

# Diodes Zetex Semiconductors Environmental Report 2009

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# Diodes Zetex Semiconductors' Environmental Report 2009

## Contents

<b><u>Section</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
1.	Foreword.....	3
2.	Introduction.....	4
3.	Environmental Policy .....	5
4.	EMS Organisation.....	6
5.	Environmental Management.....	7
6.	Environmental Performance.....	9
7.	Environmental Promotion/Recognition.....	17
8.	2009 Objectives.....	18
9.	Canals and Waterways.....	19

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# 1. Foreword

2009 was a year when all industries looked for further innovative ways to improve operational effectiveness and reduce overheads in the face of a difficult global economy. Diodes Zetex, the European arm of the global semiconductor company Diodes Incorporated, has a long history of commitment to continual improvement of site operations in addition to striving for environmental excellence. In addition to the focus on its own operations and site energy efficiency, Diodes Zetex continued to add leading products to the company's portfolio to meet customers' requirements for energy efficient solutions to their development needs.

Over the course of the year Diodes Zetex made significant progress with its carbon footprint reduction program. 2009 saw Diodes Zetex achieve a 53% saving in carbon over its baseline calculations in 2007. This achievement has been the result of both large and small scale projects undertaken over the last three years and has allowed the business to make step changes in the way in which the site operates. As well as improving environmental performance, this has also allowed the business to operate in a more efficient manner and improve organisational competitiveness.

During 2009, Diodes Zetex was again recognised for its environmental performance. In September, the organisation was awarded the 'EEF Environmental Achievement Award' for the North West region, followed by the National Microelectronics Institute (NMI) site of the year award for a second time. These awards underpin the commitment and dedication of the workforce who are constantly striving for environmental excellence.

Diodes Zetex environmental 'green team' continues to manage the site's IPPC permit to ensure full compliance along with maintaining its ISO14001 status. Diodes Zetex achieved zero non conformances during the last site audit undertaken by DQS. Further successes continue to be monitored by the organisation's environmental KPIs and new projects driven by the 'green team'.

This report will share with you the dedication and commitment of our workforce to protecting the environment and the successful projects that have lead to significant reductions in our site's carbon footprint over the last 12 months.



Colin Greene  
Diodes Inc. European President



## 2. Introduction

Diodes Incorporated is a leading provider of high quality application specific standard products within the broad discrete, logic and analog semiconductor market. DZS is an operating subsidiary of Diodes Incorporated. The enlarged company operates sales offices in Germany, France, Korea, China, Taiwan and New York, and is supported by a global network of distributors and representatives.



*Lock 55 Rochdale Canal*

As part of the overall market strategy of Diodes Incorporated, the organisation designs and manufactures a broad range of standard and applications-focused linear integrated circuits and discrete semiconductor products using a wide variety of innovative wafer-processing technologies.

One of the primary aims is to provide high-value; system-level solutions based on a unique portfolio of integrated, discrete and combination analog products. Highly-qualified specialist design engineering and marketing teams focus on pushing forward the boundaries of technology in each area.

The Diodes product portfolio includes diodes, rectifiers, transistors, MOSFETs, protection devices, functional specific arrays, single gate logic, amplifiers and comparators, Hall-effect and temperature sensors; power management devices LED drivers, DC-DC switching and linear voltage regulators, voltage references along with special function devices, such as USB switch power switches, load switches, voltage supervisors and motor controllers

Diodes products are contained within a wide variety applications, such as cellular phones, digital cameras, LCD and PDP TV's, DAB radio, audio amplifiers and automotive - to name just a few. The signal management family includes an expanding range of audio, video and direct broadcast by satellite (DBS) products, including analog and digital audio amplifiers, video amplifiers and LNB bias controllers.

Diodes Incorporated began offering its first RoHS-compliant products during 2004 and is currently converting its entire portfolio to eliminate halogens and antimony-based flame-retardants from the product range

This report details the environmental performance of Diodes Zetex Semiconductors Limited, located near Manchester in the United Kingdom, employing more than 350 people. This subsidiary of Diodes Incorporated forms part of the European arm of the business and operates a 6" wafer fabrication facility along with analog and discrete design centres, new product development and support functions.

DZS achieved certification to the international environmental management standard ISO14001 in March 2006, following 2 years of work constructing, implementing and embedding its Environmental Management System which involved environmental risk assessment of the entire organisation.

# 3. Environmental Policy



*Lock 30W Huddersfield Canal*

The most fundamental requirement of any environmental management system is that the organisation has an effective environmental policy approved by the most senior manager within the organisation, in DZS' case the Diodes Inc. European President. The environmental policy has been in place since 2003 and has four main objectives:

**Regulatory Compliance** – we will comply with or improve upon applicable legal requirements, codes of practice and industry guidelines or where we deem that these criteria may not be adequately protective we will adopt our own standards.

**Continual Improvement** – we will consider environmental implications in making company decisions at all levels, reduce to a practical minimum the impacts of our emissions to air, land, water and the noise from our operations.

We will also promote waste minimisation and take all reasonable steps to see that waste generated is recycled or disposed of in the safest and most environmentally acceptable manner.

**Communication with Stakeholders** – we will liaise with all relevant external bodies and work with our own staff to improve environmental performance.

We will undertake appropriate environmental training and self-monitoring at all levels, particularly those that advise on health, safety and environmental matters.

We will also record and investigate promptly any matters brought to our attention by members of the public or any regulatory bodies, taking appropriate action.

We will actively promote environmentally sensitive behaviour in our staff.

We will make environmental objectives that are available to all responsible managers.

We will annually publish information regarding the Company's environmental performance in the previous year.

**Establish an Environmental Management System** – we will manage our environmental responsibilities within the framework of ISO14001:2004.

We will also carry out periodic environmental self-audits as a means of setting objectives, monitoring achievement and promoting further improvement.

We will submit our environmental management system, performance and achievements to independent verification by a third party.

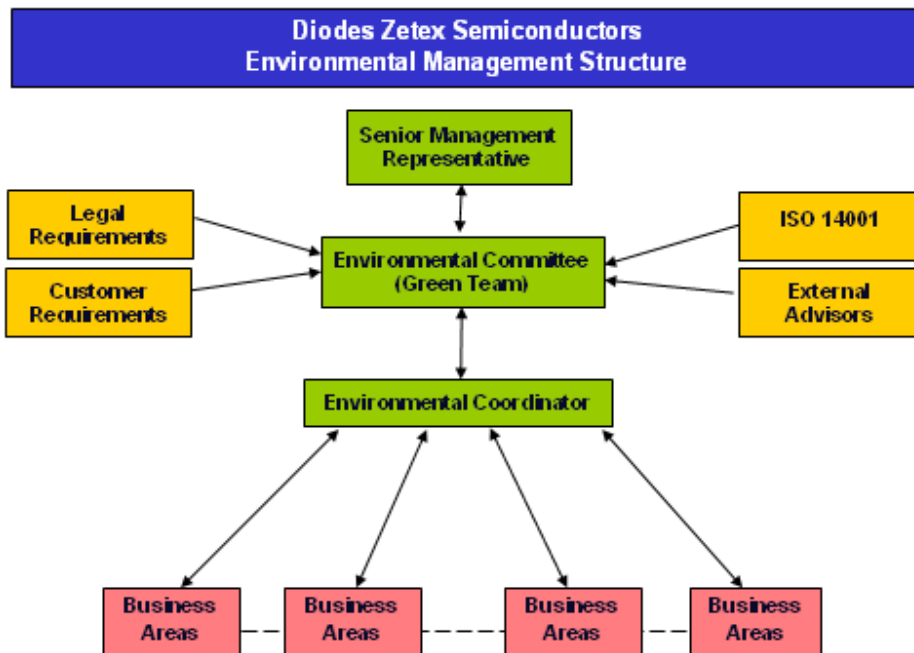
# 4. EMS Organisation

Responsibility for the environmental organisation within DZS resides with the head of HR, Quality and Systems. A cross-functional team, dubbed the 'Green Team,' oversees the operation and improvement of the company's environmental performance. It is formed from a small group of employees who possess the necessary knowledge, expertise and abilities to ensure continual improvement in environmental performance. Care has been taken to ensure that the Green Team is representative of the organisation and its functions both horizontally and vertically.



*Lock 54 Rochdale Canal*

For day-to-day operational reasons, at the grass roots of the organisation, responsibility for environmental performance is primarily with the local Business Area Managers (BAMs). One of the Green Team members liaises with the BAMs responsible for the various areas and operations within the business to ensure that they are aware of their environmental responsibilities, any corporate strategies and to assist with any difficulties that may be encountered.



# 5. Environmental Management



Upper pound, Lock 58 Rochdale Canal

In recent years, businesses have been faced with increasingly stringent legislation, the development of economic policies, and other measures that promote environmental protection. There are also increased concerns expressed about environmental matters and corporate performance. Against this backdrop, organisations such as DZS are becoming increasingly concerned with achieving and demonstrating sound environmental performance by careful management of the impacts of their activities, products and services on the environment.

DZS has always possessed a strong environmental 'conscience' and has operated an informal Environmental Management System for many years. In 2003 it was decided that the system should become more formalised and our commitment to the environment should become subject to public scrutiny. This would be best demonstrated by the achievement of certification against the ISO14001 Environmental Management Standard.

## **IPPC (Integrated Pollution Prevention and Control)**

One particular item of environmental legislation that was to seriously affect the company was the Pollution Prevention and Control (England and Wales) Regulations 2000. This legislation was introduced to impose controls through a permitting regime on companies that operated certain prescribed processes. Several of the processes operated by the company fell under the remit of these regulations, and consequently during 2004/5 an application to the UK Environment Agency was duly made for a permit to operate under these regulations. A permit was issued on 8th November 2005 and subsequently amended in 2009 to reflect the changes made to the facility with the consolidation of the wafer manufacturing operation to a single 6" fabrication line & the change in company name.

## 5. Environmental Management (cont.)

### Performance Against Permit

The IPPC permit held on this site prior to 2009 required the monitor of Hydrogen Chloride (HCl) emissions; however with the consolidation of the 6" manufacturing line and the decommissioning work undertaken in 2008, emissions had been reduced to negligible levels. Part of the variation to the IPPC permit removed the requirement for an airborne measurement of HCl and has been replaced with an overall monitor of HCl used on site in kilograms.

2009 saw a significant reduction in all of the reportable items under IPPC, this was mainly due to the consolidation of the 4 & 6" manufacturing lines, to a single 6" wafer fabrication line. In undertaking this project, the organisation was able to increase its output but reduce the overall base load on the site. This is because a 6" silicon wafer contains 2 ¼ the surface area of a 4" wafer, meaning that more silicon chips were able to fit on a single wafer. In addition, as a single wafer line was being utilised, significant savings could be made on chemicals, materials, utilities, water & effluent.

Parameter (per m <sup>2</sup> output of silicon)	2008	2009
Chemical Oxygen Demand (kg/m <sup>2</sup> )	19.47	8.48
Suspended Solids (kg/m <sup>2</sup> )	3.93	1.69
Solvent consumption (kg/m <sup>2</sup> )	8.73	6.10
Hydrogen fluoride consumption (kg/m <sup>2</sup> )	15.02	8.70
Hydrogen chloride consumption (kg/m <sup>2</sup> )	-	2.34
Water consumption (m <sup>3</sup> /m <sup>2</sup> )	202.4	173.6
Waste production (t/m <sup>2</sup> )	0.11	0.0075
Energy consumption (MWh/m <sup>2</sup> )	61.79	54.86

### ISO14001

In 2003 Zetex plc committed to formalising its environmental management system (EMS) with the implementation of the ISO14001 Environmental Management Standard. The 'green team' in conjunction with external consultants developed an action plan and co-ordinated and executed a program of activities to formalise the EMS, and to embed it within the organisation. ISO14001 certification was granted in January 2006.

The 'green team' continues to meet on a regular basis to review the performance of the EMS and its Key Performance Indicators, to identify areas for future improvement and to discuss any related issues. The activities of the business where there may be significant environmental aspects are reviewed as part of the EMS. Where practicable, actions are put in place to reduce or manage the risks caused by those aspects. The performance of the EMS is more formally reviewed at a Management Review where a comprehensive report detailing the performance of the EMS is presented to the Senior Management Team. This gives an opportunity for the discussion of strategies and to influence the future direction of the EMS.

ISO14001 certification requires an annual audit and, triennially, a more stringent reassessment. The latest annual surveillance audit conducted by DQS (UK) identified zero non-conformances and three opportunities for improvement.

## 6. Environmental Performance

Environmentally, 2009 proved to be another successful year for DZS. Consolidation of the 4" & 6" manufacturing lines realised a significant reduction in our overall environmental burden. During 2009 we reduced our carbon footprint by over 50% from its baseline year in 2007, leading to significant reductions in utilities and materials used. Site performance was monitored by the company's Key Performance Indicators (KPIs), where aggressive targets were set based on an estimate of the savings that were to be achieved from the consolidation project. Performance against the KPIs was excellent, where good progress was achieved against most of the metrics. Over the course of the year the organisation met or exceeded targets by reducing energy & water usage, along with effluent discharge and waste to landfill.



Lock 59 Rochdale Canal Lower Pound

In addition to our KPIs the 'green team' along with senior management defined 5 key objectives to drive environmental improvements during 2009. Of these objectives three of the five were either met or exceeded.

### **Key Performance Indicators (KPIs)**

#### **Energy Usage**

DZS is a large consumer of energy, 71,072MWh (Primary) in 2009. Initiatives to reduce the amount of energy required to process silicon wafers was one of DZS prime focuses during the year with both large and small scale projects being implemented. The largest reduction in energy came from the fab consolidation project, as this allowed a base load reduction on the site as a whole. Smaller projects concentrated on raising awareness, for example the implementation of power management software being installed to all P.C's to reduce power when computers were not in use. Over the course of the year the organisation achieved a 22% saving in energy compared to previous years. In terms of silicon produced the final measure was 54.9MWh/m<sup>2</sup> silicon, compared to 61.8MWh/m<sup>2</sup> silicon in 2008.

#### **Water Consumption**

DZS consumed 224,932m<sup>3</sup> of water during 2009 a 24% reduction over 2008 (296,000m<sup>3</sup> during 2008). This again was largely due to the closure of the 4" wafer manufacturing line. An additional benefit and saving from moving production to the 6" line was that more efficient rinsing methods are used, thus gaining further savings when processing wafers. An ongoing program is underway driving towards using dry etch methods where possible to minimise water usage. The final measure for 2009 was 174m<sup>3</sup> water/m<sup>2</sup> silicon (2008: 202m<sup>3</sup> water/m<sup>2</sup> silicon).

## 6. Environmental Performance (cont.)

### Effluent

During 2009 DZS discharged 164,701 m<sup>3</sup> of effluent (2008: 241,395 m<sup>3</sup>) – this equated to a 32% reduction on 2008. As less water was being used with the closure of the 4" wafer manufacturing line, less effluent was being discharged. Along with more efficient cleaning and dry etch methods significant savings could be achieved. The final measure for 2009 was 127m<sup>3</sup> effluent/m<sup>2</sup> silicon (2007: 165m<sup>3</sup> water/m<sup>2</sup> silicon).

### Waste

Waste was an area where DZS underachieved against target. Excessive packaging materials from new subcontractors plus increased transactions through warehouse due to logistics changes has realised a 120% increase in product passing through the UK warehouse. This has virtually reversed the savings achieved in the previous year. Initiatives are underway to further reduce waste generated as detailed later in this report under Waste Minimisation.

## 6. Environmental Performance (cont.)

### Carbon Footprint

In 2007 DZS began to measure the size of its UK organisation's Carbon Footprint. At the time of commencing this project there was little or no guidance on the methodology that should be adopted for this purpose, and as any guidance that existed seemed patchy and inadequate for the task, DZS developed its own methodology.

The 'green team' formed a sub-group responsible for identifying those generic activities within the business that were capable of generating carbon. Once these were determined, a methodology for measuring the activity was devised, and established conversion factors were used that would allow a verifiable conversion from activity into CO<sub>2</sub>e.

Nine criteria were eventually selected to form the basis for the footprint calculation and where necessary each of these was further divided into sub-groups to make the process manageable.

**Electricity Consumption** – Based on half-hourly meter readings.

**Emissions to Air** – Based on mass balance and process data.

**Commuting** – Based on a survey of all employees regarding their mode of commuting, vehicle engine size, fuel type and distance travelled.

**Emergency Incidents** – Based on incident records of the unintended release of any substance with a global warming potential.

**Goods Transportation** – Based on the mode of transport, the distance travelled and the weight of each consignment.

**Water Consumption & Effluent Produced** – Based on actual metered volumes.

**Business Travel** – Based on kilometres travelled by air, train or vehicles on company business.

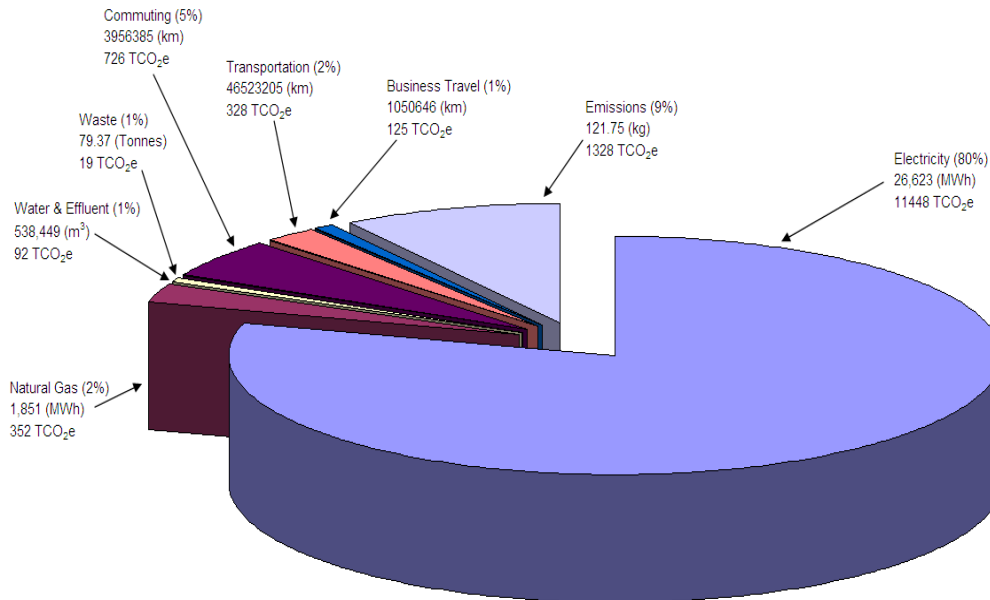
**Gas Consumption** – Based on verified meter readings.

**Waste Produced** – Based on verified weight of waste.

Conversion factors were obtained from DEFRA publication 'Guidelines for Company Reporting on Greenhouse Gas Emissions July 2005' with the exception of water, effluent and waste. These were obtained from United Utilities (for water & effluent) and the UK Carbon Trust (for waste).

## 6. Environmental Performance (cont.)

### 2009 Carbon Footprint - 14,148 tCO<sub>2</sub>e



2009 marked a significant milestone in environmental achievement for DZS. In 2007 when Diodes Zetex first carbon footprint analysis was undertaken, the goal was to understand the organisation's carbon burden on the environment. Following this year on year, DZS has made significant improvements in reducing its carbon footprint, with 2009 being recognised as the year in which the organisation has been able to halve its carbon footprint.

The analysis of the DZS carbon footprint was the initial stage in engaging the workforce, so that the organisation's environmental burden could be recognised. Once calculated, this information was used to drive improvements throughout the business and employees within the organisation were able to see how the impact of the various 'green' initiatives being undertaken throughout the organisation directly influenced the carbon footprint.

The main savings recognised over the last year have been a result of the consolidation of the 4" & 6" wafer manufacturing lines, which has led to significant savings in energy, water, effluent & waste. Although 2010 will not yield the same savings, carbon footprint and energy reduction is still at the forefront of our minds, with a project in association with the North West Development Agency and the Carbon Trust currently underway to further reduce the organisation's carbon burden and environmental impact.

During 2009, Electricity usage is still the main contributor to the footprint. Electrical energy usage is the subject of a continual improvement programme borne out of an energy usage survey carried out by agents of the Carbon Trust. This survey made a number of recommendations that were converted into a five-year action plan, 2009 was the fourth year of the plan.

Due to the low impact of travel, commuting & transportation on the footprint, DZS has continued to use the figures calculated from 2007. A program is underway which will re-calculate both commuting and transportation during 2010.

## 6. Environmental Performance (cont.)

### 2009 Objectives

#### Carbon Footprint Reduction

Over the course of 2009, consolidation of the 4" & 6" wafer manufacturing lines allowed the organisation to make significant savings in utility and material usage, which has a direct influence over the reduction of the overall carbon footprint. The largest savings were achieved in energy, water/effluent, waste and emissions. This, along with initiatives undertaken over the last three years has enabled the organisation to halve its carbon footprint from 30,660tCO<sub>2</sub>e in 2007 to 14,148tCO<sub>2</sub>e, with a 23% carbon saving over 2008.

#### Rationalisation of Waste Streams

A multi-disciplinary task group was formed to identify the waste streams and to develop a Waste Management Strategy. The aim was to maximise recycling opportunities, explore income generating opportunities and minimise spend, maintain current licences, adhere to legislation and support our ISO 14001 waste management objectives

Thirteen generic categories were formed from the thirty separate waste streams identified:

- Silicon
- Metals including precious metals
- Quartz
- Plastics
- Paper and cardboard
- Used chemicals
- WEEE (Waste Electrical and electronic Equipment)
- Polystyrene
- Wood
- Batteries
- Medical
- Catering waste
- General waste

A total of 11 separate contractors were providing the service, this has now been reduced to a single contractor supported by 4 specialist waste management providers.

Work to minimise waste going to landfill is ongoing and five of the main waste groups are now 100% recycled. Polystyrene chips have been removed from our waste stream altogether and catering waste has been reduced to a minimum using better menu planning techniques. Active waste segregation at local user levels has been encouraged by awareness activities and strategic positioning of 'recycling stations' throughout the business. This combination of initiatives and improved waste segregation at source has increased the amount of waste material available for recycling and recovery. We continue to seek other opportunities to eliminate waste from our business and will continue to work with our waste management providers to reduce the amount of waste sent to landfill each year.

Our vision is that by 2015 we aim to have zero operational waste to landfill.

## 6. Environmental Performance (cont.)

### Reduction in Water Consumption

Initiatives to reduce water consumption during 2009 realised a massive saving of 71,068 m<sup>3</sup> - a 24% reduction on 2008. The final measure for 2009 was 174m<sup>3</sup> water/m<sup>2</sup> silicon (2008: 202 m<sup>3</sup> water/m<sup>2</sup> silicon).

### Reduction in Energy Consumption

During 2009, initiatives to reduce energy consumption realised a saving of 19,308MWh - a 21% reduction on 2008. The final measure for 2009 was 54.9MWh/m<sup>2</sup> silicon (2008: 61.8 MWh/m<sup>2</sup> silicon).

### Environmental Awareness Training

During 2009, significant improvements continued to be seen in our education and execution of our lean and green initiatives within the manufacturing areas. Through our training programs we were able to improve awareness of our green strategies, increase productivity and reduce waste.

## 6. Environmental Performance (cont.)

### Reduction of Volatile Organic Chemicals (VOCs) usage

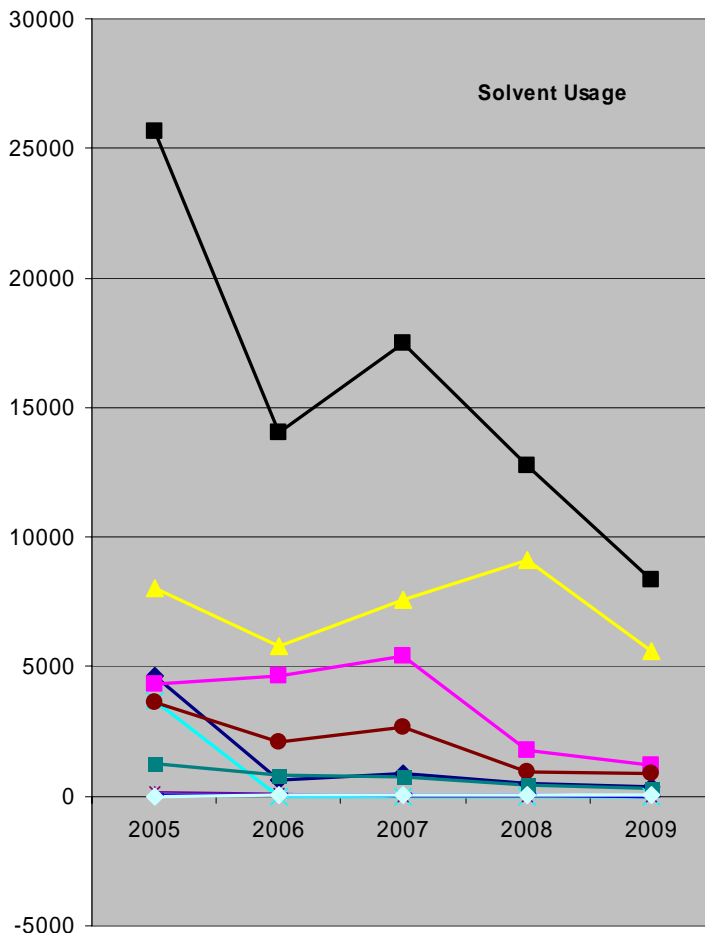
VOCs are chemicals which vaporise easily at room temperature and contain carbon in their molecular structure. Typically solvents, they are used in the manufacture of products such as paints and adhesives. DZS' principal use is for cleaning or degreasing, or for dissolving another substance and uses mainly acetone, isopropyl alcohol and photo resist chemicals.

### Environmental effects of VOCs

The release of VOCs into the environment can cause damage to soil and ground water. When released into the atmosphere they contribute to air pollution and have been found to be a major contributor to ozone which has been proved to be a health hazard. Whilst ozone in the upper atmosphere helps to protect against harmful UV radiation, ground-level ozone is a highly reactive gas that affects the normal function of the lungs. Ozone in the lower atmosphere results in the greenhouse effect which contributes to global warming and is difficult to control because it is formed in the atmosphere through a photochemical process. It is in this process that VOCs play a significant role.

### VOC Control

Over the last few years there has been a significant reduction in the quantity of VOCs used in our manufacturing processes. A process that used a large quantity has been made obsolete by the use of an alternative chemical; the automation of another process has resulted in a significant reduction in the use of acetone.



Investigations are ongoing to further reduce the impact on the environment. In order to reduce the quantity of photo resist chemical used a solvent is applied before application. This is reflected in the yellow line on the graph; total solvent used is the black line. Current work has enabled a 15% reduction in the quantity of solvent used for this application and further work has resulted in reductions of the EC Solvent during 2009.

DZS is continually examining its processes to achieve improvements in quality and impact on the environment. Processes using VOCs are carefully controlled and monitored. Further reductions in VOCs may be possible from improvements and consolidation of the manufacturing processes.

## 6. Environmental Performance (cont.)

### Auditing Hazardous Waste Disposal

During 2009 an audit was undertaken to determine the effectiveness and compliance of the company's hazardous waste management contractor. The contractor undertakes the recycling, reuse and/or safe disposal of the hazardous waste products from the manufacturing process.

The following is a summary of what actually happens to the various types of hazardous waste from DZS:

**Mixed Solvents** are tested for water content and calorific value, blended and then sold to a cement company to be used as supplementary fuel for brick kilns.

**Empty Plastic Bottles** are cleaned, shredded and sent for recycling.

**Contaminated Wipes** go through an 'Oily Rag' recovery line, where they are washed and then reused. Waste water used for washing is treated by effluent cleaning.

**Contaminated Equipment** is washed/rinsed and shredded before recycling down normal channels. Waste water used for washing is treated by effluent cleaning.

**Quartz Furnace Liners and Glass** are washed/rinsed and then recycled as glass. Waste water used for washing is treated by effluent cleaning.

**Waste Oil** is put into a separating tank to ensure any water is removed. The oil goes for recovery and reuse.

**Plastic** is shredded and then sent for recycling.

**Acids** are passed through a treatment plant, neutralised and filtered to capture any solids, this 'cake' is then tested and if the metal content is low is used for compost. If not it goes to landfill. The liquid goes via the sewers to the local water utility company for treatment. The waste company has a permit to discharge under their IPPC certificate.

**Waste Filters** are cleaned and shredded and sent for recycling; only a minimal amount goes to landfill.

**Mercury (light bulbs etc)** 100% recycled and reused. The mercury and phosphorous is extracted and recovered; end caps go to aluminium recycling; circuit boards go as WEEE waste; glass is broken up washed, rinsed and recycled.

**Refrigerant Gas Cylinders** any remaining refrigerant is incinerated, the metal cylinders are then recycled.

**WEEE waste** is stored on site until there is enough to recycle – it is then sent to a third-party WEEE recycling facility.

## 7. Environmental Promotion/Recognition

### Ride2Work Scheme

The UK Government's Green Transport Initiative offers bikes at a considerable reduction on the purchase price for journeys to and from work. In total 8% of our workforce has now purchased a bike under the Ride2Work Scheme.

Each year our cyclists cover hundreds of miles journeying to and from work and also taking part in charity fundraising cycle rides. 2009 saw a team of employees cycle the Hadrian cycleway from Ravenglass to Southshields - a total of 174 miles.



Lock 27W Huddersfield Canal

### EEF Environmental Achievement Award



DZS was awarded the 2009 EEF Environmental Achievement Award for North West England at the inaugural EEF Future Manufacturing Awards held in November at Manchester's Imperial War Museum. This award is made to companies who can demonstrate outstanding measures to preserve the environment and combat climate change. During 2009, DZS were able to demonstrate a 50% reduction in their carbon footprint over 2007, alongside internal initiatives to promote environmental awareness and reduce the overall impact on the environment.

Picture: left to right: David Ost, (EEF), Neil McCallion, (DZS), Kirsten Motyl (DZS), Dave

Benstead (DZS) and Steve Hinsley of the award sponsor, British Gas plc.

### NMI Award for Manufacturing Site of the Year

DZS won the National Microelectronics Institute's Manufacturing Site of the Year Award for 2009, in recognition the organisation's achievements in innovation, improved operational efficiency and sustained reduction in environmental impact.

Remarks from the panel of judges stated that Diodes Zetex was able to demonstrate a range of impressive achievements, resulting in improved productivity, carbon footprint reduction and enhancements to process and product capabilities to access larger markets. Pictured: Left to right Derek Boyd (NMI), Rob Davies (DZS) and Peter Eardsley (Merit Merrell Technology)



# 8. 2010 Objectives

## 2010 Outlook

2010 is set to follow 2009 in being another challenging year for industry but DZS will continue to drive continual environmental improvements and awareness throughout the organisation. 2010 will see further improvements to our energy usage through internal initiatives and projects undertaken. DZS will also look to its suppliers to make a conscious effort provide a 'greener' supply chain through the reduction of packaging materials, reducing our overall waste consumption.

2010 will see the completion of DZS free cooling project in association with the NWDA and Carbon Trust. This project will enable DZS to retire its old R22 refrigeration systems and use new innovative methods to generate cooling within the clean-room environment whilst maximising energy savings. DZS will also continue to promote awareness amongst staff to educate and explain everyone's impact on the environment and what they can do to 'make a difference'.

Finally DZS will continue with its awareness program to inform staff of the environmental impacts and benefits of the products manufactured by DZS, where these products are used and the typical carbon savings that can be achieved. As always continued support will be provided by the organisation's 'Green Team' who will continue to drive objectives, targets and new ideas throughout the organisation.

## Themes

The Management Review agreed that the 2010 Environmental objectives will be related to the following themes:

- Reduction of the DZS carbon footprint.
- Reduction in incoming packing materials
- Reduction in energy consumption.
- Completion of the Free Cooling Project in partnership with NWDA



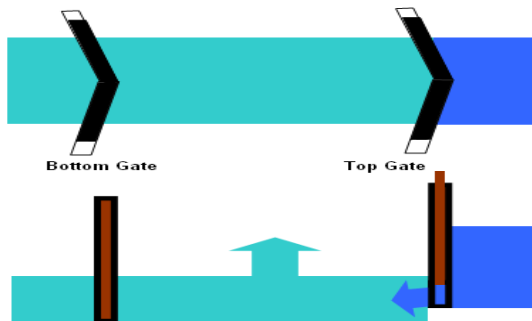
Lock 31W Huddersfield Canal

# 9. Canals and Waterways

Each section of this report features a photograph of a canal or waterway. As part of DZS' commitment to protecting the environment, the company has elected to highlight and help maintain these heritage sites and to promote British Waterways, the organisation that cares for 2,200 miles (3,500km) of the UK's canals and rivers. For further information, please visit <http://www.britishwaterways.co.uk>



Rich in heritage and abundant in wildlife, inland waterways are as popular today as they have ever been. Half of the UK population lives within 5 miles of one of our canals and rivers (DZS is within 2 miles) and an estimated 13 million people use them every year as part of their everyday life as a short-cut to work, walking the dog or simply taking time-out and watching the boats, over the years some have fallen into decline and disrepair.



At its simplest, a canal consists of a trench filled with water. Where there are differences in water levels, a system of locks or lifts needs to be employed to allow boats to progress. On canals, a lock is the simplest type of device for raising or lowering boats between stretches of water at different levels. The distinguishing feature of a lock is a fixed chamber where the water level can be varied, and a system of culverts, gates and paddles which control the flow of water.

Some canal terminology may be unfamiliar, so here is a quick guide to some of the terms.

## Rise

The change in water-level effected by the lock. The deepest lock on the English canal system is Tuel Lane Lock at Sowerby Bridge, Yorkshire on the Rochdale Canal with a rise of almost 20 feet (6m). A more typical rise would be 8-12 feet (2.4-3.7m).

## Pound

The level stretch of water between two locks. The lock allows a boat to move between the pound above it (upper pound) and the pound below it (lower pound).

## Chamber

The main feature of a lock. This is a watertight enclosure made of masonry, brick or concrete which can be sealed off from the pounds at either end by means of gates.

The chamber may be large enough to allow more than one vessel at a time to use the lock. A chamber is said to be "full" when the water level is the same as in the upper pound; and "empty" when the level is the same as in the lower pound. In some canals there are short sequences, "stairways" or "flights" of locks in which case the top gate of one lock is also the bottom gate of the next.



Inside Tuel Lane Lock © 2008 TJ Blackman  
Source: Wikimedia commons

# 9. Canals and Waterways (cont)

## Gates

The watertight doors which seal off the chamber from the upper and lower pounds. Each end of the chamber is equipped with a pair of swinging half-gates (on narrow canals such as the Huddersfield Narrow Canal they are single gates.) When closed they meet at an angle and the difference in water-level squeezes the closed gates securely together. This prevents their being opened until water levels have equalised.

## Paddles

The simple valves by which the lock chamber is filled or emptied. A paddle is a sliding wooden panel which when lifted up out of the way allows water to either enter the chamber from the upper pound or flow out to the lower pound. A gate paddle simply covers a hole in the lower part of a gate; some paddles block an underground culvert.

## Tunnels

Where it is impossible to cut a canal around steep hills or mountains, tunnels have to be dug. The highest, longest and deepest tunnel in the UK is at Standedge. This marvel of engineering, worked on by Thomas Telford, runs from Marsden in West Yorkshire through to Diggle in Greater Manchester for 3¼ miles through the hard millstone grit of the Pennines. The tunnel is 636 feet (194m) underground at its deepest point, and 643 feet (196m) above sea level - it took 16 years to construct. The tunnel is only wide enough for one narrow boat to pass through at any one time. There is no a tow path and so a method called "legging" is used to move the boat, this involves "walking" along the tunnel roof or walls whilst lying on the boat. The last commercial boat to use the tunnel passed through in 1921, and the canal was officially closed in 1944, after which it soon fell into disrepair. The Standedge canal



Entrance to Standedge Tunnel, Marsden, West Yorkshire, England. © 2008 54north  
Source: Wikimedia commons

tunnel was the beneficiary of a £5 million grant to restore the entire canal and re-opened in May 2001. The visitors' centre is situated at the Marsden portal and is located in the former warehouse, used for transshipment of goods from canal barge to packhorse during the period between 1798, when the canal reached Marsden, and 1811, when the tunnel opened. The centre contains exhibitions on the history of the tunnels, and on the canal tunnel's recent restoration.

## Locks

The Standedge tunnel Diggle portal stands at the top of the Diggle Flight, a series of 6 single-gated locks owing to the width being just under 7 feet. A distinctive feature of this flight is the ground paddles at the lock gates.



Lock 30W Huddersfield Canal

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