# Benchmarks for Predicting and Forecasting Construction Waste - Annex 3

February 2009

# Understanding and Predicting Construction Waste

- The main objective is to understand and be able to predict construction, demolition and refurbishment waste more effectively
- The ability to predict the amount and type of waste likely to arise across all construction sectors helps with:
  - minimising waste (e.g. through having waste targets in contracts), and
  - maximising resource use (e.g. through matching supply of ‘waste’ with reprocessing capabilities in a region).
- Funded by Defra

bre

# Project Aims

- Develop and define basic reporting requirements for construction, demolition and refurbishment waste.
- Collect benchmarking data on construction, demolition and refurbishment waste in terms of quantity and composition of waste.
- Convert this data into key performance indicators (KPIs) for construction type and sector.
- Use the performance indicators to model and predict waste arisings on a site, local, regional and national scale.

bre

# Basic reporting requirements

- Mandatory information
  - Project type e.g. residential, commercial office etc
  - Gross internal floor area ($m^2$) of project
  - Location
  - Project cost
  - Length of project (start and anticipated end date)
  - Number of employees
  - If the project is construction, refurbishment and/or demolition
  - Amount of waste produced (tonnes or volumes)
  - Types of waste (based on EWC codes or BRE's SMARTWaste categories)

# Key Performance Indicators (KPIs)

A number of KPIs have been produced:

Waste arisings

- Volume of waste ($m^3$)/ 100$m^2$ of floor area
- Tonnes of waste / 100$m^2$ of floor area
- Volume of waste ($m^3$)/ £100,000 of project value
- Tonnes of waste /£100,000 of project value

- % and amount (volume/tonnes) segregated – this gives an indication of how much material is available for recovery

bre

# Data collection

- Data was collected from the Benchmarking website and the BRE SMARTStart system.
- The Benchmarking website was set up as part of this project and is available at www.smartwaste.co.uk/wastebenchmarking/
- The website allows users to enter project data in either tonnes or volume whereas SMARTStart data is generally entered by volume.
- The features of the website are now incorporated into SMARTWaste Plan (BRE's free Site Waste Management Plan tool).
- The data collected is now being used to help companies estimate and forecast waste as part of SMARTWaste Plan

# Data analysis for completed projects (1)

- Data for all completed projects is subject to a number of logical and statistical tests to produce two types of performance indicator:

- For $m^3/100m^2$:
  - The floor area must be greater than 10 $m^2$.
  - The waste volume must be more than 10 $m^3$ or the data is excluded.
  - The volume of waste in $m^3$ per 100 $m^2$ floor area should be between 5 and 75.

# Data analysis for completed projects (2)

- For $m^3$/£100K:
  - The project value must be greater than £100.
  - The waste volume must be more than 10 $m^3$ or the data is excluded.
  - The volume of waste in $m^3$ per £100K of project value should be between 5 and 75
- The same criteria for the tonnage data applies

bre

# Data analysis for completed projects (3)

- Data from completed projects is analysed every two months to produce $m^3/100m^2$ and $m^3/£100K$ KPIs
- The KPIs are currently produced for 9 different project types.
- The number of projects of each type passing the logical tests is reported.
- The KPIs presented here are for new build projects

# $m^3/100m^2$ Results for projects completed by 31/08/08

| Project Type | Number of completed projects | Average $m^3/100\ m^2$ |
|---|---|---|
| Residential | 116 | 15.2 |
| Public Buildings | 6 | 26.1 |
| Leisure | 3 | 12.3 |
| Industrial Buildings | 5 | 20.0 |
| Healthcare | 14 | 15.0 |
| Education | 20 | 13.4 |
| Commercial Retail | 27 | 15.0 |
| Commercial Offices | 24 | 20.1 |
| Civil Engineering | 9 | 24.3 |
| **Total** | **224** | |

bre

# $m^3$/£100K Results for projects completed by 31/08/08

| Project Type | Number of completed projects | Average $m^3$/£100K |
|---|---|---|
| Residential | 112 | 18.3 |
| Public Buildings | 8 | 22.2 |
| Leisure | 5 | 20.6 |
| Industrial Buildings | 5 | 11.3 |
| Healthcare | 12 | 13.4 |
| Education | 21 | 17.3 |
| Commercial Retail | 24 | 10.4 |
| Commercial Offices | 22 | 14.9 |
| Civil Engineering | 6 | 20.3 |
| **Total** | **215** | |

bre

# Regional variation in $m^3/100m^2$

- The average $m^3/100m^2$ has been calculated for residential projects on a regional basis.

| Region | No. residential projects | $m^3/100m^2$ |
|---|---|---|
| East Anglia | 7 | 13.4 |
| East Midlands | 5 | 16.1 |
| London | 32 | 17.7 |
| North West | 11 | 11.2 |
| North East | 6 | 17.2 |
| South East | 9 | 11.1 |
| South West | 8 | 14.1 |
| West Midlands | 10 | 14.1 |
| Yorkshire & Humberside | 9 | 10.9 |

bre

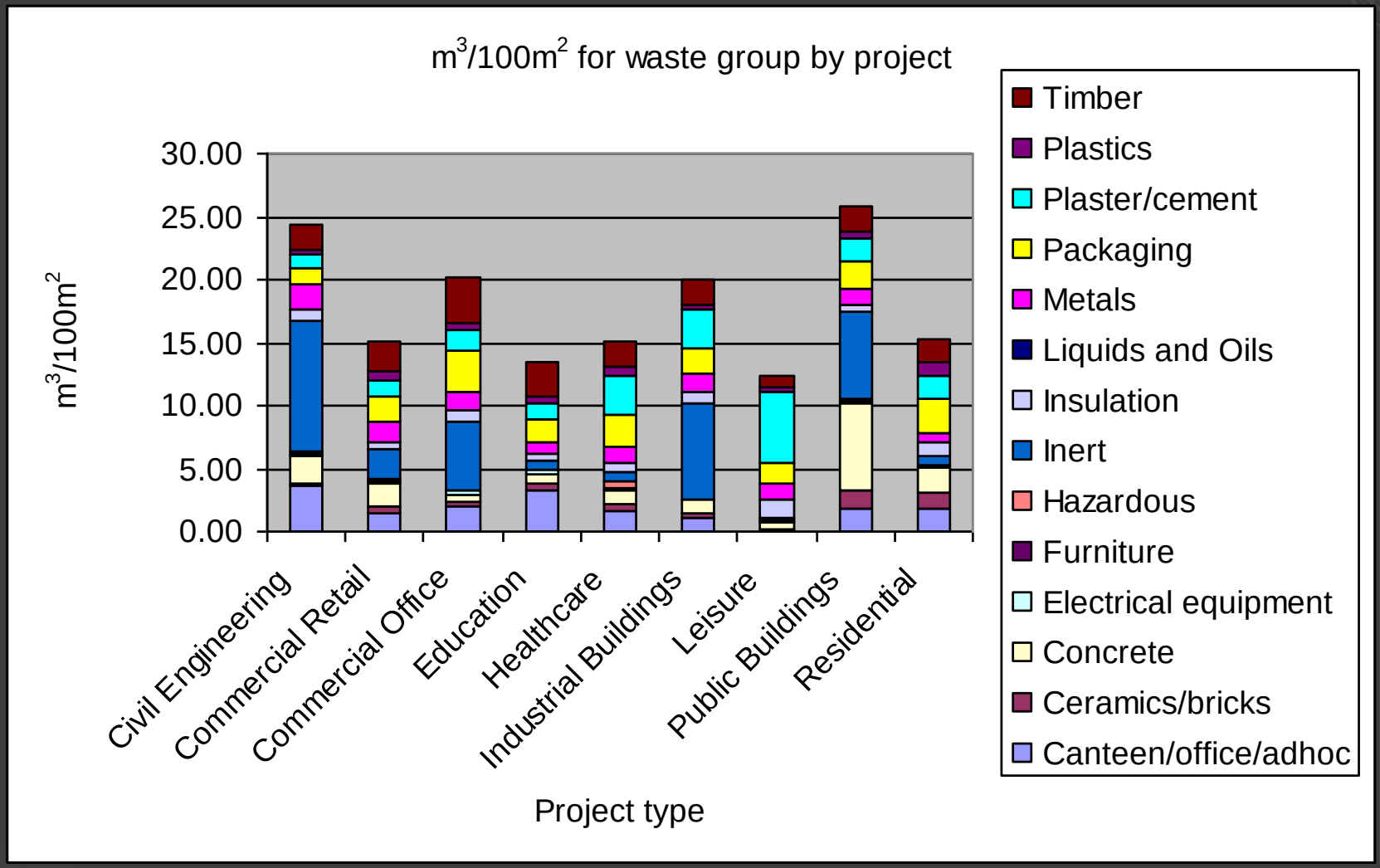
# Performance indicators by waste products

- Performance indicators (KPIs) have been calculated for waste products for each project type.
- Information by waste type provides the data for forecasting types and amounts of waste that are likely to be generated based on the floor size or cost of a particular development.
- Detailed results for residential developments are shown.

# Breakdown of performance indicators by product for residential projects

| Product | $m^3/100m^2$ | $m^3/£100K$ |
|---|---|---|
| Canteen/office/ad-hoc | 1.73 | 1.79 |
| Ceramics/bricks | 1.44 | 2.06 |
| Concrete | 1.90 | 3.26 |
| Electrical equipment | 0.15 | 0.08 |
| Furniture | 0.08 | 0.03 |
| Hazardous | 0.06 | 0.02 |
| Inert | 0.67 | 1.34 |
| Insulation | 1.09 | 1.39 |
| Liquids and Oils | 0.05 | 0.01 |
| Metals | 0.59 | 0.48 |
| Packaging | 2.71 | 3.23 |
| Plaster/cement | 1.87 | 1.84 |
| Plastics | 1.05 | 1.25 |
| Timber | 1.89 | 1.54 |
| **Grand Total** | **15.2** | **18.3** |

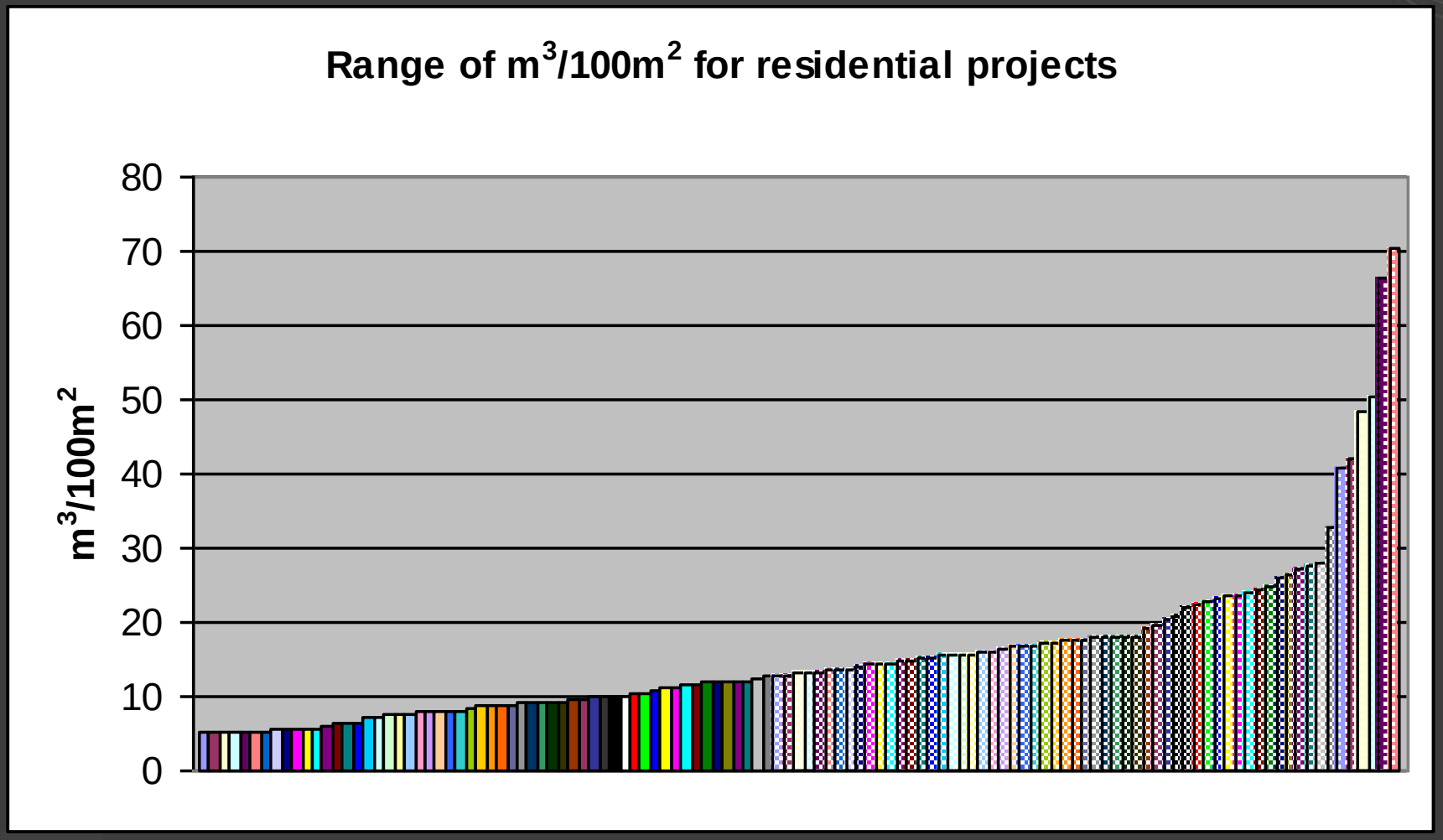
# Performance indicators by waste product for residential projects



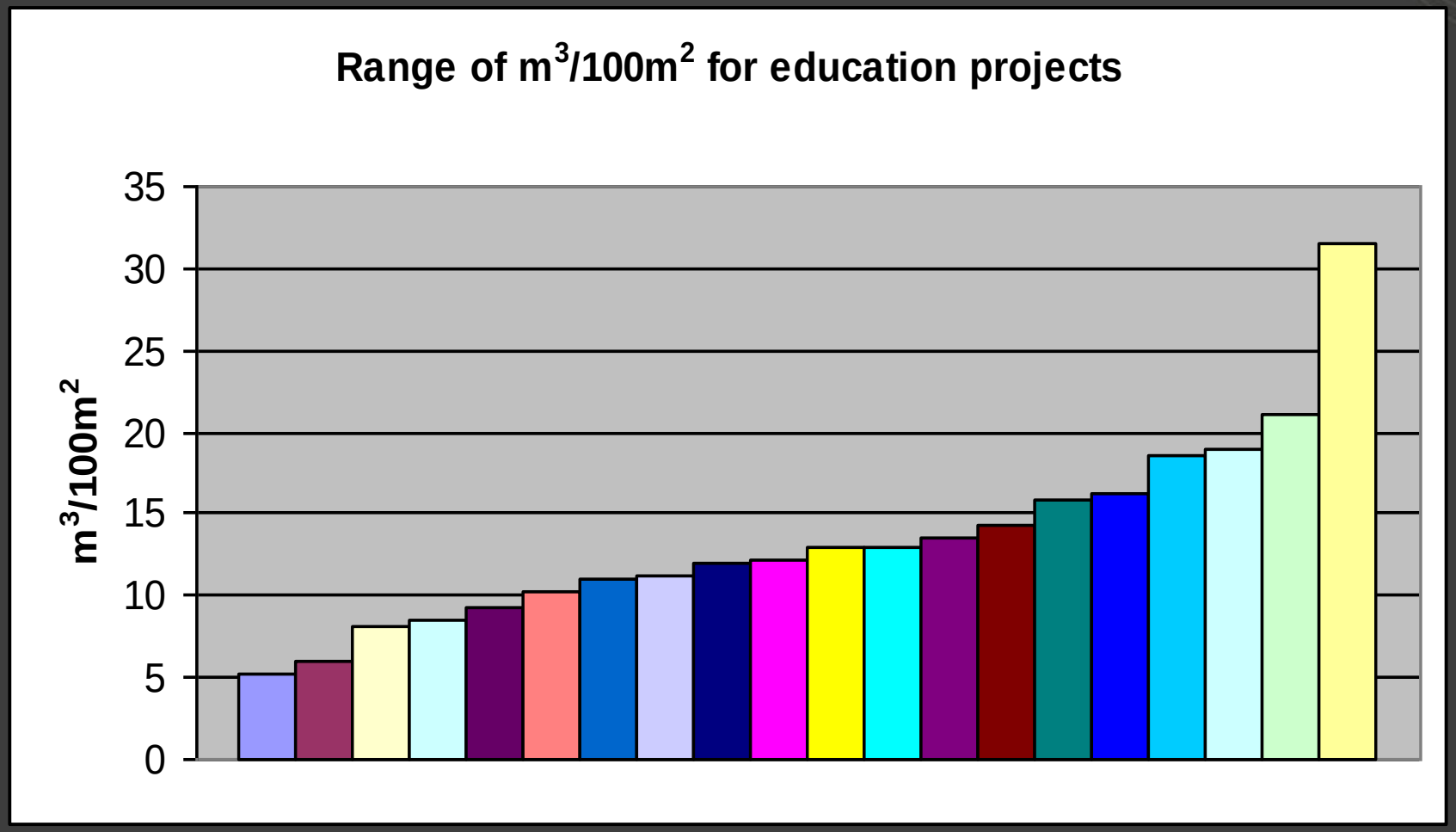
# Range of performance indicators

- The range of KPIs has been reviewed for the different project types
- The lower quartile has been assigned ‘best practice’, next quartile assigned ‘good practice’ and top two quartiles assigned ‘standard practice’.
- This has been done for residential, education, commercial retail and offices where the dataset is larger than 10.
- These can provide benchmarks for the industry to start improving their performance and moving from standard to best practice.

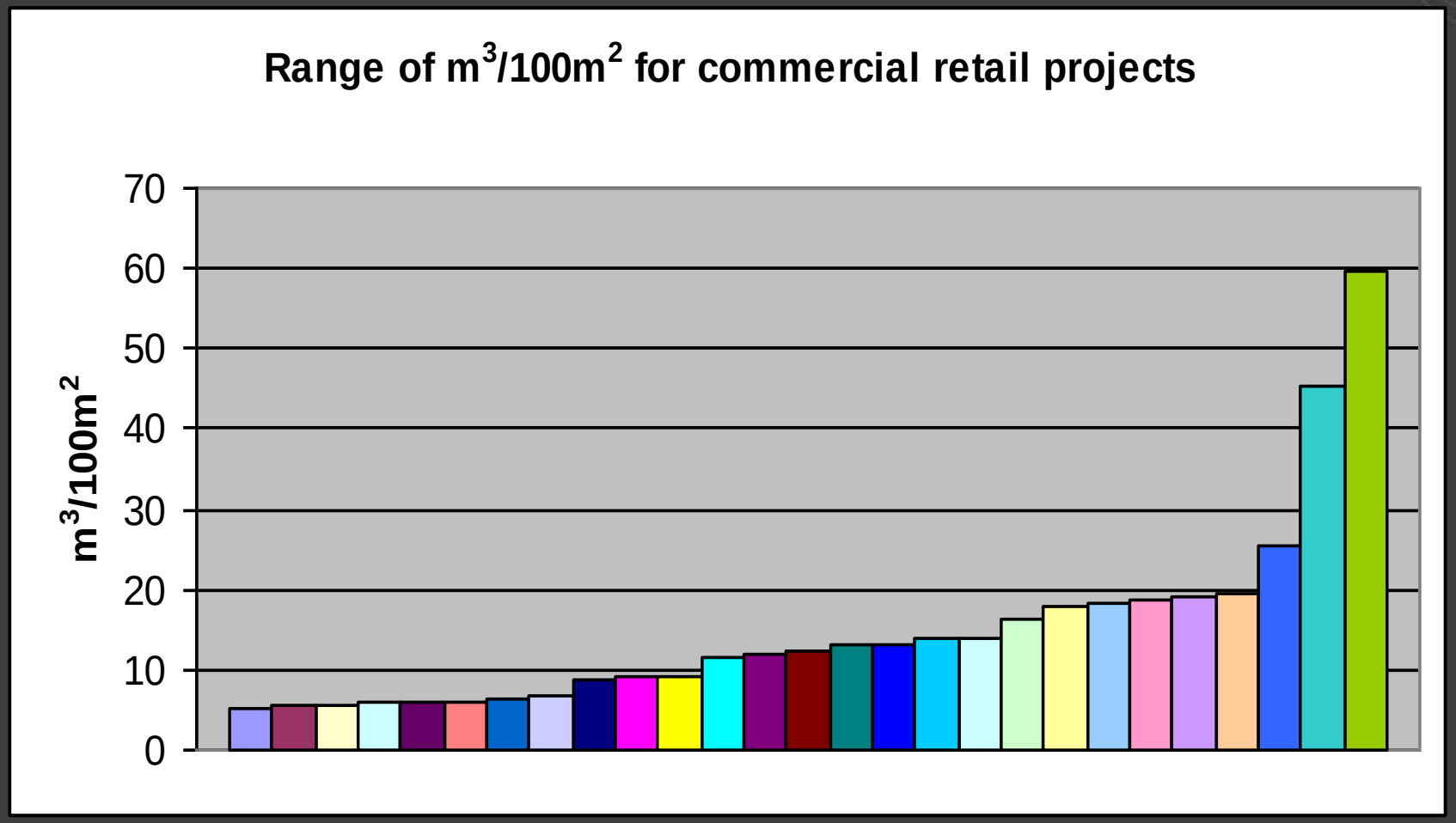
# Range of $m^3/100m^2$ for residential projects



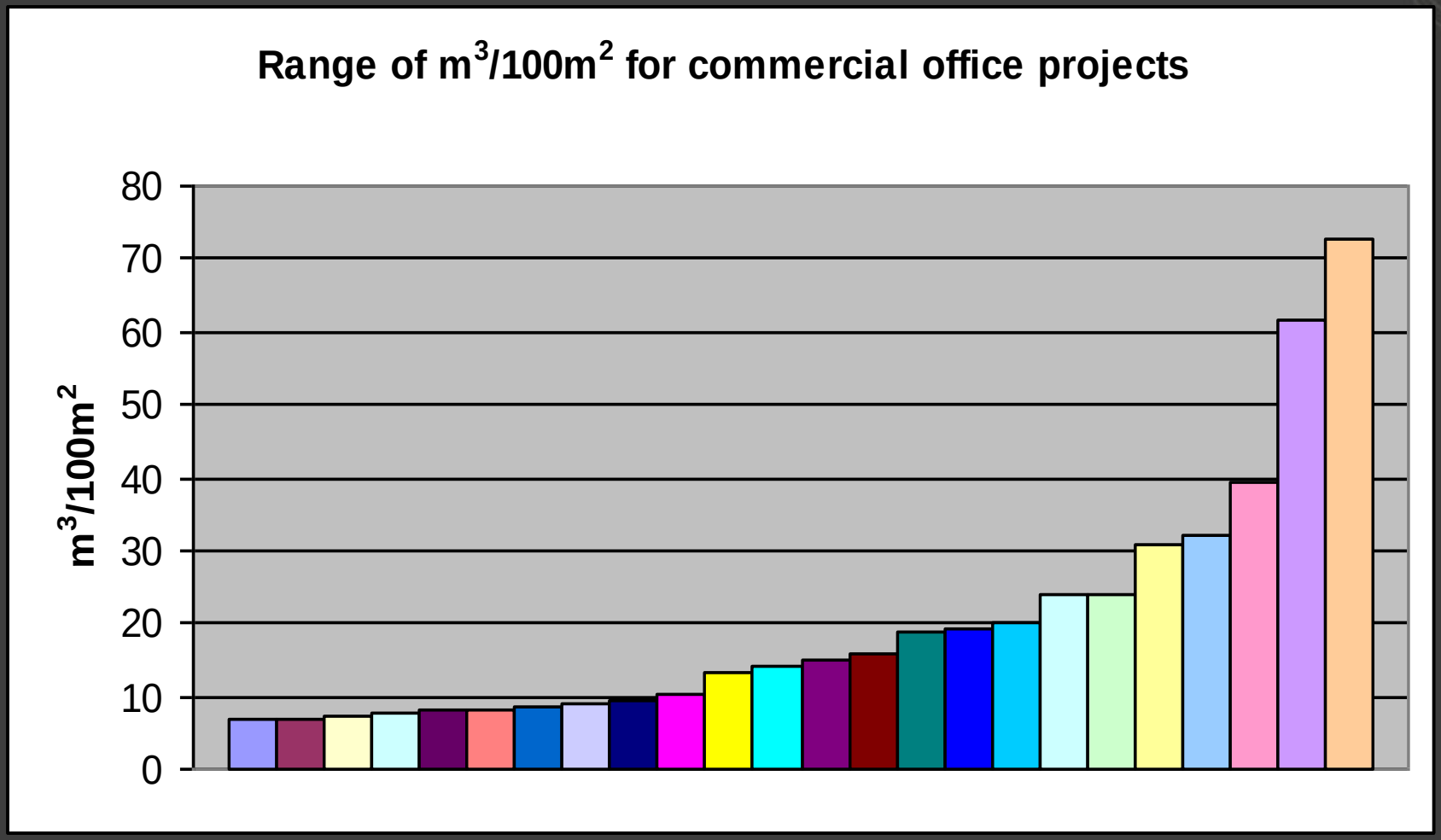
# Range of $m^3/100m^2$ for education projects



# Range of $m^3/100m^2$ for commercial retail projects



# Range of $m^3/100m^2$ for commercial office projects



# Benchmarks of $m^3/100m^2$ for standard, good and best practice

| | Best practice | Good practice | Standard practice |
|---|---|---|---|
| Residential | <9.0 | 9.0-12.9 | >12.9 |
| Commercial Retail | <6.2 | 6.2-12.1 | >12.1 |
| Commercial Offices | <8.3 | 8.3-14.0 | >14.0 |
| Education | <9.3 | 9.3-12.1 | >12.1 |

bre

# Benchmarks of $m^3$/£100K for standard, good and best practice

| | Best practice | Good practice | Standard practice |
|---|---|---|---|
| Residential | <7.7 | 7.7-13.1 | >13.1 |
| Commercial Retail | <6.5 | 6.5-8.8 | >8.8 |
| Commercial Offices | <6.3 | 6.3-9.0 | >9.0 |
| Education | <7.8 | 7.8-10.0 | >10.0 |

bre

# Comparison of performance indicators from SMARTStart and Benchmarking Website

- Density conversion factors were applied to the $m^3/100m^2$ performance indicator to produce a tonnes/$100m^2$ performance indicator.

- This was compared with the tonnes/$100m^2$ performance indicator obtained from the Benchmarking system.

| Residential projects | |
|---|---|
| Project type | Tonnes/100 $m^2$ |
| SMARTStart system | 7.9 |
| Benchmarking | 10.8 |

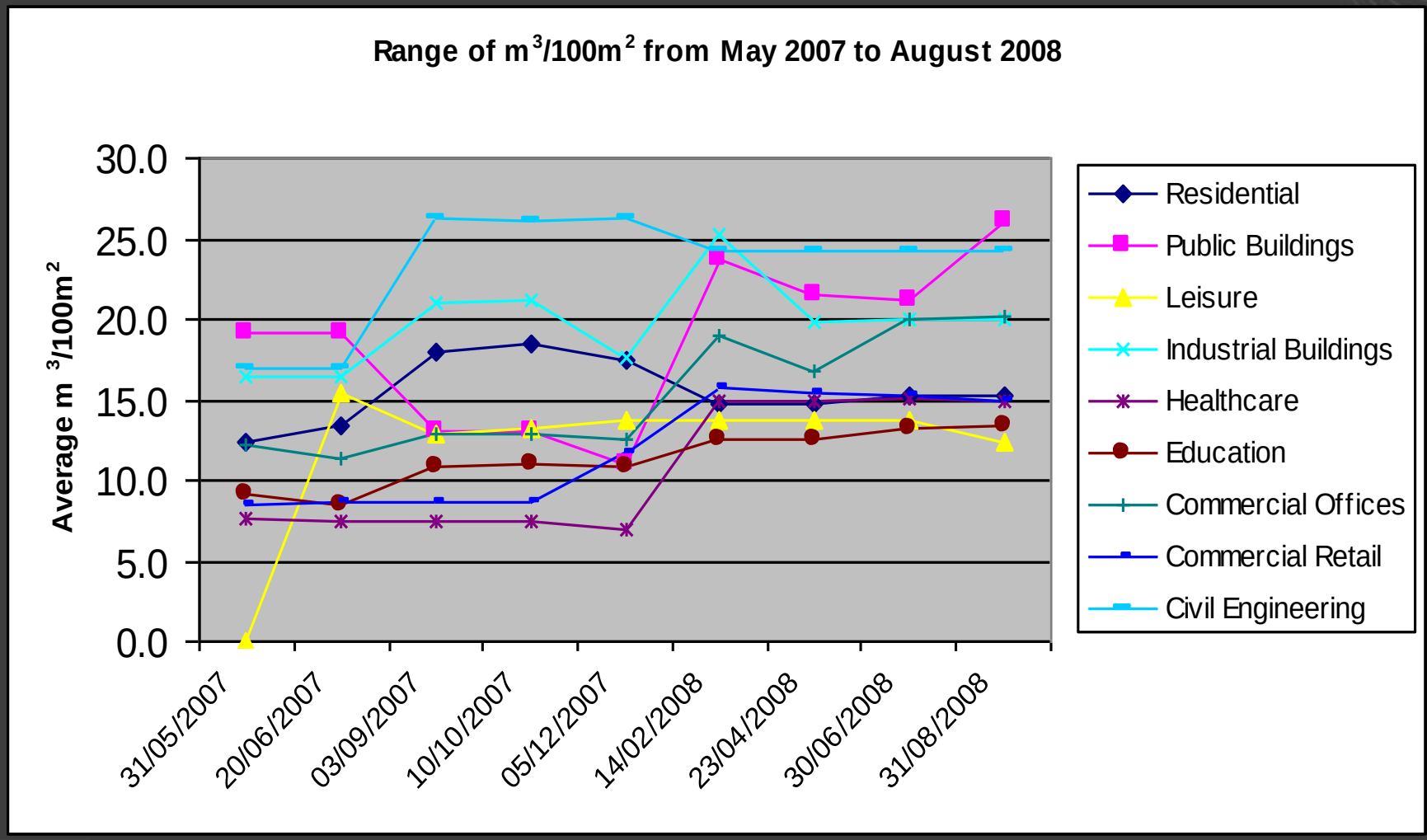
# Summary of performance indicators over time

- The performance indicators for $m^3/100m^2$ and $m^3/£100K$ have been evaluated every 2 months from May 2007 to August 2008.

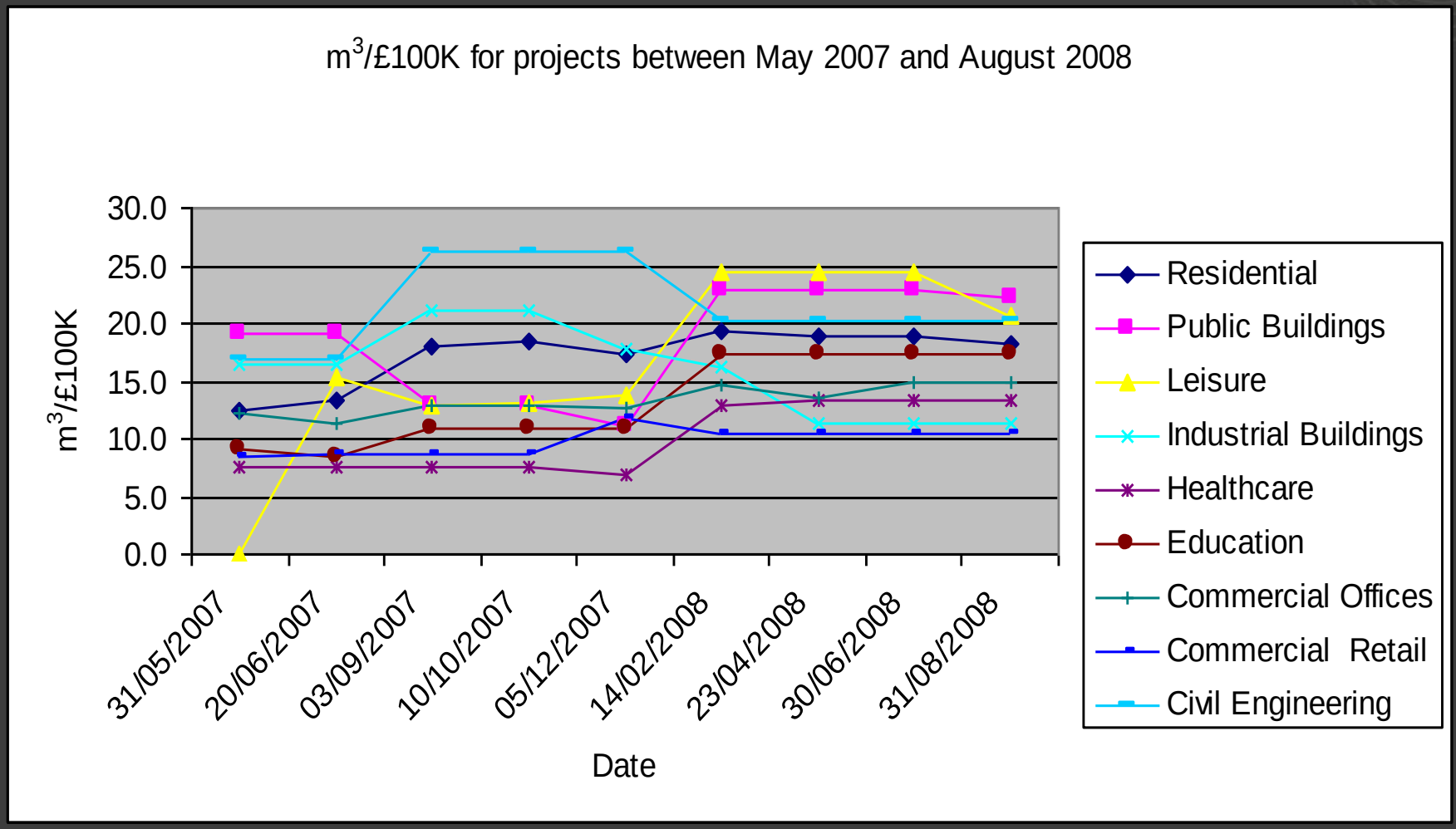
- We would anticipate the variations will reduce as more projects are included particularly following the implementation of SWMPs.

bre

# Variation in $m^3/100m^2$ over time



# Variation in $m^3$/£100K over time




bre

# Segregation rates

- Data has been collected on the volume of waste segregated on site  - used to calculate % segregation.
- Analysis of the data has been carried out and no strong correlation was found between:
  - floor area and % segregated
  - project value and % segregated
- Average and median % segregation for different project types have been calculated.

# Average % segregation for different project types

| % segregated | Average | Median |
|---|---|---|
| Residential | 18.3 | 5.3 |
| Public Buildings | 59.0 | 63.5 |
| Leisure | 20.4 | 1.6 |
| Industrial Buildings | 43.0 | 47.6 |
| Healthcare | 26.7 | 24.3 |
| Education | 29.3 | 10.9 |
| Commercial Retail | 37.5 | 22.5 |
| Commercial Offices | 38.0 | 28.2 |
| Civil Engineering | 55.7 | 62.6 |

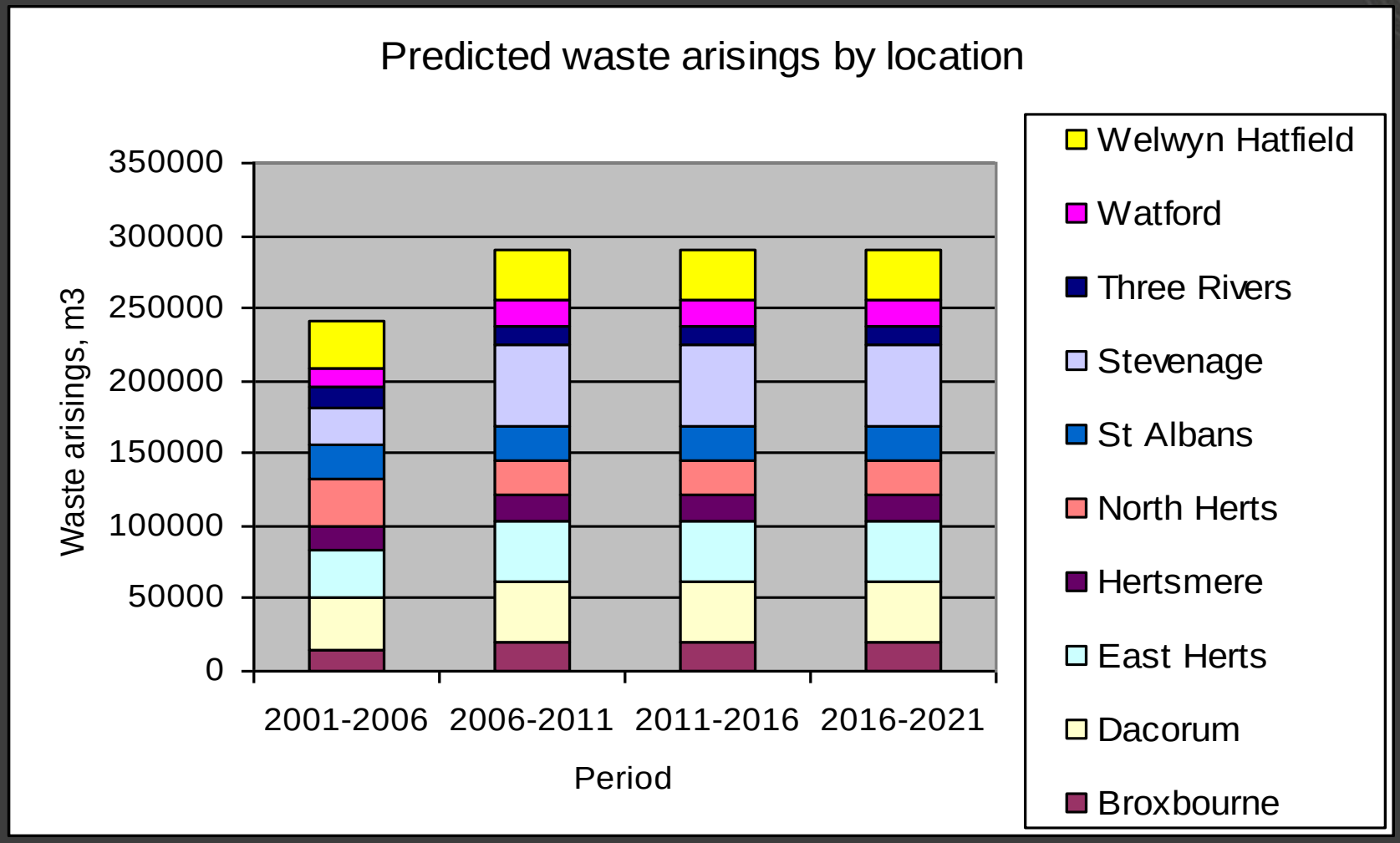
bre

# Use of benchmarks to model waste arisings

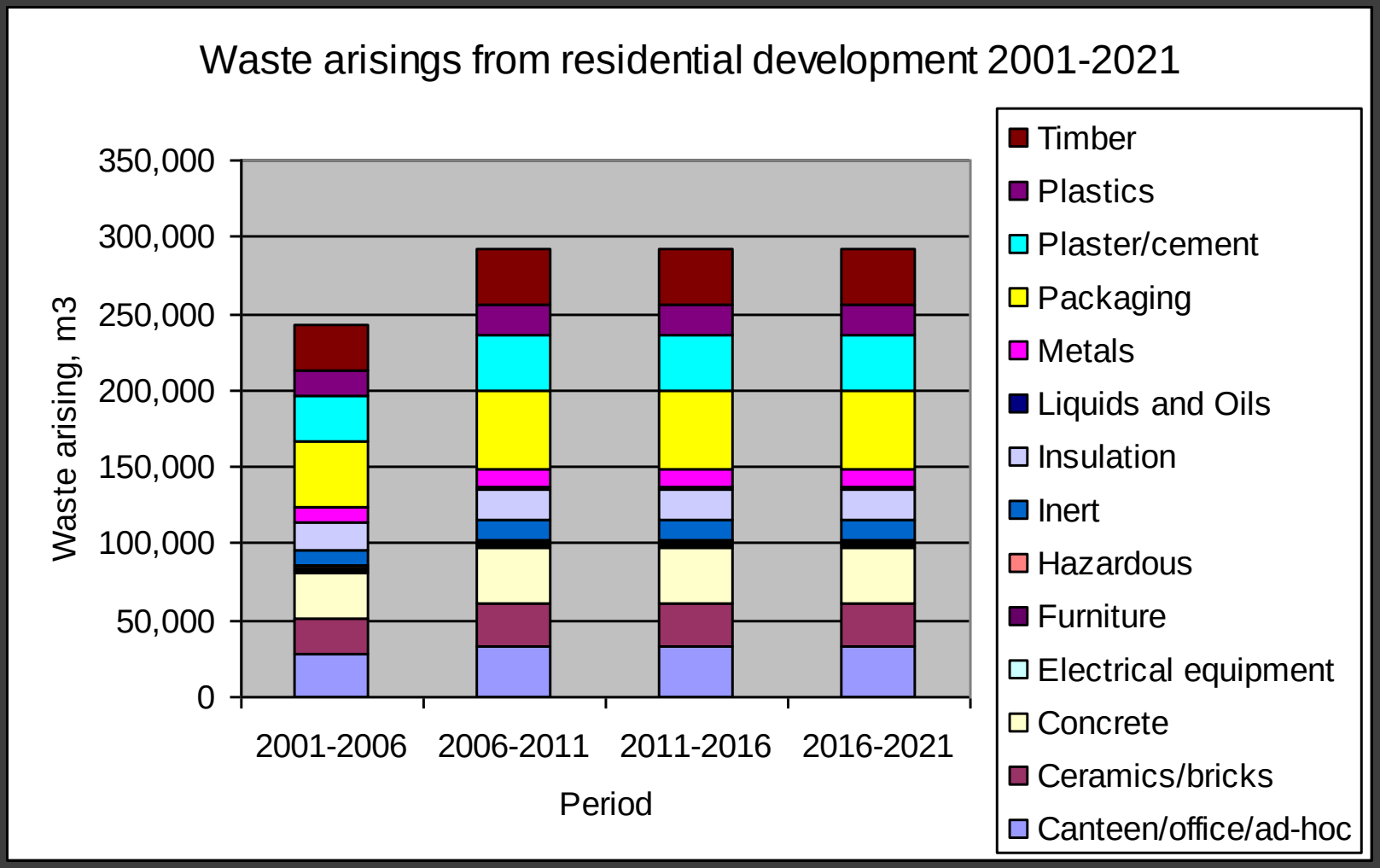
- The benchmarks calculated have been used to model waste arisings.
- The overall and waste specific benchmarks for residential projects have been applied to the planned residential developments in Hertfordshire.
- The predicted waste arising has been calculated for the various districts over a 20 year period.
- The total waste arising for different waste products have been calculated for the whole of Hertfordshire over the same 20 year period.

bre

# Predicted waste arisings by district



# Predicted waste arisings by waste product



# How can policymakers use the performance indicators?

- Provide data for forecasting and planning for sustainable waste management at a construction project level
- Help to prioritise actions and policies related to construction waste management
- Provide a benchmark for measuring and evaluating performance of policies e.g. Site Waste Management Plan Regulations
- Model possible future scenarios and capacities required for recovery of construction waste.

# How can the industry use these benchmarks?

- Provide a means for estimating and forecasting waste
- Setting targets for waste reduction and waste recovery
- Provide information for key waste streams
- Develop appropriate actions for better management of waste and waste reduction
- Benchmark performance against other projects
- Benchmark performance against industry averages

# Dissemination

- Short guides on how to use the data have been produced for:
  - Policymakers
  - Planners
  - Clients/designers
  - Contractors
- Final report has been written for Defra (SID 5); this was updated in February 2009.
- Annexes on key recommendations for waste reduction and data analysis

# The future

- KPIs continue to be updated bimonthly and are available from SMARTWaste
- BRE's free SMARTWaste Plan (a Site Waste Management Plan tool) will collect more data including waste management routes and waste data
- A free local resource planning tool has also be developed for planners and can be found at www.smartwaste.co.uk
- SMARTStart and benchmarking website have been incorporated into SMARTWaste Plan

For further information:

W: www.smartwaste.co.uk

E: smartwaste@bre.co.uk

T: 01923 664200