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**Part 4: Revenues and costs**  
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## (Pre-) Development (Anaerobic Digestion Case)

### **Preliminaries**

Land acquisition

Design

Planning and permitting

- Environmental assessments

- Legal fees

- Technical advisor fees

Procurement costs

Land investigations

Electricity network study

Contingency

### **Capital costs**

Capex fixed equipment

- Electrical engineering

- Waste processing kit

- Electricity sub-station

- Biogas upgrading equipment

- Offices, lab, welfare

- Biomethane compressor

Contingency

### **Construction**

Construction costs

- Legal

- Insurance

- Site welfare

- Groundworks / civils

- CQA

- EPC contractor fees

- Professional fees

Project management

Highways access

Gas pipeline gas grid connection

Gas project management

Electricity grid connection

Recruitment and training

Contingency

Project funding or debt

Government grant (?)

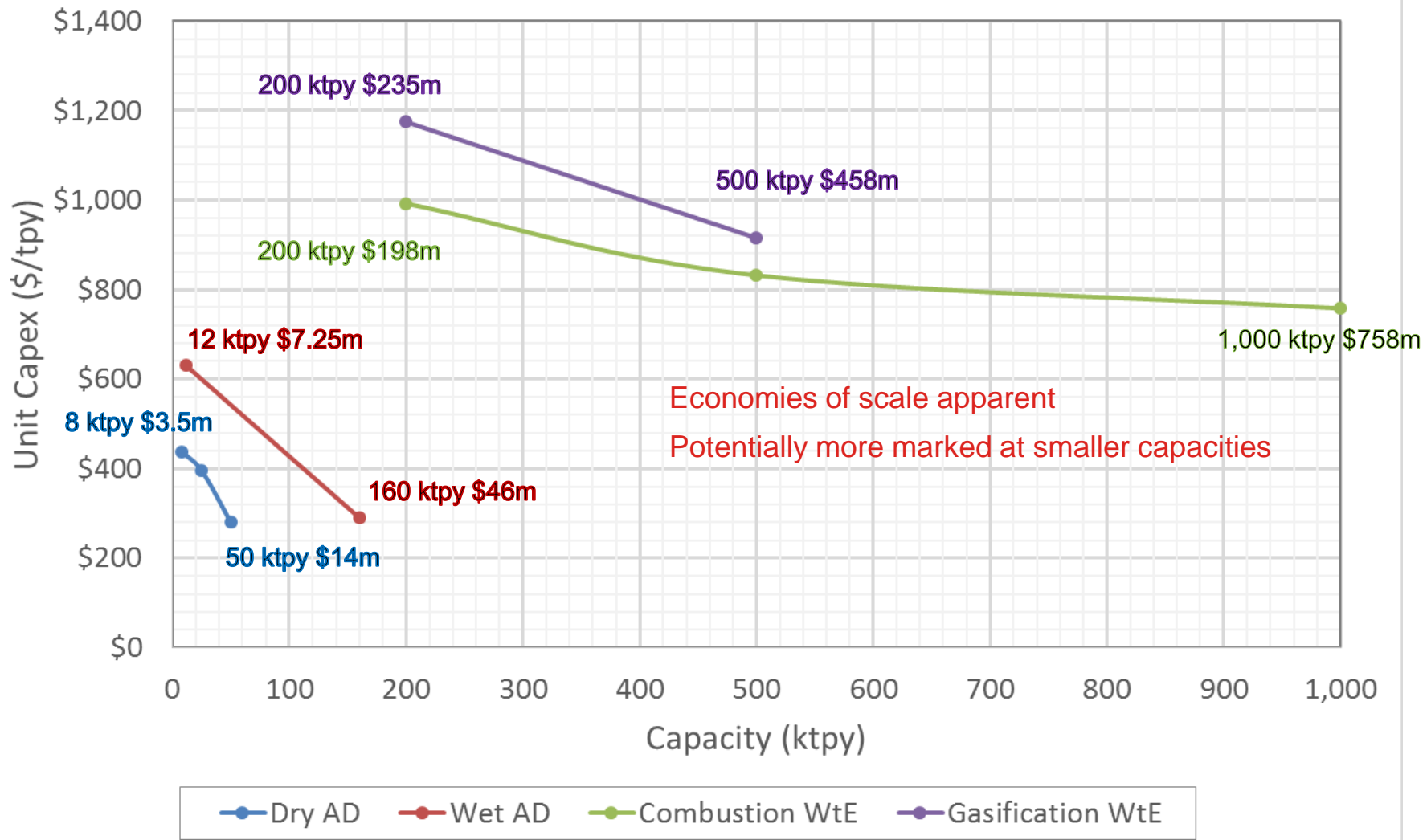
# Summary Cost and Revenue Streams



## Operations

Conventional WtE		Anaerobic Digestion	
Land rental/rates	Gate fee	Land rental/rates	Gate fees
Servicing debt	Energy sales	Servicing debt	Energy sales
Leasing mobile plant	Electricity	Leasing mobile plant	Electricity
Staff costs (salary, training)	Heating/cooling	Staff costs (salary, training)	Heating/cooling
Capex (replacement kit)	Grid or private wire/ private pipe	Capex (replacement kit)	Biomethane
Maintenance (plant, vehicles)	Recovered materials	Maintenance (plant, vehicles)	Grid or private wire/ private pipe
Operating consumables	Recycling	Operating consumables	Digestate sales
Lime	IBA metals	Activated carbon	Renewable energy payments
Ammonia	IBA aggregate	Water	Government subsidies
Activated carbon	Renewable energy payments	Power	
Water	Government subsidies	Biofilter media	
Power		Gas membranes etc.	
Support fuel (start-up)		Propane	
Vehicle fuel		Regulatory compliance	
Regulatory compliance		Advisor / legal fees	
Advisor / legal fees		Permit subsistence	
Permit subsistence		Insurance	
Insurance		Transport	
Transport		Process water treatment	
Disposal/recovery		Process water disposal	
APC		Water treatment chemicals	
IBA		Disposal costs	
Rejects		Digestate	
Contingency capacity		Rejects	
		Contingency capacity	

# Capital Costs (Capex)



- Capex derived from schemes developed in Europe and North America
- While unit rates may be different, trends are likely to be similar

# Capex for WtE

- 200,000 tpa plant (composite UK example)
- Actual Capex will vary significantly by
  - Plant location (staff and materials costs)
  - Technology provider (and location)

Parameter	Cost
Design development	~£7m
Civils	~£23m
Mechanical and electrical (M&E)	~£107m
<b>Total Capex</b>	<b>~£137m (~\$US 198m)</b>

Source: Various UK studies



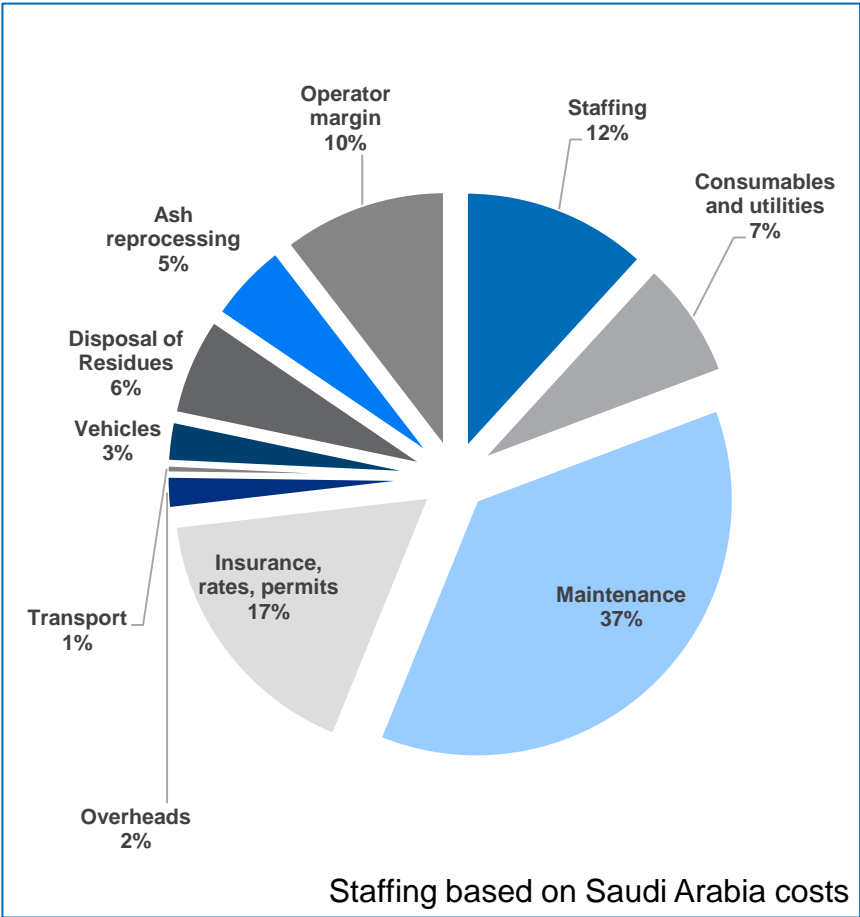
# Opex and Revenues for WtE plants

**200,000 t/year capacity plant could generate electricity ~108,000 MWh per year  
Revenue from electricity sales only ~850M Philippine Peso (~\$US 18m)**

**Revenue = \$US 90 per tonne of waste**

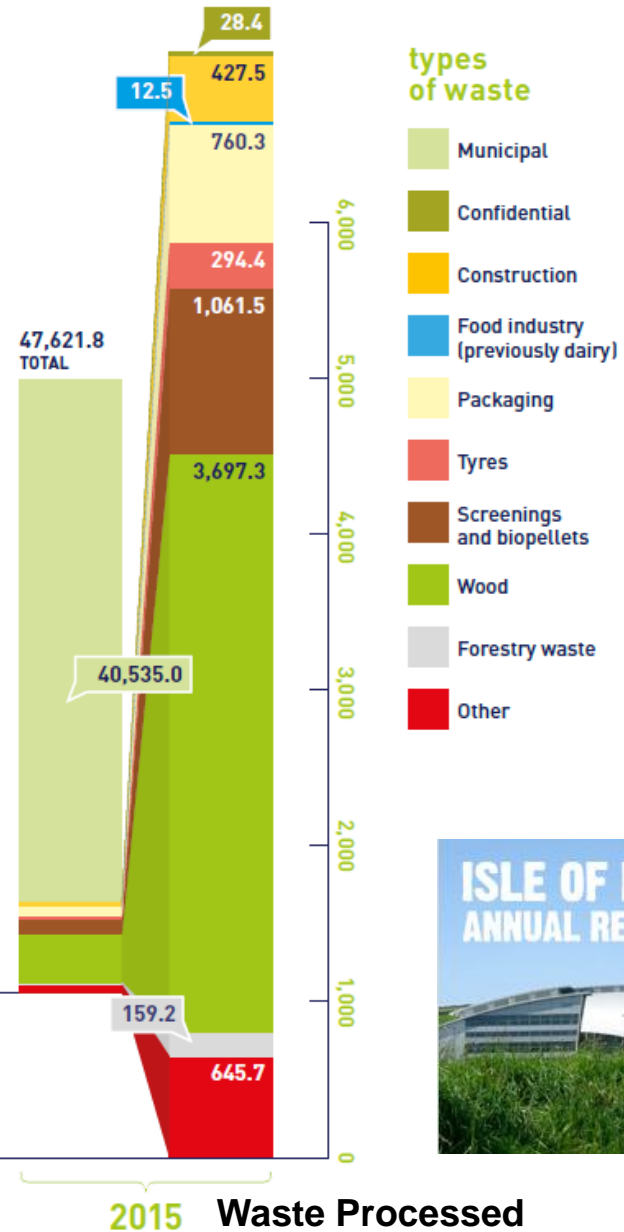
Waste	200,000	tpa
CV	8	MJ/kg
Energy in waste	1,600,000,000	MJ
	444,444,444	kWh
Efficiency (assumed)	24%	
Electricity generated	106,666,666	kWh

**Opex = \$US 50 to 70 per tonne of waste**



- Electricity revenue (\$90) – Opex (\$50-70) = Margin (\$20-40)
- Don't be misled! Opex excludes debt financing and ROI
- Sensitivity: potentially significantly higher energy revenue from
  - Significant heating/cooling energy user
  - Higher CV waste
  - More efficient process
  - Higher electricity price (assumed 8 Philippine peso/KWh)

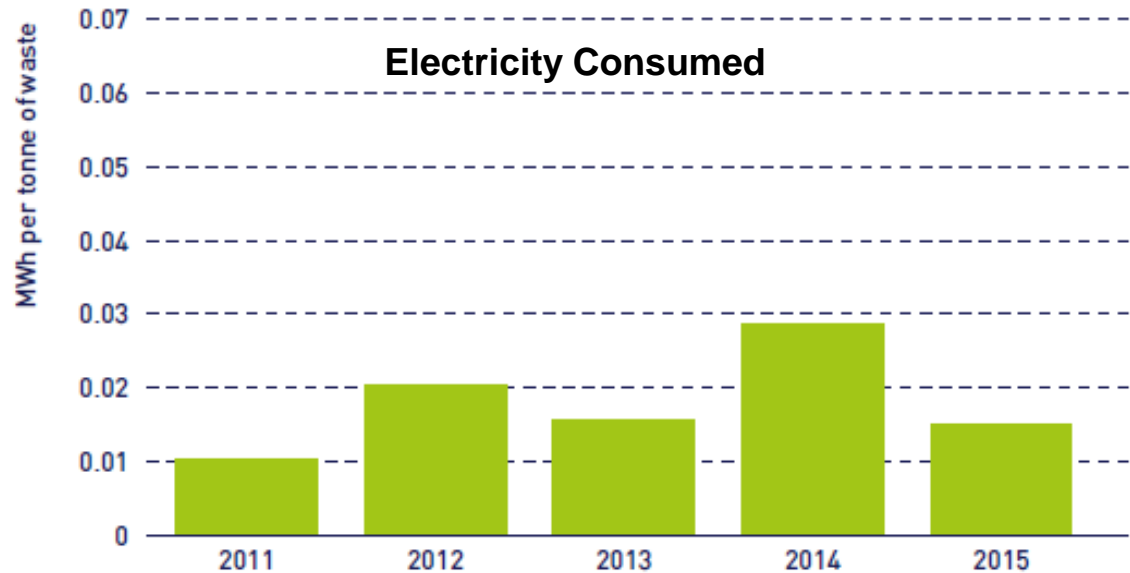
# Small Scale UK WtE – Energy Revenue Potential



## types of waste

- Municipal
- Confidential
- Construction
- Food industry (previously dairy)
- Packaging
- Tyres
- Screenings and biopellets
- Wood
- Forestry waste
- Other

- Isle of Man WtE facility has two Incineration lines
  - 60,000 tonnes of MSW + C&I
  - 5,000 tonnes of clinical waste
- Waste managed = over 48,000 tonnes (2015)
- Electricity generated equivalent to 0.5MWh per tonne of waste
  - Relatively typical of smaller scale scheme
  - Internal energy consumption not significant



# Summary

- **Capex is high for WtE plants**
  - ‘Normalised’ Capex lowest for dry AD; highest for advanced thermal
  - Balance potential revenue surplus against cost to service debt
  - Economies of scale evident
- **WtE can realise strong power revenues**
  - Heat user could realise significant additional revenue
  - Local electricity price key to determine revenues (consequently return on investment)
- **Gate fee likely to be important for overall financial feasibility**
  - Dependent on funding approach and covering cost of financing debt
  - Even with revenue surplus gate fee may be needed to deliver required ROI
- **Consider additional costs**
  - Recovery of ash residues or digestate could realise income
  - But immature market likely to result in a cost
  - Consider extra system costs e.g. RDF preparation, front-end recycling
  - Changes to scheduled maintenance cost strongly influences Opex