestion – circular economy for food organics

The bacterial breakdown of suitable organic materials in controlled conditions and in the absence of oxygen producing methane-rich biogas and digestate

Suitable feedstock includes:

- **Food waste** – high biogas yields
- **Green / garden wastes** – moderate / low biogas yields
- **Sewage sludge / livestock slurry** – low biogas yields
- **Energy crops (maize / silage)** – high / moderate biogas yields

Benefits:

- **Proven technology** with long history of use
- AD biogas (methane) provides **renewable energy** options as heat, electricity, bio-methane vehicle fuel
- Output is well-suited for end-use as **compost** with beneficial properties
- Bio-stabilisation of feedstock achieved in **less time** than for aerobic processes
- **Fully enclosed** wet process – minimises odour, etc.
- **Income** from sale of electricity, heat and/or methane;
- **Carbon neutral** process

Conventional thermal treatment

Benefits:

- Handles mixed MSW or C&I waste with **no pre-treatment required**;
- **Proven** and commercially viable technology;
- Considered to be **highly 'bankable'**;
- **Reduces waste stream** tonnage by up to 90%;
- Can be **integrated** with heat distribution.

Key issues / risks:

- **High capital costs**. Since fixed costs are high, the need for consistently high utilisation is paramount;
- **Negative public perception** – NIMBY / NIMTOO (stack emissions / lack of understanding of technology);
- Risk of **'crowding out'** recycling;
- **Residue quality and disposal**, although bottom ash can be reused;
- **Minimum materials recovery**, except for ferrous metals.

Advanced thermal treatment (ATT)

Gasification and Pyrolysis are thermal technologies that involve partial combustion of waste under reduced or no oxygen conditions

Suitable feedstock:

- Process Engineered Fuels (PEF / RDF)
- Biomass fibre
- Tyres
- Sorted MSW / C&I waste

NOTE: mixed waste feedstock not ideal input

- Both technologies produce combustible gas containing very high quantities of CO, CH4, and H2 (composition is temperature dependent);
- Resulting 'syngas' contains all of the calorific value of the fuel;
- **Pyrolysis** – in the absence of oxygen;
- **Gasification** – starved oxygen;
- May be operated in sequence, i.e. the outputs from a pyrolysis unit can then be gasified;
- Can also be used in conjunction with **plasma arc** for 'syngas' refinement

CONTENTS

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3. THE ROLE OF WASTE TO ENERGY

4. PROJECT CASE STUDIES

5. CONCLUSIONS

CASE STUDY 1 – Anaerobic Digestion Plant, London

- Client: Foresight Group (**private equity**)
- Location: **Dagenham**, London
- Scale of Plant:
  - **20,000 tpa IVC** (green waste)
  - **30,000 tpa wet AD** (segregated food waste)
- Energy output: **1.5MW$_e$** (gas engine, power export to grid)
- Technology provider:
  - **IVC – TEG**
  - **AD – Anaergia / UTS**
  - **Gas engines – Pro$_2$ (German)**
- Capital cost: **A$36 million**
- Operating costs: **A$2 million (approx.)**
- Date commissioned: **February 2012**

Foresight group

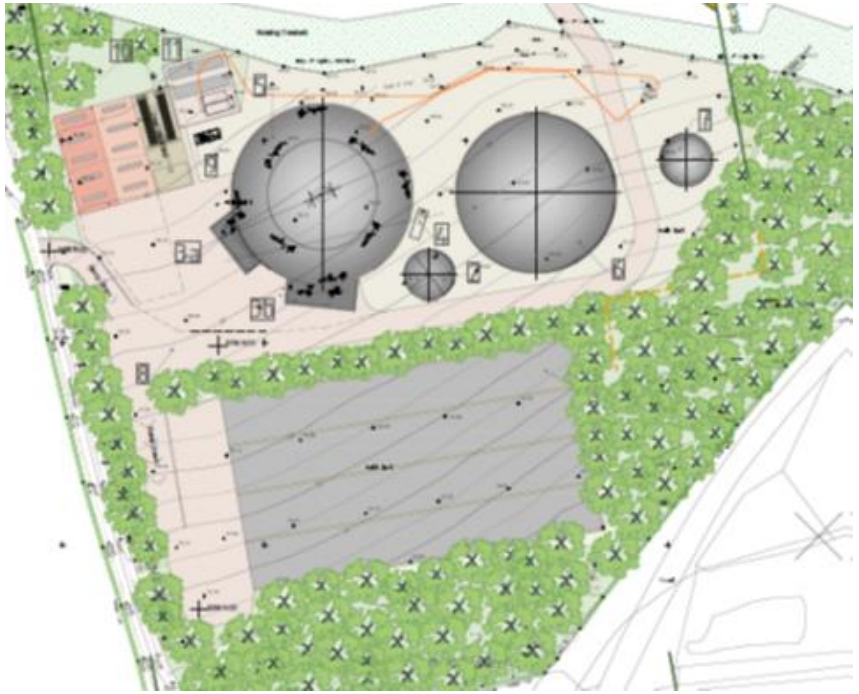
CASE STUDY 2 – Anaerobic Digestion Plant, Scotland

- Location: **Dunfermline, Scotland**
- Scale of Plant:
  - **43,000 tpa dry fermentation AD** (40,000 of co-collected green and food waste; 3,000 of commercial food waste)
- Energy output: **1.6MW$_e$** (gas engine, power export to grid)
- Digestate: **good quality compost** for sale
- Technology provider:
  - **AD – BioFERM (Viesmann); engines – ENER-G / MTU**
- Capital cost: **A$30 million**
- Operating costs: **A$2 million (approx)**
- Date commissioned: **Mid-2014**

Fife Council

CASE STUDY 3 – Anaerobic Digestion Plant, Somerset, UK

- Location: **South Petherton,** Somerset
- Scale of Plant:
  - **48,100 tpa wet AD** (37,100 of agricultural crops; 11,000 of animal manure / slurry)
- Energy output: **4.2MW$_{th}$** (gas upgrade and export to natural gas grid)
- Digestate dewatered and used by local farmers
- Technology provider:
  - **AD – Biogest**
  - **Gas upgrade – DMT**
- Capital cost: **A$22 million**
- Operating costs: **A$5 million (approx)**
- Date commissioned: **2015**
- Principal challenge: **gas upgrade relatively new to the UK** (well proven in other parts of Europe)



CASE STUDY 4 – AD and Gasification Plant, Surrey, UK

- Location: **Shepperton, Surrey**
- Scale of Plant:
  - **40,000 tpa wet AD**
  - **55,000 tpa RDF gasification**
- Energy output: 3.5MW
- Technology provider:
  - **AD – Biogest**
  - **Gas upgrade – DMT**
- Capital cost: **A$130million (funded off balance sheet)**
- Date commissioned: **2018**
- Principal challenge: **proving the gasification technology for this specific application**

CASE STUDY 5 – Small Scale Thermal Plant, Exeter, UK

- Location: **Exeter, Devon**
- Regional recycling rate: **60%+**
- Scale of Plant:
  - **60,000 tpa oscillating kiln technology**
- Energy output: 4MW (power for 5,000 homes close by)
- Technology provider: Tiru / Cyclerval
- Capital cost: **A$70 million**
- Date commissioned: **2014**

CASE STUDIES – Larger Scale Thermal Plant, Global

CONTENTS

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2. ‘SMART’ CITIES - GLOBAL CASE STUDIES

3. THE ROLE OF WASTE TO ENERGY

4. PROJECT CASE STUDIES

5. CONCLUSIONS

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- The **‘Circular Economy’** sees waste as a resource
- Provision for the treatment and reprocessing of segregated material streams, and the residual stream, is vital if a move away from landfill reliance is to be achieved
- State and Local Government in Australia have the greatest ability to influence decisions on technology selection through policies, byelaws and contractual / procurement decisions.
- The application of Anaerobic Digestion for the treatment of a range of organic wastes can play a key role in circular economic thinking
- To achieve 90-95%+ diversion from landfill thermal processing of residual waste is required

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