Determine the most beneficial use for heat from the Energy from Waste Facility

1. EXECUTIVE SUMMARY

1.1. This report considers the CO_2 /Greenhouse gas (GHG) reduction potential of retrofitting heat recovery technology and infrastructure at the Energy from Waste Facility (IoM EfW), heat which could then be used to off-set reliance on fossil fuel heating.

1.2. The IoM EfW produces electricity, but does not recover the heat generated as part of the combustion system as a combined heat and power plant (CHP). Although the heat is used in part within the Plant, it is not exported in the form of district heating. The Plant could be modified to allow for the recovery of heat, which could be exported and used to heat buildings, thereby reducing reliance upon fossil fuel based energy.

1.3. In 2010 a report by AEA Technology estimated the costs of retrofitting the EfW with heat recovery equipment, and developing the infrastructure to distribute through a District Heating (DH) system, to be £10.1 million, with circa £700 k per annum for operation and maintenance costs. The recipient of the heat was future development around the Cooil Road area, much of which has since been developed. The assumptions made in this report are therefore to be reviewed by an EfW Technical specialist to provide contemporary information on costs and performance. It is understood that if the EfW was modified to enable heat recovery this would significantly reduce the efficiency of the EfW, reducing the amount of renewable electricity generated. Alternative uses for the recovered heat are also considered. This work stream needs therefore to be progressed following a detailed review by specialist engineers and energy advisers.

1.4. The EfW could, depending on technical consideration and costs, be retrofitted with the equipment necessary to recover heat generated through the combustion process. The heat could then be exported for use in a district heating scheme or locally for a specific industrial process.

1.5. In terms of its contribution to the net zero GHG target, as this DH scheme would be for new development, its GHG savings would not contribute to the target for reduction of current emissions. In fact as the DH scheme would require a standby heat source (AEA identifies the need for a 6 MW capacity fired boiler) which, if dependent upon fossil fuel, would potentially increase net GHG emissions.

1.6. Similarly due to the low value of heat energy, its use in a commercial development is unlikely to be economically viable unless cost of development is subsidised, and the capex for retrofitting heat recovery to the EfW and annual operations and maintenance costs would need to be paid for by IOM Government.

2. THE CHALLENGE

2.1. The Isle of Man (IOM) is seeking ways to reduce its Greenhouse Gas (GHG) emissions to achieve a target of net zero emissions by 2050. According to the IOM GHG inventory the energy and residential sectors contribute the greatest to total GHG emissions per annum (Aether, 2019).

2.2. Residential heating is predominantly via combustion of fossil fuels: gas (direct), heating oil; or electricity produced through combustion of gas in the power station. Replacing fossil fuels with renewable sources of heating for residential, key service sector (schools etc.) or commercial premises will reduce GHG emissions. Addressing the need to decarbonise residential and commercial heating is addressed in other work packages.

2.3. The Energy from Waste (EfW) process involves the incineration of waste at temperatures over 850°C. The heat from the process is used to create steam which can then be used to make electricity via a turbine, or by distribution to local homes and businesses (district heating). If facilities produce both electricity and heat they are called combined heat and power (CHP) plants.

2.4. This report considers the option of retrofitting the EfW with heat recovery technology, and connecting this via the required pipe infrastructure, to a receptor/s as a source of renewable heat energy.

3. THE OPPORTUNITY

3.1. The IoM EfW was designed to produce electricity, converting the heat generated through incineration of waste materials into steam and then to electricity. Some of this electricity is used on site (the 'parasitic load' in 2018 was 817 MWh, or 0.015 MWh/tonne of waste) and the remainder is exported to the National Grid. Electricity export in 2018 was 25,000 MWh (Suez, 2018). The EfW meets the design criteria for classification as a recovery plant, in accordance with the European Union Waste Incineration Directive (Environment Agency, 2016). The electricity produced by the EfW therefore contributes to the total amount of renewable electricity produced on Island.

3.2. The efficiency of the EfW in generating energy is, put simply, dependent upon the operation of the boiler, which in turn is reliant on the tonnage, characteristic and calorific value of the waste feedstock.

3.3. The EfW is not a combined heat and power plant (CHP). CHP is considered a 'highly efficient process that captures and utilises the heat that is a by-product of the electricity generation process. By generating heat and power simultaneously, CHP can reduce carbon emissions by up to 30% compared to the separate means of conventional generation via a boiler and power station (BEIS, 2013).

3.4. A report by Sustainable Development Commission Scotland (2010) 'Energy from Waste Potential in Scotland' concluded that the 'highest energy output could be achieved from EfW plants if all thermal output is used for heat production because overall efficiency is potentially 80% or more.' However it recognised that 'without market support, most large EfW plants are likely to generate electricity as this is more valuable commodity'.

3.5. The EfW could be modified to enable the recovery of heat which is then exported and used, thereby reducing current reliance upon fossil fuel based energy.

3.6. To allow consideration as a viable climate change option there needs to be up to date information on the following:

a) Comprehensive technical assessment of the works, plant and equipment needed to recover the heat from the EfW
b) a technical assessment of the impact recovery of heat will have on the performance of the EfW in generating electricity
c) best estimate and auditable costs associated with a) and b)
d) a receptor for the heat generated, mindful this could be an existing or proposed residential, commercial or industrial area (district heating) or a specific industry use
e) heat demands for d) including, details of fossil fuel energy off-set through replacement or use of district heating, or industry specific
f) cost of the purchase and installation of the infrastructure required to connect to the EfW (pipes, insulation and joints; civils - digging and reinstating trenches; Connections includes the Hydraulic Interface Units (HIUs) and connections within buildings to the HIU; design and legal costs, safety and associated construction costs)
g) maintenance and replacement costs for infrastructure, plant and equipment
h) the seasonality of heat demand
i) the impact of heat source maintenance or breakdown on reliability of heat supply.

District heating

3.7. In 2010 the Department of Environment Food and Agriculture (DEFA) commissioned a study into renewable energy on the IoM. The study, 'Renewable Energy Sustainability - Impacts and Opportunities for the Isle of Man' includes, in Chapter 8 and Appendix 15 of its report, a review of the 'current and future opportunities for District Heating' (AEA, 2010). This review includes the use of existing thermal plant, including the Energy from Waste Plant.

3.8. The Report identifies heat demands in the vicinity of the EfW (Annex A) with a focus on District Heating (DH) (Annex B). The Report concludes the DH demand of 5 - 10 MWth heat would 'be a good match' to the potential energy production by the EfW (5-10 MWh heat). It is important to note that a significant part of the area identified in the AEA report has already been developed.

3.9. The capital cost of DH development was estimated by AEA as £10.2 M, with annual operating and maintenance of £726k pa (Annex C).

3.10. In terms of its contribution to the net zero GHG target, as this DH scheme would be for new development, its GHG savings would not contribute to the target for reduction of current emissions. In fact as the DH scheme would require a standby heat source (AEA identifies the need for a 6 MW capacity fired boiler) which, if dependent upon fossil fuel, would realise a net increase in GHG emissions.

Waste industry receptors for heat

3.11. Options for using EfW recovered heat for industrial waste processes have been discussed with industry specialists. Neither the Animal Waste Processing Plant (AWPP) rendering process, nor the Manx Utilities Authorities (MUA) sewage sludge drier are considered options worthy of more detailed investigation:

- The AWPP uses tallow (animal fat) and waste oil as part of the high temperature rendering process. The option of replacing tallow (which has an economic value if sold) with heat was discussed with rendering plant engineers who advised this was not technically feasible and would not provide the temperatures required for rendering animal wastes.

- The MUA sewage treatment facility at Meary Veg provides a strategic facility for the treatment of sewage sludge. This process involved the drying of the sludge into pellets which are then disposed of via the EfW. It requires a temperature of 140 degrees. The current electric drier was installed in 2016, with a life expectancy of 20 years. It uses circa 4000 MW electricity (circa £600 k pa). Relocating the drier to land adjacent to the EfW would cost an estimated £10 m. Other costs include transportation of 20 tanker loads of sludge per day from Meary Veg to the EfW, provision of a supply of fuel/heat source to maintain temperatures and to provide a heat source when the EfW is on maintenance shutdown. In addition MUA has advised it is exploring options for generating heat on site via digestion and/or heat recovery with the aim of achieving energy self-sufficiency.

3.12. This work stream could explore other commercial users for the heat which, if co-located near the EfW, would reduce the need for, and cost of installing and maintaining heat distribution infrastructure. Examples include horticulturalists and vertical greenhouses. However given the value of heat energy, and the capital investment required to retrofit heat recovery and fund a commercial development, any business is highly unlikely to be economically viable unless subsidised. By way of an example, in 2013 Suffolk County Council planned to use heat from a new 269 kt pa EfW in Suffolk to grow tomatoes through a £30 million commercial greenhouse project (Letsrecycle.com, 2013). The Council set up the company as it was unable to identify a use for the heat. However the 'withdrawal of a Government subsidy for such projects' meant it was 'no longer commercially viable' to use EfW heat and the Council changed to use of biomass (East Anglian Daily Times , n.d.).

4. ISSUES

4.1. The AEA 2010 report has been briefly reviewed by a UK EfW energy consultancy which has raised the following issues concerning the retrofitting of the heat recovery plant and equipment and costs:

4.2. The assumptions made regarding revenues from heat sales are questionable as heat has no inherent or guaranteed value/market price, unlike gas or electricity.

4.3. The cost allowance of £2.5 million for a new turbine needs to be reviewed.

4.4. The Report states that figures present a 'worst case' but makes no allowance for:

- The wholesale disruption of installation (e.g. removal of existing turbine) unless a separate new 'power island' (turbine generator set) building is constructed at significant additional cost
- loss of revenue from EfW energy production as, at a minimum, the turbine would be out of action for a minimum of 6 months (£1.25 million based on 16,000 MWh lost).

4.5. Depending on the scale of heat extraction 'this might be more realistically achievable through modification of bleeds or a live steam offtake.'

5. THE ACTIONS

5.1. This work stream needs to be progressed following a detailed review by specialist engineers and energy advisers.

5.2. In addition the assumptions made regarding development around the Cooil Road business park are need to be revisited in light of:

- Development which has already taken place since 2010
- land use allocations contained in the Area Plan for the East (draft shown in Annex D)
- a detailed review of costs of the pipeline and associated infrastructure required to connect the EfW to the heat user and the GHG savings from the proposed EfW DH scheme considered alongside the potential for all Island renewable energy sources and alternative sources of building heating.

6. CONCLUSION

6.1. The EfW could, depending on technical consideration and costs, be retrofitted with the equipment necessary to recover heat generated through the combustion process. The heat could then be exported for use in a district heating scheme or locally for a specific industrial process.

6.2. The efficiency, effectiveness, cost and benefit of heat recovery is contingent in the first instance on how readily the now 15 year old facility can be retrofitted with the equipment needed. The impact this may have on EfW performance (electricity generation), and the operating and maintenance costs is also a key consideration. This work stream needs therefore to be progressed following a detailed review by specialist engineers and energy advisers.

6.3. Due to the low value of heat energy, its use in a commercial development is unlikely to be economically viable unless cost of development is subsidised, and the capex for retrofitting heat recovery to the EfW and annual O&M costs are paid for by IOM Government.

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DEFRA	2019	Guidance 'Waste incinerator plant: apply for R1 status'	Available on line at:	https://www.gov.uk/guidance/waste-incinerator-plant-apply-for-ri-status Energy from Waste plants
East Anglian Daily Times	2016	Government changes scupper greenhouse plans for Great Blakenham	Available on line at:	https://www.eadt.co.uk/business/farming/government-changes-scupper-greenhouse-plans-for-great-blakenham-1-4451042
Letsrecycle	2013	Tomato firm looks to use heat from SITA EfW	Available on line at:	https://www.letsrecycle.com/news/latest-news/tomato-firm-looks-to-use-heat-from-sita-efw/
Suez Isle of Man Ltd	2018	2018 Annual Public Report	Available on line at:	http://www.suez.co.im/wp-content/uploads/2019/05/SUEZIOM-AnnualPublicReport-2018-web.pdf page 15
Sustainable Development Commission Scotland	2010	Energy from Waste Potential in Scotland	Available on line at:	https://www2.gov.scot/resource/doc/311011/0098129.pdf
UK Department for Business, Energy & Industrial Strategy	2018	Guidance: 'Combined Heat and Power'	Available on line at:	https://www.gov.uk/guidance/combined-heat-and-power

Annex A

AEA 2010 Report (page 138) Heat Demands in the Vicinity of EfW

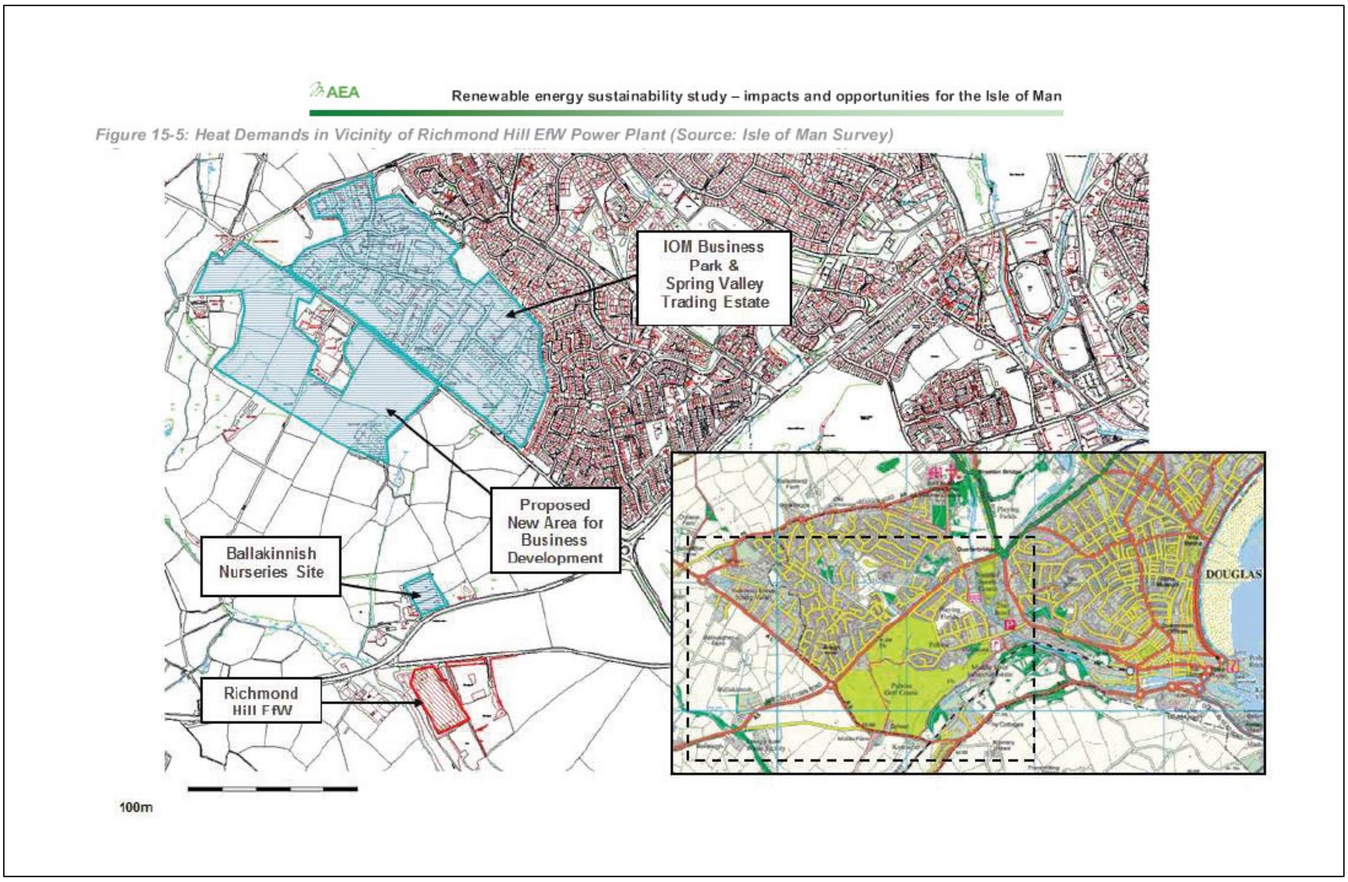

Figure 15-5: Heat Demands in Vicinity of Richmond Hill EfW Power Plant (Source: Isle of Man Survey)

Annex B

AEA 2010 Report : Figure 15-6 (page 140) Concept Design for DH network around EfW

Figure 15-6: Concept Design for DH Network based around Richmond Hill EfW Power Plant

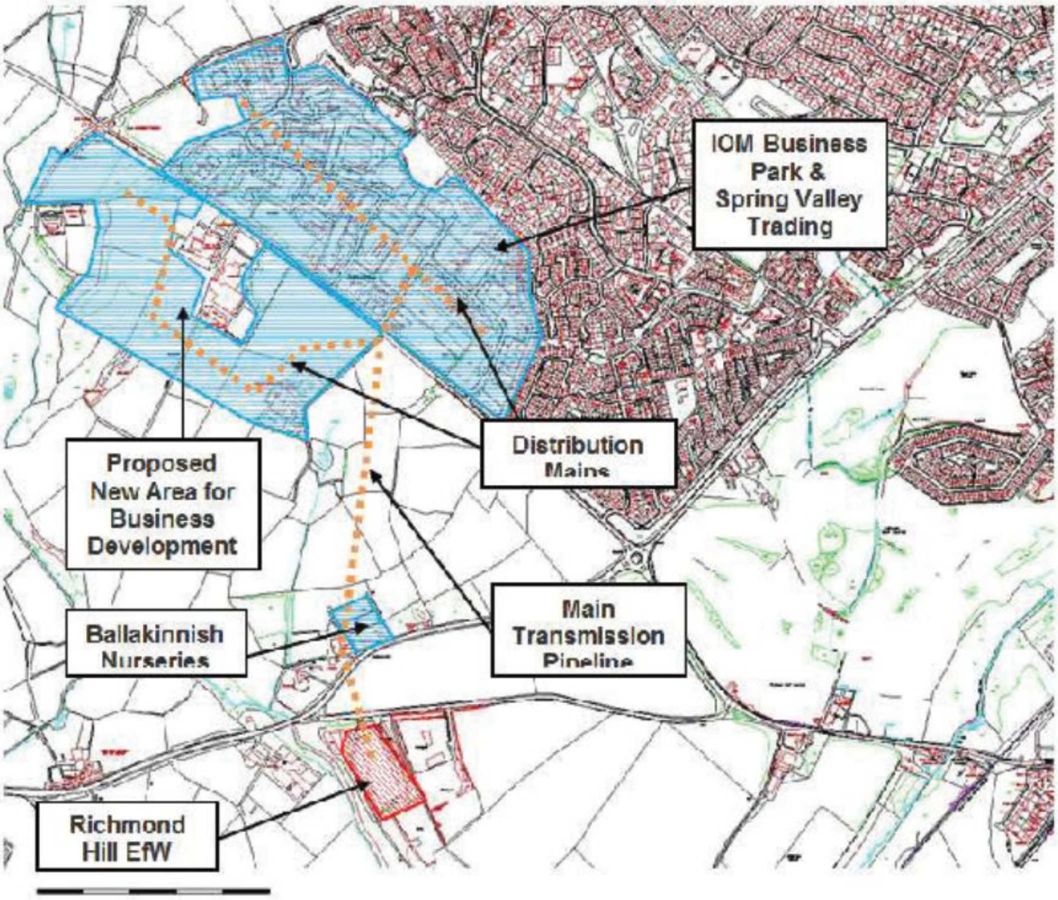

Table 15-5: Estimate of heat demand

		IOM Business Park / Spring Valley Trading Estate	New Cooil Road Business Development	Ballakinnish Nurseries Development
Approximate Land Area (ha)		30	20	-
Development Density (m^2/ha)		2,000	2,000	-
Total Floorspace (m^2)		60,000	40,000	14,000
Total Annual	kWh/m^2	150	150	200

Annex C

AEA 2010 Report EfW DH costs

Table 15-7: Capital costs for the development of the DH scheme

Item	Cost (£k)
Total DH Network Infrastructure Costs	6,500
EfW Plant Modification Costs	2,500
Connection Costs	770
Standby heat source	390
Total	**£10,160**

Table 15-8: Annual operating and maintenance costs for the running of the DH scheme

Item	Cost (£k)/year
O&M Costs	305
Costs due to Loss in Power Generation	154
Fuel costs for standby heat source	267
Total	**£726**

Annex D

Draft Area plan for the East