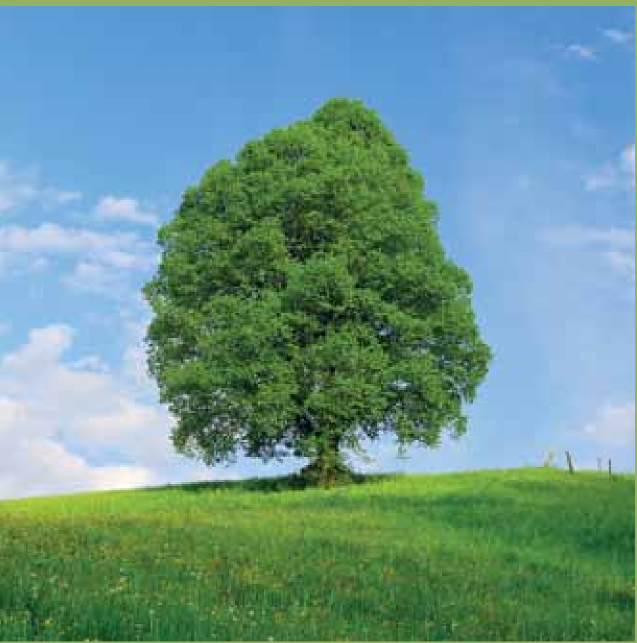
You get lower emissions from concrete pipelines.

cpsa
concrete pipeline systems association



What's the true environmental cost of sewerage pipeline systems?

These days, most people would agree that we need to reduce the impact of human activity on our environment. And our day to day decisions play an important part in this.

There's less agreement on how we measure that impact. As a result, decision makers can face a bewildering array of information.

Take, for example, the term "carbon footprint". It is often based on the amount of carbon dioxide emitted. Yet a true carbon footprint should include emissions of a number of greenhouse gases (GHG) – such as methane, which is up to 25 times more damaging than CO_2. A true carbon footprint is reported as "carbon dioxide equivalent" (CO_2e).

In addition, concentrating on a single activity such as transporting products to site, which is part of a wider process can be misleading and lead to false conclusions. Studies should be based on a true life-cycle approach, taking into account all the significant environmental costs over the lifetime of the asset.

Concrete and carbon emissions

Currently, the most accepted methodologies for carbon footprint measurement are ISO 14040/14044 and PAS 2050. These provide the basic "rules" for carbon accounting, measuring all greenhouse gases over the full life cycle of a process.

A recent series of three reports into the environmental impact of concrete and plastic sewerage pipeline systems was carried out by the CPSA and sustainability experts, Carbon Clear.

Report 1: **Demonstrates 20 – 60% lower embodied carbon for concrete pipes and manholes compared to values for generic precast concrete within many industry databases and carbon calculators.**

Report 2: **Concludes that when concrete pipes are compared with plastic pipes to a recognised methodology, the carbon footprint of concrete pipes is up to 35% lower.**

Report 3: **Shows that circular precast base manhole systems have a carbon footprint 30 – 43% lower than other forms of manhole.**

This short brochure summarises the findings of the reports. The complete set of documents can be downloaded at http://www.concretepipes.co.uk/sustainability.php

Concrete versus Plastic pipes

Some plastic pipe studies have under-reported the true level of embodied carbon emissions. A proper carbon footprint should take account of numerous greenhouse gases, not just CO_2. For example, the emissions of methane during the manufacture of plastic pipes can increase the CO_2 only carbon footprint by over 25%. This has been recognised by the University of Bath in their revised Inventory of Carbon and Energy (ICE) where CO_2 only data has been updated to include CO_2e. The ICE also refers to the CPSA Carbon Clear study as a more reliable source of data for precast concrete pipes and manholes.

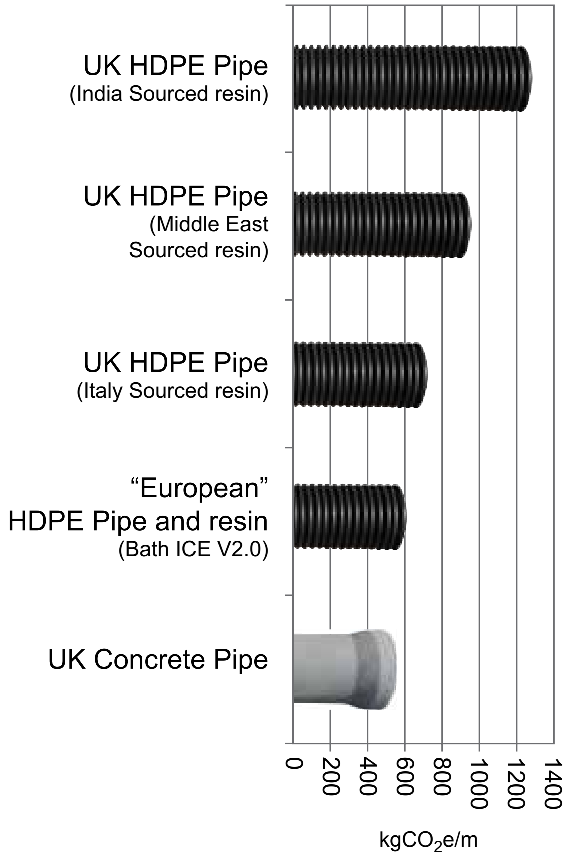
The origin of raw materials is also an important factor. The location of resin manufacture and associated transport emissions are an essential part of any realistic measurement.

Plastic pipes are undeniably lighter to transport. This has lead to claims that they are more environmentally friendly. A true measure should consider all transport movements, not just the pipes. The transport of granular material for pipe bedding and the removal of excavated materials should be part of the calculation. As concrete pipes may be installed with less granular material, this can lead to substantial reductions in installation cost and environmental impact.

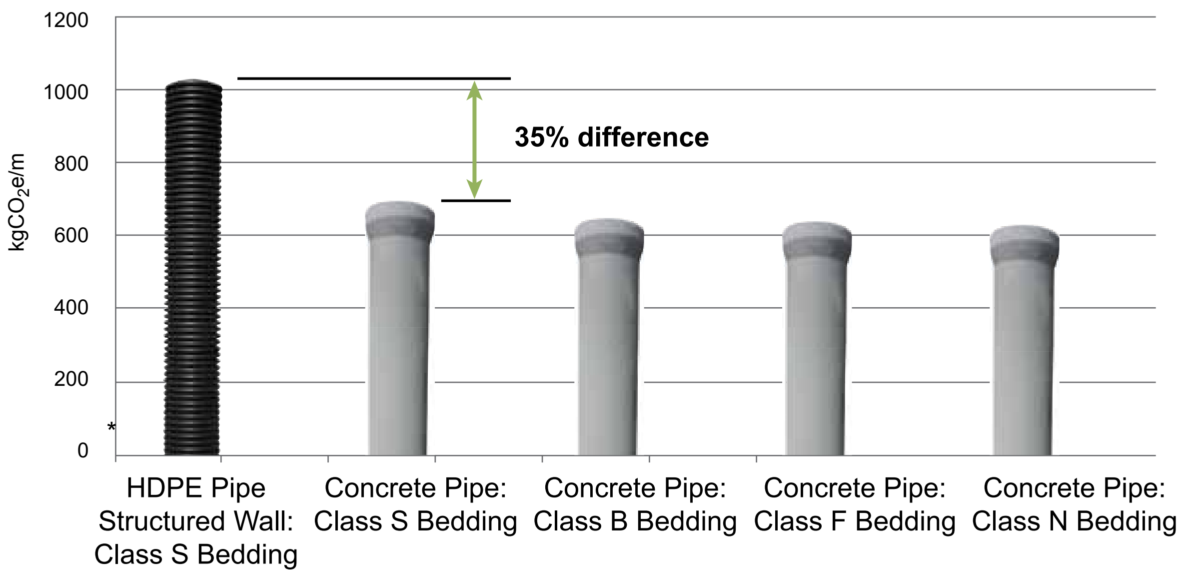
The charts on this page show that concrete is the most environmentally sound choice, and its benefits are particularly marked for large diameters of pipe.

The CPSA Carbon Clear report independently verifies the carbon footprint of concrete pipes and manholes to PAS 2050. This ensures that it covers all the major environmental impacts and that data is calculated using a recognised methodology. Data produced in any other way should be treated with caution.

HDPE and concrete pipe cradle-to-gate comparison relative to origin of resin for UK pipe manufacture (DN2100 pipe)



HDPE and concrete pipe cradle-to-site comparison (DN2100 pipe)



*Based on global distribution of resin manufacture – 35% UK; 24.5% Middle East; 16% Europe; 24.5% Asia

Concrete Pipeline Systems:
A life cycle approach to carbon emissions

1. Manufacturing

- All raw materials are responsibly and locally sourced with a transparent chain of custody through the supply chain. Concrete manufacture is a local operation with low transport distances for raw materials and correspondingly, very low transport emissions per tonne of product.
- Recycled material is extensively used to reduce or replace virgin raw material. CPSA manufacturers use 100% recycled steel for reinforcement; ground glass is used to substitute some fine aggregates; fly ash (by-product from coal fired power stations) to minimise cement use – all of which contribute to lower embodied emissions and help to preserve natural resources.
- Manufacturing operations use efficient, modern production technology and keep waste to a minimum. Concrete waste that does arise may be graded and recycled for other applications such as granular fill material, coarse drainage media and certain grades of concrete. Energy consumption and emissions per tonne of product for precast concrete pipe manufacture is extremely low compared with many other materials.

- Targets are in place throughout the concrete sector to further reduce the embodied impacts of raw materials and operational processes. The concrete industry's Sustainable Concrete Strategy has won the prestigious 2010 Trade Association Forum (TAF) Best Practice Awards for Environmental Initiative. The awards recognise and celebrate best practice and reward the achievement of trade associations from all industry sectors.

2.Transport

- The installation of a sewerage pipeline usually requires the transport to site of the pipes themselves plus an amount of granular bedding material. Concrete pipes are structural elements and unlike flexible plastic pipes, the integrity of the installed pipeline is derived mainly from the pipe itself. After making appropriate structural calculations, this means that it is often possible to use a bedding design for concrete pipes that requires less granular material than typically required for flexible (plastic) pipes - and the re-use of excavated material for embedment, if suitable. Emissions associated with the provision and transport of the granular material can therefore be reduced. There is a further reduction in the transport emissions arising from the disposal of excavated material to landfill.

For further information see the table overleaf.

Gate-to-site transport emission – example

DN2100 concrete pipe – 48 to 84 kgCO_2e/m (Class N – Class B bedding)

Transport of pipes 100km 24 kgCO_2e/m

Transport of Granular – 30km 4 – 10 kgCO_2e/m

Granular for bedding (0.9 – 2.2.m^3) 16 – 40 kgCO_2e/m

Site

Transport of excavated material from site - 30km
4-10 kgCO_2e/m

24 + 4 + 16 + 4 = 48 kgCO_2e/m (Class N)
24 + 10 + 40 + 10 = 84 kgCO_2e/m (Class B)

DN2100 HDPE pipe – 143 kgCO_2e/m (Class S bedding)

Transport of pipes - 100km 11 kgCO_2e/m

Transport of Granular - 30km 23 kgCO_2e/m

Granular for bedding (4.9m^3) 86 kgCO_2e/m

Site

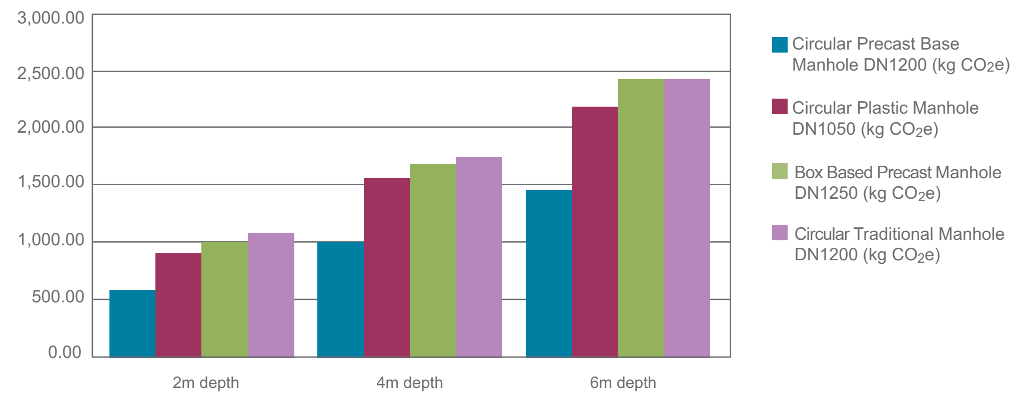
Transport of excavated material from site - 30km
23 kgCO_2e/m

11 + 23 + 86 + 23 = 143 kgCO_2e/m (Class S)

3. Installation

- When using a full granular bedding surround (a normal requirement for many plastic pipes), it is sometimes necessary to apply considerable mechanical compaction effort to ensure that the pipeline is adequately supported. This can lead to increased emissions and construction time when compared with some alternative bedding designs.
- Health and Safety Executive Guidelines for manual handling indicate that if Best Practice is to be adhered, DN300 and larger pipes are outside safe manual handling weight limits and should be mechanically lifted. On this basis, the emissions associated with mechanical lifting and handling of pipes on site can often be considered similar for all pipe materials.
- The CPSA study also reviewed alternative methods for the construction of manholes. The study concluded that **CPSA members' circular precast concrete base systems have a carbon footprint 30 – 43% lower than traditional manhole construction, imported box type and plastic alternatives.**

Comparison of Manholes (kgCO_2e)



4.Operation and maintenance

- As set out in the National Infrastructure Plan 2010, the UK Government is committed to ensuring that whole life principles are adopted in making effective and smarter use of existing assets. Concrete is an extremely durable material. Many design standards and specifications acknowledge the long service life of concrete stating a design life of 100+ years; examples exist of concrete pipes that are well over 100 years old and are in such good condition that can be expected to last for many more years. This demonstrable track record of long service life provides confidence that a concrete pipeline system should operate successfully for many years with minimal intervention, keeping emissions associated with repair or replacement to a minimum.

5.End of life

- Numerous case studies exist from around the world where concrete pipes originally installed 50-100 years earlier have been exhumed and after testing to today's Standards, have been successfully re-used on other projects, thus minimising emissions.

Additionally, concrete has the ability to absorb carbon dioxide. Depending on the density of the material and porosity of the surface, carbon dioxide from the atmosphere can be absorbed into the concrete throughout its service life. For structural concrete, the rate of "carbonation" is kept to a minimum in order to protect reinforcing steel from corrosion and there will be limited absorption of carbon dioxide during the service life. However, when concrete is broken up as rubble at the end of its life, the large surface area open to the atmosphere and exposed to carbon dioxide can lead to rapid absorption of CO_2, even for structural concretes, including precast concrete pipes. This means that concrete can have a "carbon negative" contribution at the end of life. For example, it is estimated that a DN450 precast concrete pipe can absorb end of life up 10% of the CO_2 emitted during manufacture.

The Case for Concrete

Whilst these reports demonstrate that concrete outperforms plastic pipes in terms of CO_2e, there are many other benefits to concrete as a building material.

- **Low embodied energy**
- **Low embodied carbon**
- **Low embodied water**
- **No raw material resource scarcity**
- **High recyclability end of life**
- **Second life re-use potential**
- **High use of recycled raw materials**

CPSA: 60 Charles Street, Leicester, LE1 1FB
Tel: 0116 253 6161
email@concretepipes.co.uk

As part of our commitment to sustainable development, this brochure has been printed using vegetable-based inks on paper sourced from managed forests as certified by the Forest Stewardship Council.
June 2011.

Your free copy of the Carbon Clear Reports

This independent series of three reports, verified to PAS 2050 provide a detailed examination of the true environmental cost of concrete and plastic pipework. For your complimentary copies download from the address below.

http://www.concretepipes.co.uk/sustainability.php

cpsa
concrete pipeline systems association