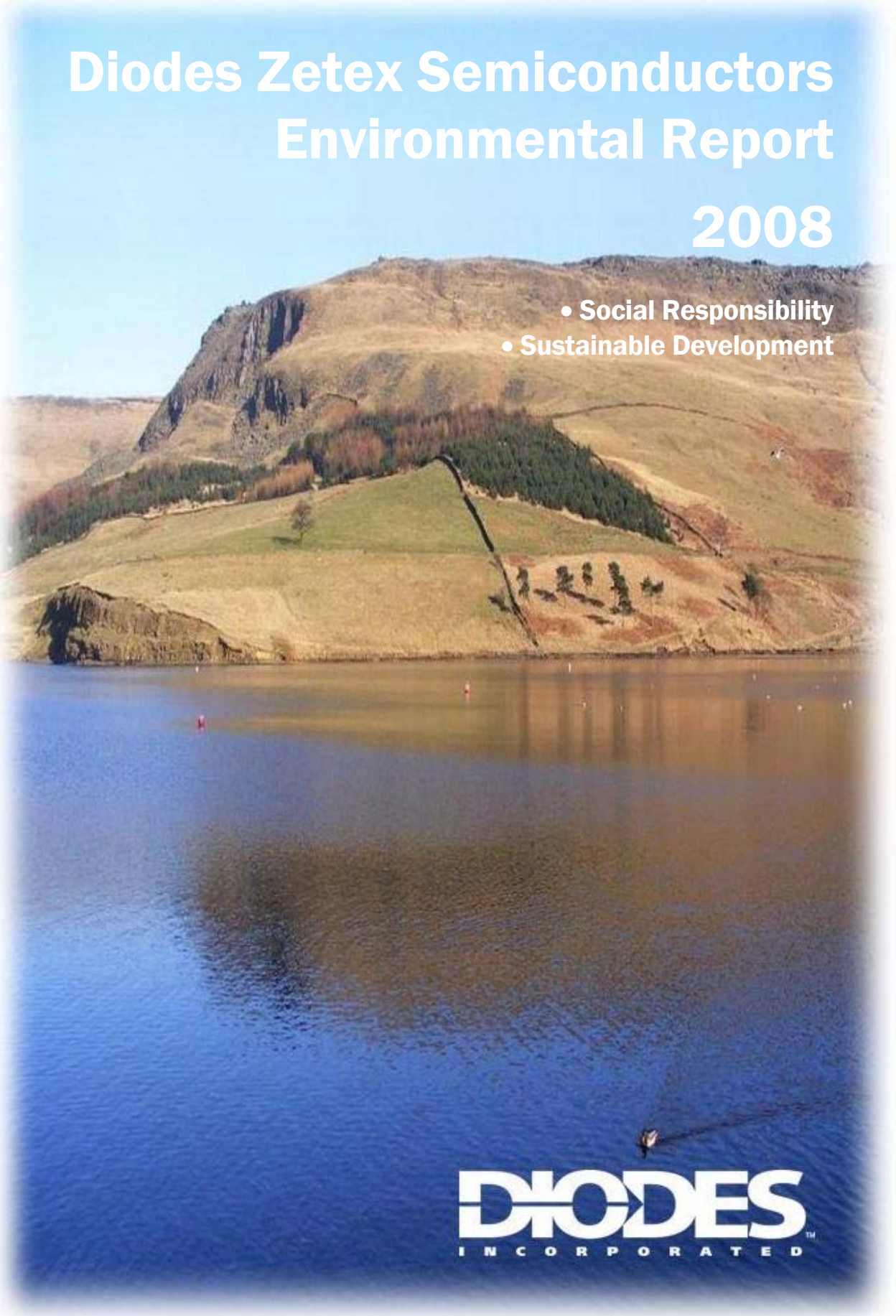
Diodes Zetex Semiconductors Environmental Report 2008

- Social Responsibility
- Sustainable Development



DIODES INCORPORATED

Diodes Zetex Semiconductors' Environmental Report 2008

Contents

Zetex Semiconductors plc was previously a wholly owned subsidiary of Zetex plc. In June 2008, Zetex plc was acquired by Diodes Incorporated and Zetex Semiconductors plc was renamed Diodes Zetex Semiconductors Limited, and is abbreviated to "DZS" within this document.

Butterfly images shown within this report are from English Nature and are used with their kind permission. Section 9 gives fuller details.

1. Foreword by Colin Greene (Diodes Inc. European President)

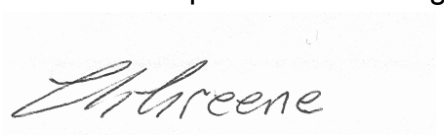
Colin Greene receiving the Elektra 2008 Environment Award

In June 2008, Zetex plc was acquired by Dallas-based Diodes Incorporated. Both companies had previously developed independent product portfolios that address the requirements of improved energy efficient designs. The combined strengths of the companies will continue to solve this demand for improved energy performance. The global world we live in is confronted with unprecedented environmental challenges. At DZS, these challenges are at the forefront of our minds, and we are constantly striving to improve our environmental performance through internal initiatives and working closely alongside our customers to develop and provide more energy efficient solutions.

During 2008, our efforts were rewarded as we received a number of awards for our continued environmental commitment. The National Microelectronics Institute (NMI) awarded DZS the Low Power "Green" Design Award for our ZXGD3101 device. DZS also received the Elektra award for our commitment and business strategies that are reducing our impact on the environment.

A number of initiatives proposed by our 'Green Team' were introduced during 2008 to save energy, reduce water consumption and reuse materials, along-side our key performance indicators. These initiatives are driven throughout the organisation through strong commitment by the workforce in reducing the organisations carbon burden on the environment. 2008 also saw the triennial re-certification audit of our ISO14001 environmental management system conducted by UL, where our system was found to be fully complaint with the standard.

Over the course of this report we hope to demonstrate our dedication in reducing our impact on the environment through strong commitment and continual improvements throughout the organisation.



Colin Greene
Diodes Inc. European President

2. An introduction to Diodes Zetex Semiconductors

DZS, a leading provider of high performance, analogue semiconductor products for signal processing and power management applications, is a subsidiary of Diodes Incorporated, 'Diodes' The enlarged company now operates sales offices in Germany, France, Korea, China, Taiwan and New York, and is supported by a global network of distributors and representatives.

Polyommatus bellargus Adonis Blue

DZS designs and manufactures a broad range of standard and applications-focused linear integrated circuits and discrete semiconductor products using a wide variety of wafer processing technologies.

Located near Manchester in the United Kingdom, DZS employs more than 500 people world-wide. The company operates two wafer fabrication facilities in the UK and carries out package development, assembly and test at group facilities in Germany and China.

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

The product portfolio comprises power- and signal-management products used in an increasing variety of applications, such as cellular phones, digital cameras, LCD and PDP TV's, DAB radio, audio amplifiers and automotive - to name just a few.

In power management, a growing range of energy efficient IC products, including LED drivers, single/dual cell boost converters and fan motor controllers is offered.

The signal management family includes an expanding range of audio, video and direct broadcast by satellite (DBS) products, including analogue and digital audio amplifiers, video amplifiers and LNB bias controllers.

The company also produces a wide range of discrete semiconductor products including latest generation low-saturation bipolar transistors, low on-resistance N and P channel MOSFETs and Schottky rectifiers.

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.

DZS 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.

3. Environmental Policy

Plebejus argus Silver-studded Blue

A 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.

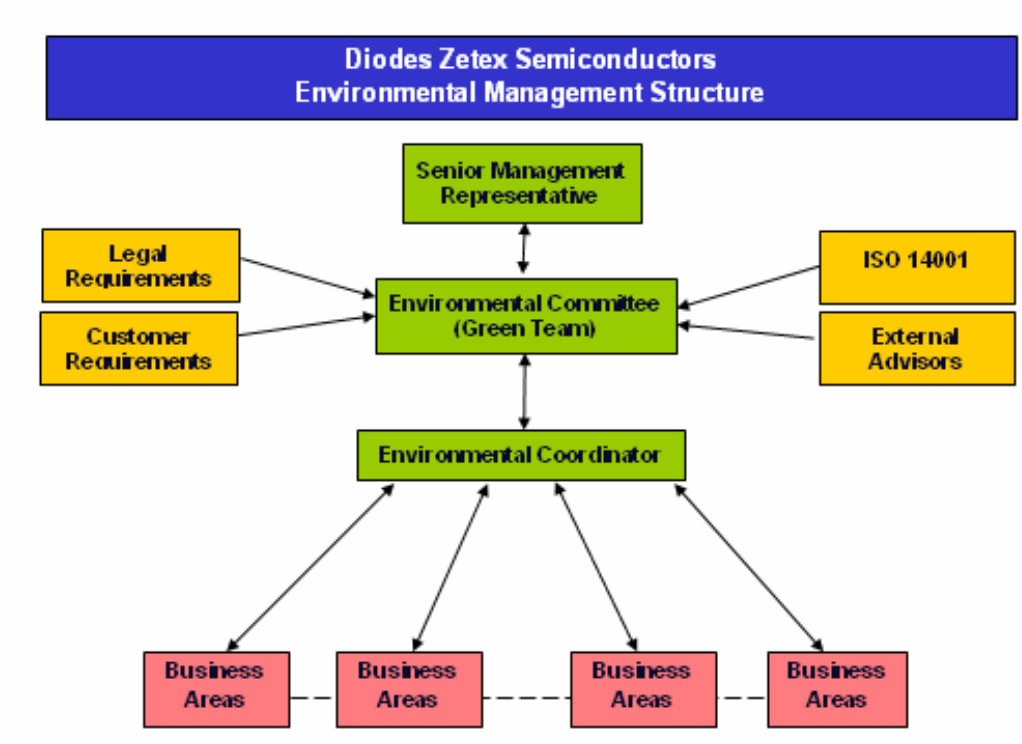
We will submit our environmental management system, performance and achievements to independent verification by a third party.

4. Environmental Management System Organisation

Responsibility for the environmental organisation within DZS resides with the HR, Quality & Systems Director; a cross-functional team has been created to overview the operation and improvement of the company's environmental performance. Dubbed the 'Green Team,' it is formed from a small group of employees who possess the necessary knowledge, expertise and ability 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.

Mellicta athalia Heath Fritillary

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

Boloria euphrosyne Pearl-bordered Fritillary

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 by stakeholders and other interested parties 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 continues to be in force to date.

5. Environmental Management (cont.)

Performance Against Permit

The IPPC permit specifically requires DZS to monitor the emission of Hydrogen Chloride (HCl). During 2008 we completed the decommissioning of a number of Gemini Epitaxy reactors, which were the main source of the HCl emission. These were substituted with more-advanced processing equipment reducing these emissions to negligible levels. Therefore under agreement with the Environment Agency, the requirement to monitor or report HCl has been withdrawn.

Parameter (per m^2 output of silicon)	2007	2008
Chemical Oxygen Demand (kg/m^2)	10.56	19.47
Suspended Solids (kg/m^2)	2.80	3.93
Solvent consumption (kg/m^2)	10.27	8.73
Hydrogen fluoride consumption (kg/m^2)	8.12	15.02
Water consumption (m^3/m^2)	226	202.4
Waste production (t/m^2)	0.06	0.11
Energy consumption (MWh/m^2)	65.24	61.79

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.

Diodes Incorporated acquired Zetex plc in June 2008 and have since re-affirmed their commitment to maintaining the ISO 14001 accreditation.

In order to maintain ISO14001 certification we undergo annual surveillance audits and, triennially, a more stringent reassessment. The most recent surveillance audit was completed in February 2008 were we achieved the exceptional result of zero non-conformances and zero opportunities for improvement. Reassessment is due in 2009.

6. Environmental Performance

Environmentally, 2008 proved to be a successful year for DZS. Performance against the Company's Key Performance Indicators (KPIs) was excellent, with good progress made against all of the metrics. During the year we continually met or exceed targets by reducing energy & water usage, effluent discharge and waste to landfill. 2008 also saw the continued work in reducing the company's carbon footprint which will be a continued theme throughout 2009.

Maculinea arion Large Blue Butterfly

As well as our KPIs, the 'Green Team' along with senior management defined five objectives to drive environmental improvements during 2008. Of these objectives, four of the five were met or exceeded, with the fifth making significant improvements upon our 2007 performance.

Key Performance Indicators (KPIs)

Energy Usage

DZS is a large consumer of energy, 90,380MWh (Primary) in 2008. Initiatives to reduce the amount of energy required to process silicon wafers continued and this realised a reduction of over 2.1% during 2008. During the same period the output of silicon wafers rose by over 3%. The final measure for 2008 was 61.8MWh/m^2 silicon (2007: 65.2 MWh/m^2 silicon).

Water Consumption

DZS consumed 296,000m^3 of water during 2008 - a 7½% reduction on 2007. 28,836m^3 of water was recycled, both of these against a backdrop of a 3.3% increase in production. The final measure for 2008 was 202m^3 water/m^2 silicon (2007: 226m^3 water/m^2 silicon). Recycled water showed an increase over 2007 this was mainly due to recycling more deionised water.

Effluent

During 2008 we discharged 241,395 m^3 of effluent (2007: 241,827 m^3). The final measure for 2008 was 165m^3 effluent/m^2 silicon (2007: 171m^3 water/m^2 silicon).

6. Environmental Performance (cont.)

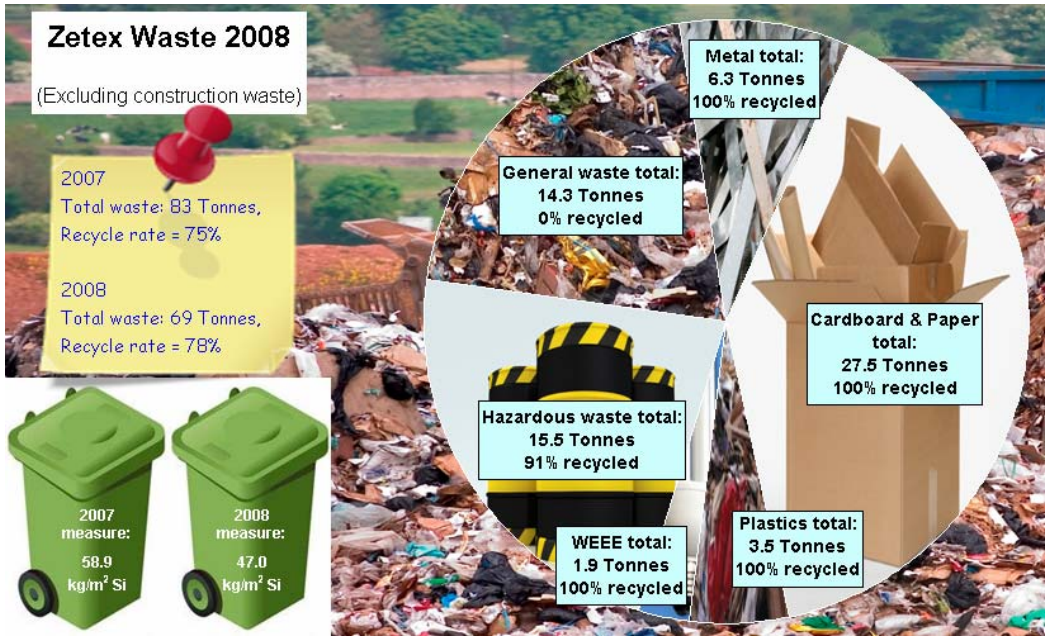
Waste

During 2008, construction of the 6 inch line extension generated 95 tonnes of waste, of which 60 tonnes (63%) was recycled. To enable a like-for-like comparison with 2007 this has been excluded from the figures quoted below.

2008 Highlights:
Total waste: 69 tonnes (2007: 83 tonnes) – 15% reduction
Recycled rate: 78% (2007: 75%)
Hazardous waste recycled: 91% (2007: 78%)
Waste going to landfill: 15 tonnes (2007: 21 tonnes) – 28% reduction
Production measure: 47 (2007: 59) units kg/m^2 silicon

Initiatives are underway to further reduce waste generated as detailed later in this report under Waste Minimisation.

WEEE (Waste Electrical and Electronic Equipment) and plastic waste are also included in the 2008 figures which account for 1.9 tonnes and 3.5 tonnes respectively.



6. Environmental Performance (cont.)

Carbon Footprint

As national and international concerns regarding global warming are growing, and awareness of the cause of this phenomenon (so called greenhouse gases, mainly CO_2) is becoming widespread, a decision was made to measure the size of the 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_2e.

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.

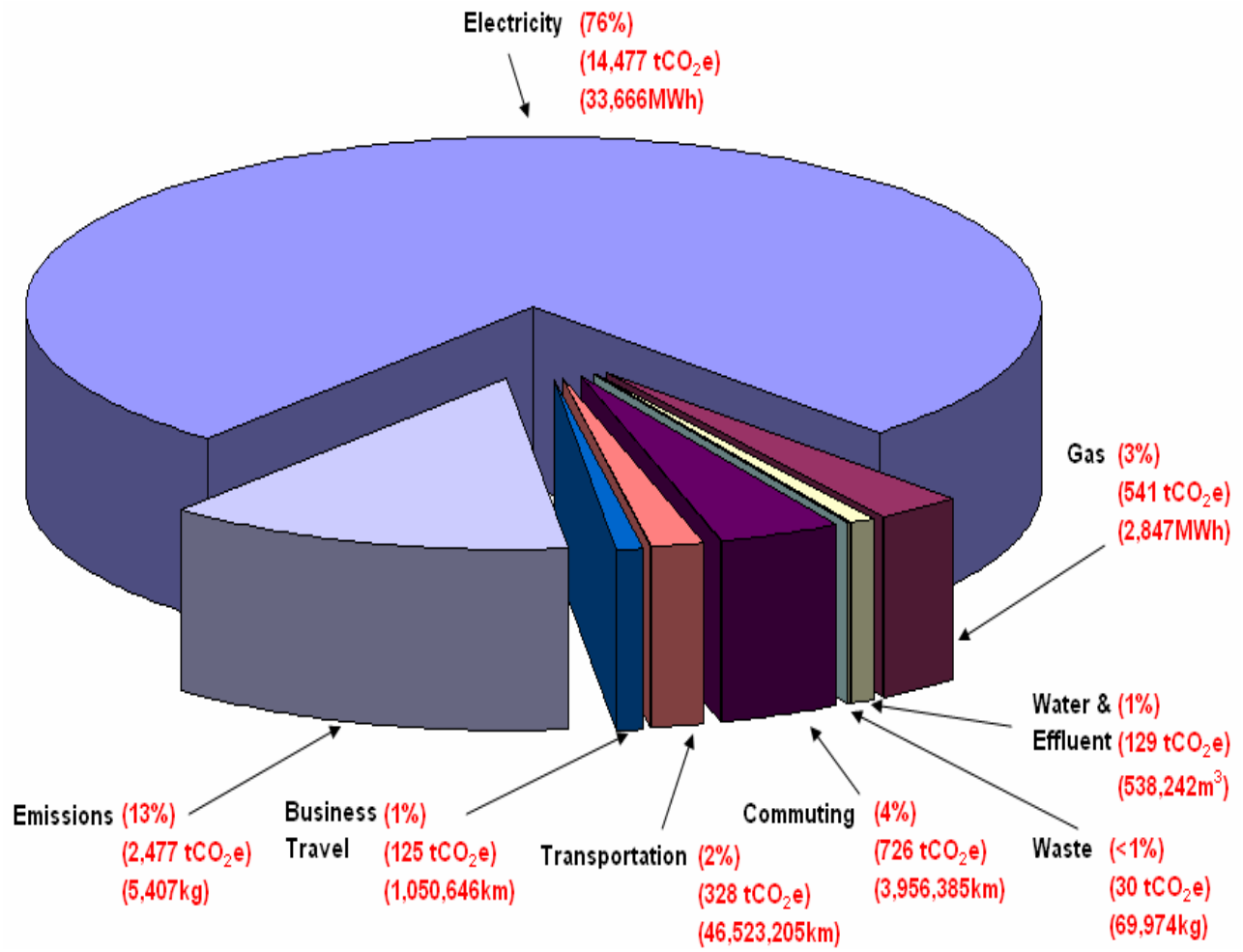
Gas Consumption – Based on verified meter readings.

Waste Produced – Based on verified weight of waste.

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

6. Environmental Performance (cont.)

2008 Carbon Footprint - 18,833 tC02e



2008 saw a 38% reduction in our carbon footprint from 30,660 tonnes in 2007 to 18,833 tonnes. This reduction was achieved by the work undertaken in the reduction of emissions to air through abatement.

Electricity usage continued to be 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, 2008 was the third 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, of which will be reviewed once again in 2009.

6. Environmental Performance (cont.)

2008 Objectives

Carbon Footprint Reduction

The two main contributors to the DZS footprint were electricity usage and emissions to air. During 2008, DZS concentrated on reducing its emissions to air by abatement. This work had a significant impact on the reduction of emissions from 13,289 tonnes in 2007 to 2,477 tones in 2008 (an 81% reduction).

Packaging Reduction

Building on the good work done in previous years, three areas for action were identified: Waste Reduction at Source, Packaging Waste and the Removal of Harmful Substances from Packaging.

Waste Reduction at Source

The aim was to reduce the volume of incoming postal waste by removing mail addressed to ex employees, generic departments or job titles from the postal flow. Multiple copies of catalogues and journals were also scrutinized. An ambitious target of 1 tonne during 2008 was set.

Incoming mail was monitored for 32 weeks. During which 1,464kg of mail was received, of that figure, 385kg (26.3%) went straight to recycle. Requests were made to the senders to remove names from their mailing lists but this has been met with limited success as many companies rely on the quantity of “executives and decision makers” on the circulation list to sell advertising.

Weekly receipts dropped from an average of 51½ kg to 40kg - a reduction of 11½kg per week or almost 600kg per annum or 22⅓%.

Reduce Packaging Waste

The target was 40+% smaller (by volume) wafer pots with fewer foam and paper inserts by June 2008 and also to reduce the amount of card used in outer cartons by 10% September 2008.

The changeover to smaller wafer pots completed against target. In volume we are reducing by just over 50%, reduction in foam discs equates to 3.2M cubic centimetres per annum. A new style of packing boxes has been agreed. Implementation expected to be complete by end of December.

6. Environmental Performance (cont.)

Reduce Harmful Substances

Previously all cardboard materials used for component packaging was whitened using a Chlorine-free bleaching process. Our aim was to move to a more environmentally-friendly unbleached type. This objective has been achieved with material made from at least 90% recycled fibres, which can be recycled again, it is additionally, fully biodegradable.

We are pleased to report that DZS have now achieved closure of the recycling loop by recycling waste card and buying boxes and cartons made with recycled card.

Reduction in Water Consumption

During 2008 initiatives to reduce water consumption realised a saving of 23,715 m^2 - a 7½% reduction on 2007. This was also achieved with a 3.3% increase in production. The final measure for 2008 was 202m3 water/m2 silicon (2007: 226m3 water/m2 silicon).

Reduction in Energy Consumption

During 2008 initiatives to reduce energy consumption realised a saving of 1,941MWh - a 2.1% reduction on 2007. This, again, was achieved with a 3.3% increase in production. The final measure for 2008 was 61.8MWh/m^2 silicon (2007: 65.2 MWh/m^2 silicon).

Environmental Awareness Training

During 2008, significant improvements were 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

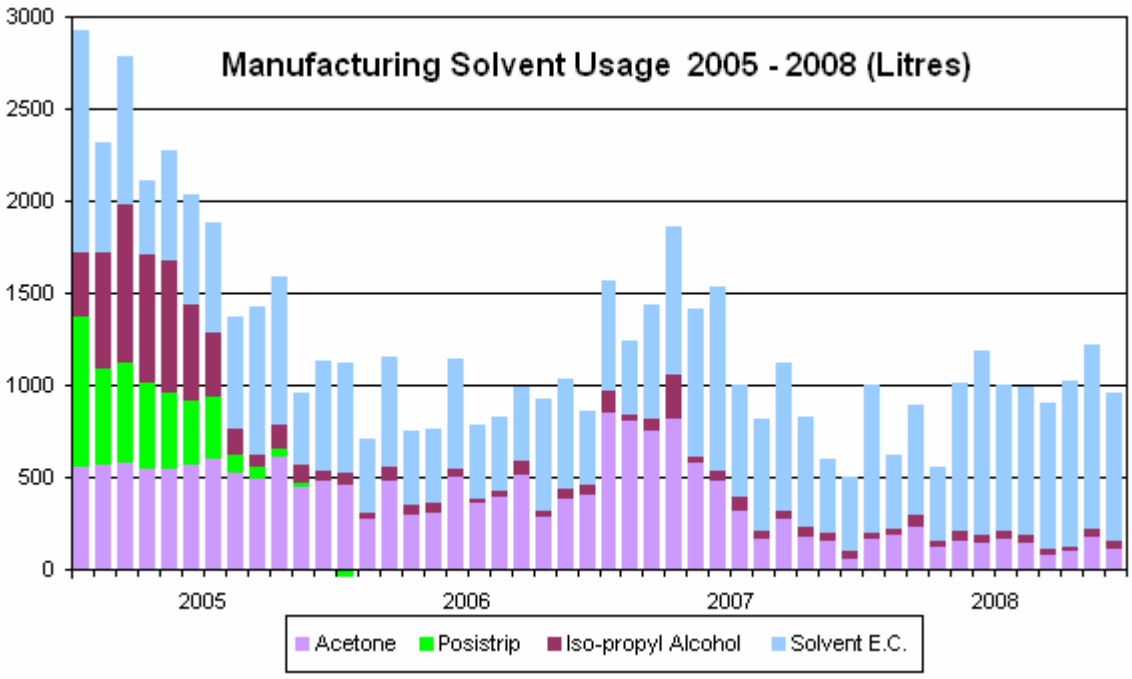
VOCs are chemicals which vaporise easily at room temperature and contain carbon in their molecular structure. Typically solvents, they are used in the manufacture of products such as paints and adhesives. DZS' principal use is for cleaning or degreasing, or for dissolving another substance. DZS uses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

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.



6. Environmental Performance (cont.)

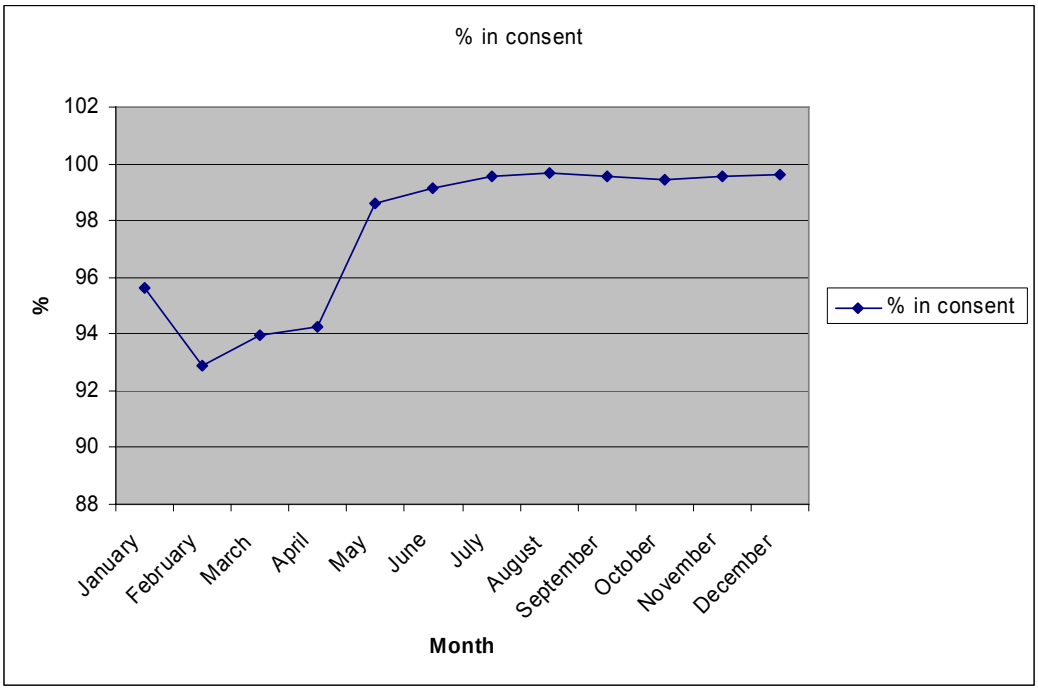
Work is ongoing to investigate further reductions both on the grounds of cost and to reduce the impact on the environment. In order to reduce the quantity of photo resist chemical used a solvent is applied before application. This is reflected in the light blue column in the graph. Current work has enabled a 15% reduction in the quantity of solvent used for this application and should therefore show a reduction during 2009.
Spent solvents are collected at point of use, stored and externally tested for calorific value and water content, after blending they are reused as supplementary fuel for cement kilns.

DZS continually examines its processes seeking 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.

Other Improvement Initiatives

Effluent divert tank

During 2008 we discharged 241,359m^3 of effluent to sewer. During the first 4 months, the average compliance percentage was 94%. The divert tank became fully operational from the end of April 2008 increasing the average compliance percentage to 99.5% in consent. This immediately had a dramatic effect on the number of consent outages as can be seen on the graph below.



This is a dramatic incremental step, the aim is to improve on this and take the total compliance percentage to 100% which equates to zero out-of-consent discharges.

7. Environmental Promotion/Recognition

Lycaena dispar Large Copper Butterfly

Ride2Work Scheme

Following the launch of the scheme in November 2007, 5% of our workforce has purchased a bicycle under the Ride2Work Scheme, each receiving a considerable reduction on the purchase price of a new cycle.

The scheme was implemented to promote healthier journeys to work and to reduce environmental pollution. An added advantage is improving the general fitness level of our staff by encouraging cycling-related activities such as participation in the Charity Fundraising 60 mile Manchester-to-Blackpool cycle ride. As an environmentally aware organisation, DZS will continue supporting Ride2Work throughout 2009.

NMI Award for ZXGD3101T8

Diodes Incorporated has won the National Microelectronics Institute's Low Power Green Design Award for 2008 for its Zetex-designed ZXGD3101T8 MOSFET rectifier controller.

ZXGD3101T8 enables power supply designers to achieve higher electrical and thermal efficiency, a reduction in size and weight, and a simplification of overall circuit design.

Remarks from the panel of judges stated that they were particularly impressed by the innovative and elegant design, which had potentially the biggest positive impact on energy consumption.

The controller is aimed at mains adaptors for LCD TVs, set-top boxes and other applications. Further information can be found here

Elektra Award

DZS was awarded the '2008 Environmental Award' at the annual Elektra Awards held in Munich in November 2008. This award is given to companies who can demonstrate how their business strategies are reducing their impact on the environment along with their commitment to sustained environmental improvement and promotion of environmental initiates throughout the organisation.

Elektra 08
European Electronics Industry Awards
WINNER

The Elektra Awards are regarded as the most prestigious electronic product, technology and business awards in Europe, and recognise the achievements of individuals and companies throughout the European Electronics industry.

8. 2009 Objectives

2009 Outlook

2009 is set to be a challenging year but will not detract from DZS continued commitment to the environment. During 2009 we hope to further reduce our impact on the environment through consolidation of our manufacturing facility, reducing our usage of utilities and chemicals to have a positive impact on our carbon footprint reduction program.

Hesperia comma Silver-Spotted Skipper

2009 will also see DZS launch education and awareness sessions to make members of staff aware of how the products we produce have a positive impact on the reduction of global warming and power usage throughout the world. Continued support will be provided by our green team who will continue to drive objectives throughout the organisation and help with achieving our KPI targets.

Themes

The Management Review agreed that the 2009 Environmental objectives will be related to the following themes:

- Reduction of the DZS' carbon footprint.
- Reduction in the volume of waste to landfill.
- Reduction in water consumption.
- Reduction in energy consumption.

Manufacturing Facility Investment

During 2008 a multimillion pound investment was made, and work began to extend our most efficient wafer fabrication facility, 'Fab3', to enable all product from January 2009 to be manufactured using 6 inch wafers with the capability of submicron geometries. This has allowed the older, less efficient 4 inch wafer production line 'Fab2' to be retired.

From this investment and the introduction of lean manufacturing and existing continual improvement programmes, we are targeting a very ambitious absolute reduction in manufacturing resource usage for 2009 which includes energy, water, and bulk gases.

8. 2009 Objectives (cont.)

Water Reduction – Step change

The Fab3 extension, which does not carry any additional wet-bench processes, and the closure of Fab2, will realise a reduction in the amount deionised (DI) water required. Fab2 has a large amount of wet processes which will no longer be required. A reduction of 30% usage in DI water should be achievable. However, owing to technical issues, the DI plant cannot operate at this reduced level of flow. To achieve the 30% reduction, further modifications will be necessary and are under review. With less demand on the DI water plant, the frequency of certain maintenance operations can be reduced, resulting in savings of the amount of water and chemicals necessary for plant maintenance.

Effluent reduction -Step change

Following the closure of Fab 2 and the transfer of manufacture to Fab 3, it is envisaged that 30% less water will be required to maintain the manufacturing throughput. This will be shown as a reduction in effluent output. Fab 3 operates on a high-flow/low-flow system. Which, although it is total loss, is more efficient. When there is no product in the weir the flow drops to a trickle is to keep the weir fresh, it then opens to full flow when cleaning of product is required.

The Fab 2 weirs were also total loss but flow was at a faster rate permanently, even if no product was being processed. It was therefore wasteful. The new Fab 3 line extension has no requirement for wet processes. The reduction will come ultimately from the closure of the Fab2 Facility.

As an additional saving we are in consultation with our water treatment suppliers with the intention of reusing the “waste” water from the water treatment plant as a top up for the cooling towers. This, if possible would create more savings and improve our water recycling total.

9. Endangered butterfly species

Each of the report sections features a photograph of an endangered butterfly species. As part of DZS' commitment to protecting the environment, the company has elected to highlight these butterfly species and once again to promote English Nature who have kindly given permission to reproduce their photographs. For further information, please visit their website at http://www.naturalengland.org.uk

NATURAL ENGLAND

Adonis Blue
(Polyommatus bellargus)

The Adonis Blue is a species which prefers south-facing slopes of England's chalk downlands, where it flies low over the warm, sheltered spots of short-grazed or closely-cropped turf.

The males have brilliant sky-blue wings, while the females are brown and far less conspicuous. Both sexes can be distinguished from other species by the distinctive black lines that enter or cross the white fringes to the wings.

© Peter Wakely /Natural England

Despite its restricted distribution, the butterfly can be seen in many hundreds on good sites. There are two broods each year. It has undergone a major decline through its entire range, but has recently re-expanded in some regions, notably Dorset and Wiltshire.

9. Endangered butterfly species (cont.)

Silver-studded Blue
(*Plebejus argus*)

© Michael Hammett/Natural England

The butterfly occurs on lowland heathland, calcareous grassland and at a single peatland site in Wales. Most heathland colonies exist on sites that have been either recently disturbed, such as sand pits, quarries and firebreaks.

The silver-studded blue has undergone a severe decline in range this century, estimated at 80%. It has become extinct in Scotland and northern England, and throughout most of central, eastern and south-eastern England. It remains widespread only on the heaths of Dorset and Hampshire, although strong populations also occur in North Wales. It occurs throughout Europe except Scandinavia, occurring in a wide range of habitat, including alpine grassland, meadows, forest clearings and xerophytic scrubland, but it is declining in the west of Europe (eg Belgium, the Netherlands and Denmark).

Heath Fritillary
(Mellicta athalia)

© Peter Wakely /Natural England

Heath Fritillary is one of the rarest of our small fritillary species, distinguished by its dusky wing colours. It is widespread and often abundant in continental Europe, but has declined in many countries, including the UK, where it is confined to southern England where it breeds on heathland, species-rich grassland and coppiced woodland respectively.

It has declined severely during this century, with just 43 colonies known in 1989, including 2 sites in Essex where it has been successfully re-introduced since 1984.

The main foodplant on woodland and heathland sites is Common Cow-wheat (Melampyrum pratense). Foxglove (Digitalis purpurea) can be a secondary foodplant, especially on Exmoor.

Reduction of coppiced areas and increased isolation of new clearings in Kent are current factors causing loss or decline, also abandonment or inappropriate management of species-rich grasslands in the south-west.

9. Endangered butterfly species (cont.)

© Michael Hammett/Natural England

Pearl-bordered Fritillary *(Boloria euphrosyne)*

The pearl-bordered fritillary was formerly widespread and locally abundant through much of Britain, but has declined very rapidly over the last 50 years in the south of England, and is now extinct over large parts of its former range. Its main centres of distribution are in parts of Wales and southern England, although it is still widespread and abundant at localities in north-west England and in the Highlands of Scotland. It is absent from Northern Ireland. In southern England few large colonies are known, many are small and highly vulnerable to extinction, and the rate of loss of sites is estimated at 39% per decade in central southern England.

Current factors causing loss or decline are loss of open clearings and canopy gaps within modern high forest systems, cessation of grazing on unimproved grassland and abandonment of traditional bracken and gorse management.

The butterfly breeds either in woodland clearings or unimproved grassland habitats with scattered scrub or abundant bracken.

Large Blue Butterfly *(Maculinea arion)*

The range of the large blue butterfly is declining rapidly, with less than 10 colonies surviving in most northern European countries. The butterfly once occurred in 90 colonies in Britain, but declined rapidly in the 1950s and became extinct in 1979 owing to loss of habitat, combined with lack of grazing. It has since been re-established successfully at five sites in south west England using Swedish stock.

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9. Endangered butterfly species (cont.)

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Large Copper Butterfly
(Lycaena dispar)

The Large Copper became extinct in the UK in 1851 and was last recorded at Bottisham Fen in Cambridgeshire. The butterfly has a sad history in England, having been discovered in the East Anglian wetlands at the end of the 18th century only to be driven to extinction by collectors by the middle of the 19th century. Although the species was never widespread, it is believed that its former range also included Lincolnshire, Norfolk Huntingdon-shire, and Somerset.

There have been several introduction attempts. Unfortunately, all have ultimately failed although the species has, once again, been re-introduced with partial success to Woodwalton Fen. A project is being undertaken at Keele University to determine the feasibility of a re-establishment programme in the UK. This is a wetland butterfly with a wide distribution in central and eastern Europe but is generally scarce and difficult to find, due to a combination of the increasing destruction of wetland habitats and the low density of the butterfly at its sites.

The British race was larger and brighter coloured than the continental race, though a similar race. *L. dispar batavus*, flies in Holland - it was this race that was reintroduced to East Anglia (Woodwalton Fen, Hunts).

Silver-Spotted Skipper
(Hesperia comma)

© Michael Hammett/Natural England

The silver-spotted skipper is widespread in central and southern Europe. In the UK it formerly occurred as far north as Yorkshire, and west to Devon, but underwent a rapid decline in the 1950s and, by 1982, was reduced to 49 localities in 10 area. In 1980 it was confined to southern chalk downland grassland in southern England representing a decline in range of at least 89%. However, it has recently expanded its range a little, with a 30% increase in the North and South Downs since 1980. Current factors causing loss or decline are insufficient grazing by stock and rabbits, loss of unimproved calcareous grasslands and fragmentation of remaining habitats.

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