**Pearson Edexcel Level 3 Certificate in Mathematics in Context**

**PRACTICE TASK: WASTE AND RECYCLING**

County councils are faced with the task of the collection, treatment and disposal of rubbish (waste) in their area. Currently, the UK burns or buries £650 million worth of recyclables.

This task raises some of the issues facing councils currently, based on the experience of Wiltshire County Council.

Household waste (HHW)

Other waste

Municipal Solid Waste (MSW)

Biofuel

Landfill

Recycling/composting

**Figure 1: The flow of waste from production to disposal**

Councils collect household waste (HHW) and other waste (e.g. road sweepings) for treatment/disposal. The combined waste is given the name Municipal Solid Waste (MSW).

Some MSW is recycled, some is burned as biofuel and the rest goes to landfill.

**Data source A**

**Table 1: Actual and forecast values of Municipal Solid Waste (MSW)**

|  |  |  |
| --- | --- | --- |
| **Year** | **MSW tonnage** | |
| 2002 | 233 900 (Actual) |  |
|  |  |  |
| 2005 | 259 700 (Actual) |  |
|  |  |  |
| 2012 | 245 200 (Actual) |  |
|  | **High forecast** | **Low forecast** |
| 2013 | 247 600 | 244 600 |
| 2014 | 250 100 | 226 100 |
| 2015 | 252 600 | 248 600 |
| 2016 | 255 100 | 251100 |
|  |  |  |
| 2020 | 265 500 | 261200 |

All figures for tonnage have been rounded to the nearest 100 tonnes.

**Data source B**

**Table 2: Wiltshire’s landfill targets**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **MSW landfill as a percentage of MSW** | **Council target (%)** | **Weight of MSW used as landfill** | **Council target as tonnage** |
| 2007 | 60.4 |  | 158 600 |  |
| 2008 | 61.5 |  | 158 700 |  |
| 2009 | 56.4 |  | 141 600 |  |
| 2010 | 47.2 |  | 115 600 |  |
| 2011 | 37.5 |  | 91 600 |  |
| 2012 | 36.6 |  | 89 600 |  |
| 2013 |  |  |  |  |
| 2014 |  | < 25 |  | 61 500 to 65 500 |
|  |  |  |  |  |
| 2016 |  | < 25 |  | 62 800 to 63 800 |
|  |  |  |  |  |
| 2020 |  | < 25 |  | 65 300 to 66 400 |
|  |  |  |  |  |

Landfill is very expensive. The UK is committed to making large reductions in the amount of landfill - otherwise it will have to pay a fine to the EU.

**Data source C**

**Table 3: Tonnages per year of municipal solid waste (MSW) and household waste (HHW) in Wiltshire**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **2005** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** |
| **Municipal solid waste (t)** | 259700 | 251000 | 251143 | 244933 | 242876 | 245112 | 242393 | 253894 |
| **Household waste before recycling (t)** | 228066 | 231010 | 222041 | 216542 | 212754 | 213335 | 213274 | 221446 |

**Data source D**

**Table 4: Household and population change 2005 to 2014 in Wiltshire**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **2005** | **2008** | **2011** | **2014** |
| **Households** | 181 000 | 187 000 | 193 000 | 197 000 |
| **Population** | 445 000 | 454 000 | 462 000 | 470 000 |
| **Average number of persons per household** | 2.46 | 2.43 | 2.39 | 2.38 |

**Data source E**

Here are some statements taken from the council's website.

The council will pursue a target of reducing waste after recycling and composting from 606 kg per household in 2012 to 545 kg per household in 2016.

The Wiltshire target was to increase recycling to 50% by 2014 and reduce landfill to less than 25% by the same date.

At the time at which the original strategy was adopted the recycling and composting rate had doubled over the previous 5 years to reach 31.5% in 2006. Since then recycling reached the rate of 42.9% in 2012.

Wiltshire aims to meet the Government target of reducing biodegradable landfill to 35% of the 1995 total by 2020.

By 2020, 50 000 tonnes of MSW will be used as biofuel.

The population of Wiltshire is projected to be 492 000 in 2020.

**Refer to data sources A and B**

**1** Use the information in **Table 1** to find the percentage change in MSW from 2005 to 2012. Interpret your answer. **(3)**

**2** Use **Table 1** and **Table 2** to verify the landfill tonnage for 2012. Make a comment on your answer. **(3)**

**3 Use Table 2** to work out an estimate for the MSW tonnage in 2009. Give your answer to a sensible accuracy. **(3)**

Wiltshire will need a new landfill site from 2020. One proposal is to excavate a hole of depth 15 m and width 200 m and length 200 m.

**4** By what year will this landfill site be full if it takes all the landfill produced in Wiltshire?

Use **Table 2** and assume 1 tonne of landfill, when compacted, occupies a volume of 0.9 m3. **(4)**

**5** (a)Use **Data source C** to draw a suitable diagram to show the correlation between the amount of household waste (HHW) and the amount of Municipal Solid Waste (MSW). Use the HHW figures as the independent variable. **(4)**

The equation of the line of regression of *y* on *x* is *y* = 0.707*x* + 91300.

The square of the correlation coefficient is 0.686.

(b) Interpret this information. **(3)**

**6** Based on the evidence in **Data source C and Data source D,** is the trend for a households to produce more waste? **(4)**

In 2014, the average weight of household waste was 606 kg after recycling.

**7** (a)If the council had been able to achieve its target of 545 kg per household after recycling what tonnage would they have saved in 2014?  
**(Use data source D and data source E) (3)**

(b) Work out an estimate for the MSW that will have to be used as landfill in Wiltshire in 2020 if the council does **not** succeed in reducing the HHW after recycling from 606 kg.

You should list any assumptions that you make and show enough working to justify your estimate. **(7)**

**Total 34 marks**

**Source information**

2 Tables and text adapted from *Wiltshire Municipal Waste Management Strategy 2012: Source: Waste Service for 2013-14*, pp.4, 5, 6, 8, 11, 12 <http://www.wiltshire.gov.uk/waste-2012-wiltshire-waste-management-strategy.pdf>, Table from Waste Management Update – 2013/14 <http://www.recycleforwiltshire.com>, and Extracts from *Wiltshire Population 2011 - Wiltshire and Community Area Population Estimates and Projections 2001 to 2026: Trend based,*  p.3. Source: Wiltshire Council.