Environmental protection

As we push the boundaries of science and develop new medicines, we must conserve natural resources and ensure our products are environmentally safe at all stages in their life cycle. We strive to manage our environmental impacts across the entire value chain from research, development and production through patient use and final disposal.

Protecting natural resources

Our business is built on cutting-edge science and we base our environmental targets and monitoring on sound scientific data and insight. In 2015, we set specific targets for the period 2016–2025 to drive our efforts to reduce greenhouse gas (GHG) emissions, water consumption and waste. We committed around $25 million to natural resource projects to reduce our impacts across our sites in 2016.

5%
cut in emissions down to 1,657 ktCO_2e since 2015, exceeding our 2016 target

Quadrupled
our sourcing of certified zero carbon power from renewable sources to 445,000 Megawatt hours since 2015

5%
reduction in water consumption since 2015

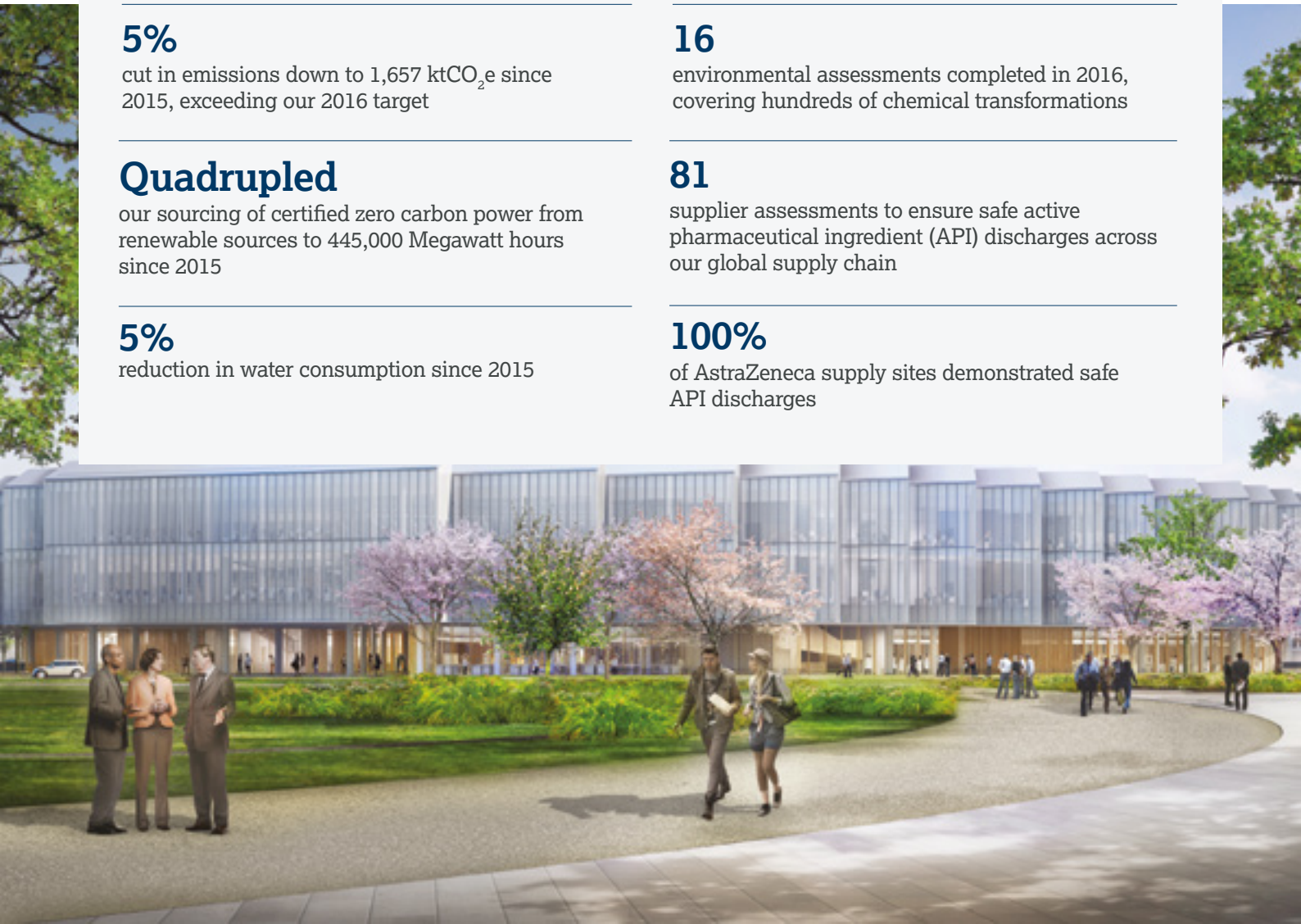
Ensuring the environmental safety of our products

As a minimum, we are committed to ensuring effective environmental management of our products from pre-launch through to product end-of-life. We aim to lead our industry in understanding and mitigating the effects of pharmaceuticals in the environment (PIE).

16
environmental assessments completed in 2016, covering hundreds of chemical transformations

81
supplier assessments to ensure safe active pharmaceutical ingredient (API) discharges across our global supply chain

100%
of AstraZeneca supply sites demonstrated safe API discharges



Our approach

In 2016, we reaffirmed environmental protection as one of our three core sustainability priorities. We are committed to operating in a way that respects and protects our climate and natural resources through a science-based approach that drives continuous improvement across our value chain.

In 2016, we embarked on a new strategy that sets ambitious commitments up until 2025. As we develop more innovative medicines and technologies, we constantly face new challenges and opportunities. We take a robust, science-based approach to balancing health benefits with the need to protect the environment. Ensuring all our sites comply with the relevant regulatory and industry standards is the minimum we must do to retain our licence to operate. We aim to go much further by leading our industry to understand its risks and to make the most of opportunities to reduce our collective impacts on the environment.

Our strategy and commitments

1 Protect natural resources

Improving the environmental performance of our operations and supply chain, including reducing our GHG footprint

Commitments

Climate change:
Limit our 2025 extended operational GHG footprint[1] to 2015 levels

Science-based target:
Reduce absolute Scope 1 emissions by 20% and Scope 2 emissions by 95% by 2025 against the 2015 baseline, and reduce all Scope 3 emissions by 25% per million USD of sales in the same timeframe

Reduce GHG emissions from waste incineration, business air travel, primary distribution (freight and logistics) and first tier APIs and formulation & packaging (F&P) suppliers (>90% of category spend, energy only) by 20% by 2025 from a 2015 base-year

Reduce GHG emissions per device from patient use of inhaler therapy devices over the same time period

Improve primary data collection within Scope 3 value chain GHG accounting by 2020

Other climate change targets:
10% absolute reduction in energy consumption against a 2015 baseline by 2025

100% renewable power consumption globally by 2025; interim ambition of 100% in the US and Europe by 2020

70% air to sea conversion in primary distribution by Q4 2017

Waste: 10% absolute reduction against a 2015 baseline by 2025

Water: Maintain usage at 2015 levels as our business grows by 2025

90% of **API** syntheses meet resource efficiency targets at launch

Establish equivalent resource efficiency targets for **biologics** (for example antibodies, oligonucleotides and peptides)

2 Ensure the environmental safety of our products

Reducing environmental impacts throughout the entire life cycle of our medicines, including understanding and minimising the long-term effects of PIE

Commitment

Ensure effective environmental management of our products from pre-launch through to product end-of-life

For scope and boundaries of our environmental reporting see page 26.

[1] Extended operational footprint includes: Scope 1, Scope 2 and some Scope 3 GHG emissions. It covers energy use, road fleet, process emissions, waste incineration, business air travel, primary distribution (freight and logistics), first tier outsourced supply of API and F&P (90% of spend, energy only), and patient use of pressurised metered dose inhalers (pMDIs), measured in tonnes carbon dioxide equivalent (tCO_2e).

What we have achieved

Our first year's progress against our commitments for 2016–2025 is summarised in the table below:

Key

- Target exceeded
- Full target achieved
- Ongoing progress
- Target not achieved, some progress

Goals	Target progress	Progress highlights
Reduce operational GHG footprint[1] by 2% (against a 2015 baseline) to 1,708,335 tonnes CO_2e by 2016	Target exceeded	Our operational GHG footprint totalled 1,656,917 metric tonnes in 2016, a 5% reduction from our 2015 baseline
Have our climate change targets approved by the Science Based Targets (SBT) initiative by 2016	Full target achieved	We attained verification that our climate change targets are science based
Set out a target for 100% renewable power by 2016	Full target achieved	We launched our commitment to 100% renewable power consumption globally by 2025 and in the US and Europe by 2020 through the RE100 initiative
Publicly disclose information associated with our climate change performance by 2016	Full target achieved	We increased the scope of our operational carbon footprint reporting in 2016
Reduce waste generation by 2% (against a 2015 baseline) to 36,760 tonnes by 2016	Target not achieved, some progress	In 2016, our total waste was 37,923 metric tonnes, a 1% increase on 2015
Reduce water use by 2% to 4.13 million m^3 (against a 2015 baseline) by 2016	Target exceeded	In 2016, our water footprint was 3.99 million m^3, a 5% reduction compared with 2015
90% of API syntheses meet resource efficiency targets at launch by 2016	Full target achieved	100% of API syntheses (avibactam) met launch target in 2016. In addition we achieved 9% reduction in our resource efficiency metric, process mass intensity (PMI), across the portfolio
Ensure effective environmental management of our products from pre-launch through to product end-of-life by 2016	Full target achieved	Safe API discharges were confirmed for 100% of our own and >90% globally managed supplier sites in 2016 We completed a comprehensive review for our EcoPharmacoVigilance (EPV) programme

[1] Extended operational footprint includes: Scope 1, Scope 2 and some Scope 3 emissions. It covers energy use, road fleet, process emissions, waste incineration, business air travel, primary distribution (freight and logistics), first tier outsourced supply of API and F&P (90% of spend, energy only), and patient use of pressurised metered dose inhalers (pMDIs), measured in tonnes carbon dioxide equivalent (tCO_2e).

Our environment management system

At the highest level, the AstraZeneca Code of Conduct sets out the ethical standards we expect of our employees, including carrying out business in an environmentally responsible manner.

Our Global Safety, Health and Environment (SHE) Policy is the overarching document for our SHE Management System and is applicable to all functions and locations. It is supported by detailed global standards and procedures that establish mandatory requirements in key risk areas. Our SHE performance is regularly monitored and managed through comprehensive assurance programmes that include performance reporting, internal auditing and an annual management review.

Our approach to SHE management is compatible with ISO14001 and, although it is not a requirement, our facilities have the option of seeking this certification. Additionally, two of our largest sites have now attained ISO50001 certification – Gaithersburg in the US and Macclesfield in the UK. Our internal SHE auditors are trained in techniques for auditing against ISO14001 and OHSAS18001.

In Focus: How do we use science to protect the environment?

Because we believe science should be the driver for everything we do, it goes without saying that it plays a critical role in helping us understand and manage our environmental impacts and opportunities. From improving the sustainability of our medicines to reducing our carbon footprint and developing understanding of the risks of PIE, we invest significant time, resources and expertise in leading on science-based environmental protection for our industry.

In October 2016, we became one of only four FTSE 350 companies to have its climate change targets approved by the SBT initiative. SBT is a partnership between CDP, the UN Global Compact (UNGC), World Resources Institute (WRI), and World Wide Fund for Nature (WWF). It seeks to create systematic change in how companies set targets, ensuring they contribute their fair share of the challenging emissions reduction needed to limit global temperature increase to less than 2 degrees Celsius. In this way, science-based emission-reduction targets are founded not only on the GHG reduction projects in a company's pipeline, but also on the fair, sector-specific contribution it can make to help avoid the worst impacts of climate change. We are now working to deliver our science-based target and will develop it as we further our understanding and GHG monitoring matures.

Improving the environmental performance of our product pipeline is another critical area that involves a delicate balance between meeting patient needs while reducing environmental impacts and other sustainability considerations. Pharmaceutical production is extremely complex and the needs of patients will always come first. But we are committed to the proactive development of medicines that have a lower environmental footprint and place considerable importance on integrating environmental considerations across a medicine's entire life cycle – from research to manufacturing, commercialisation, use and disposal. We take a broad view and apply a wide range of approaches including Life Cycle Analysis (LCA), environmental risk management plans, green chemistry, packaging improvements and research. This considers the natural resources we use to manufacture our products and the safety of our pharmaceutical products in the environment.

Using cutting-edge science to develop industry-wide knowledge and understanding of the risks of PIE, including potential issues that are yet to be regulated and key scientific questions that need to be resolved, is an area on which we are particularly focused. In 2016, we invested around $1.1 million in research specifically related to PIE, collaborating with leading universities and academic scientists and helping to leverage around $5 million per annum. Our investment includes co-funding research on regulatory protection goals for antimicrobial resistance (AMR) – an area where there is still much to do but in which we believe following science will play a vital role in developing science-based policy and regulation.

SCIENCE BASED TARGETS

Managing the impacts of our outsourced manufacturing

The ethical business expectations for all third parties we work with are set out in our Global Standard Expectations of Third Parties, including standards for environmental protection and conservation. We outsource a significant proportion of our manufacturing, in particular production of the API, to third parties and we make it a priority to measure and report on the environmental impacts that arise from this outsourcing.

In 2016, we continued to focus on our globally managed first tier suppliers in the API and formulation and packing (F&P) categories, as this is the group of suppliers with which we have a high degree of influence and collaborative opportunity. We work closely with these suppliers to set appropriate environmental standards and targets and to collect environmental performance data.

We capture environmental performance data for over 90% (based on spend) of our global outsourced manufacturing of APIs and F&P suppliers across our established brands. For the first time, we are presenting data for first tier supplier energy carbon dioxide (CO_2) emissions, waste generation and water consumption over a four-year period. With the introduction of our new strategy, the energy used by our globally managed first tier suppliers is also incorporated in our operational GHG footprint scope.

As part of our commitment to ensuring the environmental safety of our products, we have an industry-leading programme to ensure safe API discharges from our manufacturing sites, including those managed by our suppliers. We work with them to help them understand the environmental and reputational importance of this issue and provide annual training and a simple tool to facilitate assessments. We technically review these assessments to ensure accuracy and consistency. In 2016, 45 APIs and 49 suppliers across 18 countries were included in scope and we completed 81 supplier assessments. All demonstrated safe API discharges representing 92% compliance for the identified scope. This met our target of demonstrating >90% compliance, which allows for the pace of change in our supplier base due to new product introductions and business development projects.

We want to promote holding third-party suppliers accountable for protecting the environment across our supply chains as active members of the Pharmaceutical Supply Chain Initiative where we share our experience and learn from others across our industry. In June 2016, we presented our safe API discharge programme as best practice and discussed the specific challenges posed by antibiotic-containing effluents at a European Pharmaceutical Industry Trade Association workshop hosted by Medicines for Europe.

AstraZeneca's globally managed suppliers in scope for environmental initiatives (environmental footprint data reporting and safe API discharges)

Number of supplier sites by country

Belgium	5	Netherlands	1
Canada	2	Poland	1
Finland	1	Puerto Rico	1
France	5	South Korea	1
Germany	4	Spain	1
India	2	Sweden	2
Ireland	3	Switzerland	6
Italy	5	Turkey	2
Japan	9	USA	3

Minimising impacts across the product life cycle

To minimise the environmental impacts of our products, we take a whole life-cycle view and work with all those involved throughout the lifespan of a product – from discovery and development through to patient use and end-of-life disposal.

Our approach to environmental stewardship involves a wide range of activities, including:

> LCA of key products to understand impacts and opportunities

> Developing environmental risk management plans for all new products

> Applying green chemistry principles to our manufacturing processes

> Continual improvement of environmentally sustainable packaging

> Ongoing commitment to the safety of medicines in the environment.

Once our medicines are on the market, we provide healthcare professionals with clear information on their appropriate use. We also work with authorities and industry partners to guide patients on how to safely dispose of unused medicines. See page 24 for how we are tackling PIE.

Understanding the impacts of a medicine

We use LCA to understand and address the complexity of our individual products, their APIs and the wide variety of delivery systems. In recent years, our application of LCA has expanded significantly, developing our understanding of key strategic areas such as natural resources and the environmental safety of our products, forging stronger working partnerships and helping to identify productive improvements.

We conduct LCAs in a pragmatic manner, applying the appropriate tools and data analysis to further our sustainability understanding and goals. For more comprehensive studies, we work with third-party consultants using detailed tools and databases to develop a thorough insight of product impacts with attention focused on the highest impact areas of the product life cycle. Alternatively, for fast paced, high attrition and dynamic activities such as API synthesis, we support projects with rapid, insightful reviews that can be conducted in-house. In this instance, we use (and lead in the development of) the American Chemical Society Green Chemistry Institute Pharmaceutical Roundtable PMI-LCA tool.

In 2016, we conducted nine in-depth, cradle-to-grave product LCAs. In addition, we completed PMI-LCAs for 48% of the development portfolio in respect of the API synthesis.

Driving efficiencies: process mass intensity

Post-launch improvements in material costs and quality are obvious business drivers, but environmental performance is also key. At AstraZeneca, we do not consider the environmental aspects as a special condition: they are embedded within the core deliverables for our process development teams. We have adopted a metric called process mass intensity (PMI) as a measure of our efficiency in using materials. PMI is measured as kg of raw materials used to produce 1kg of final API. We set a PMI target for all drug molecules to achieve at launch, based on projected peak year sales. PMI has been a fundamental strategic corporate target since 2010 and has been a very useful tool to show the impact we can have as an organisation, to focus our approach and recognise successes in our product pipeline.

Life cycle of a medicine

Life-cycle stage	What the stage involves	Our approach to managing the impacts
1 API production, tableting and formulation	Extraction of resources and manufacturing of organic and inorganic commodity chemicals Use of excipients, additives and solvents Energy in preparation of starting materials, intermediates and processing Solvent disposal Potential release of API to the aquatic environment from manufacturing	Green chemistry – developing effective manufacturing processes that use fewer chemicals and fewer natural resources including energy and water Investing in the recycling and reuse of solvent wastes Safe API discharge programme with AstraZeneca and globally managed supplier sites
2 Device production (where required)	Use of materials for device manufacture (e.g. glass, plastics, metals and electrical components)	Environmental Sustainability Assessments for the device and packaging in the development stage for the selection of the most sustainable device
3 Packaging	Use of materials, including: – Primary packaging (bottle, blister packs, vials etc.) – Secondary packaging (Cartons, leaflets etc.) – Tertiary packaging (Shipping box, pallet and shrinking wrap etc.)	Developing more sustainable packaging solutions that reduce resource consumption and waste, including: – Reducing packaging size and materials used – Switching to materials from recycled or renewable sources – Using materials that can be easily recycled
4 Distribution	Transportation	Pursuing more efficient and sustainable modes of transport such as switching from air to sea
5 Patient use	Use by patients of our medicines and devices	Environmental risk assessments conducted as part of product approval Patient communication and education programmes to promote sustainable use of medicines EcoPharmacoVigilance programme to monitor environmental product risks globally
6 Disposal	Disposal of unused medicines Energy reclamation from waste	Responsible waste management including promoting the safe disposal of medicines

Life Cycle Analysis in action

We have been exploring the use of a connected digital device that can be coupled with our Symbicort dry powder inhalers to treat asthma and chronic obstructive pulmonary disease.

The addition of the connected digital device component has an environmental burden through the plastics, battery and additional packaging it involves. But one of the main drivers behind the use of the Smartinhaler™ device is that it improves patient adherence to prescribed medicine. This increased adherence is claimed by Adherium to reduce the use of rescue medication by 44%[2] and to reduce the number of unplanned hospital admissions by 80%[3].

The Coalition for Sustainable Pharmaceuticals and Medical Devices has developed guidance for assessing the environmental impacts of care pathways. We have used this guidance, coupled with LCA, to assess the impacts of the device and identify the number and type of events that would be needed to rebalance the environmental burden.

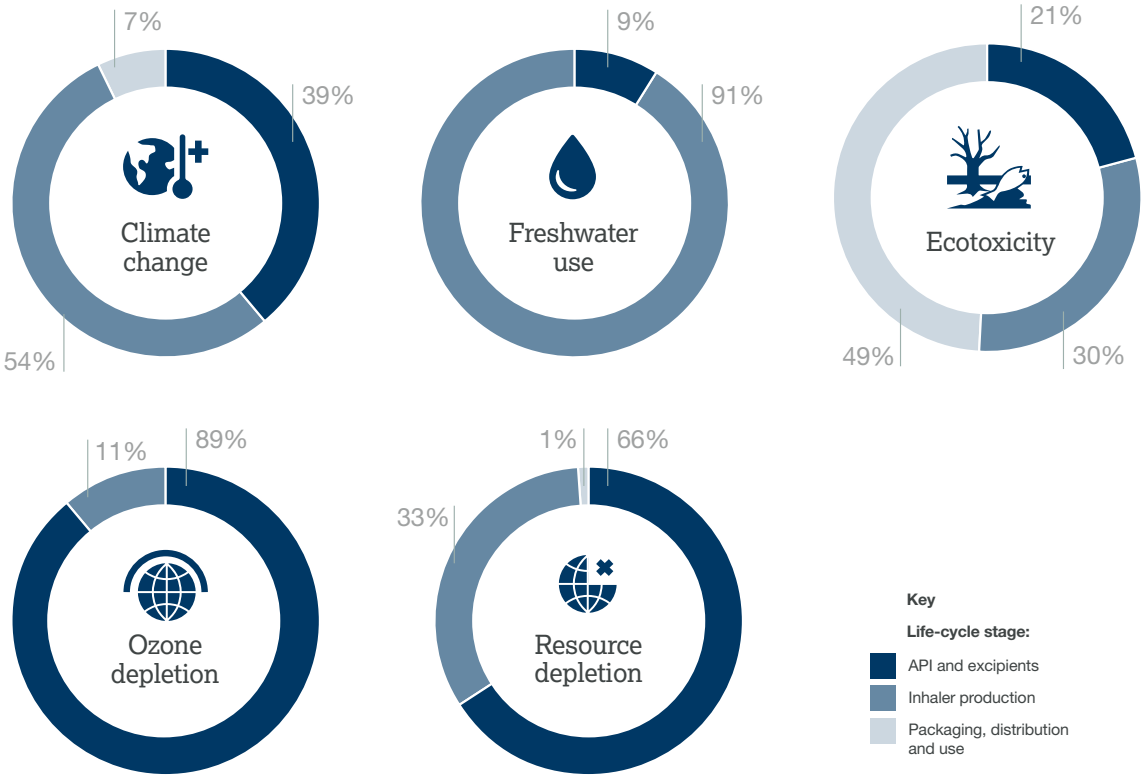
How do the impacts stack up?

We have calculated that every single avoided visit to an Accident and Emergency department balances the life-cycle impacts of 45 Symbicort Turbu+™ or 34 pMDI+™ digital devices.

This means that, in addition to improving patient care, the positive environmental benefits through reduced hospital admissions outweigh the environmental costs of the device.

Comprehensive LCA of the Symbicort Turbu+™

Environmental impact



[2] Chan AHY, Stewart AWS, Harrison J, Camargo C, Black PN, Mitchell EA. The effect of an inhaler with ringtones on asthma control and school attendance in children. Lancet Respir Med. January 21 2015. http://dx.doi.org/10.1016/S2213-2600(15)00008-9

[3] Morton RW, Heather E Elphick, Alan S Rigby, William J Daw, David A King, Laurie J Smith, Mark L Everard. Thorax 2016; 0:1–8. doi:10.1136/thoraxjnl-2015-208171

Embedding sustainability in design and manufacturing: SHE Triggers model

Our SHE Triggers model ensures we consider environmental factors at the earliest possible stage of development. It is designed to promote the sustainability of our design and manufacturing processes – including APIs, products, devices and packaging. By flagging potential safety, health and environmental issues at an early stage in the development process, they can be investigated and, where possible, designed out of the process. The model incorporates environmental assessment tools that enable our scientists to assess environmental risks and challenges in the products they are developing.

In 2016, we completed 16 environmental assessments of development products. The reviews detailed hundreds of chemicals for potential impact on our environment alongside legislation and green chemistry considerations.

Making history with Tagrisso™

AstraZeneca made history and fulfilled an unmet patient need with Tagrisso™ being one of the fastest development programmes ever – from start of clinical trials to approval and launch in just over two and a half years.

In the early stages of development, osimertinib (the active component of Tagrisso™) had a PMI of 501. This was quickly reduced to 324 in the early stages of development, surpassing the original PMI target of 500. However, despite the low annual peak tonnage expected for an oncology product, our efforts to reduce resource consumption did not end there. We continued to develop our manufacturing process and further reduced the PMI by more than 70% to 112.

This achievement represents:

> A GHG footprint reduction of 1,215kg CO_2e/kg of osimertinib (from 1,566 to 351kg CO_2e/kg API)

> A hazardous waste reduction at peak year sales of 778 tonnes per annum (1,001 tonnes to 223 tonnes), just over the amount of hazardous waste produced by 4,100 EU citizens a year[4].

778 tonnes
reduction in hazardous waste

[4] http://ec.europa.eu/eurostat/statistics-explained/index.php/Waste_statistics#Hazardous_waste_generation

Protecting natural resources

Increasing global population and per capita consumption are expected to trigger the largest growth in resource demand the world has ever experienced[5], with demand for natural resources expected to rise by more than a third by 2030[6]. Climate change will further increase the challenge and will have important consequences for the health of society and the pharmaceutical industry. It is vital we use resources wisely and minimise emissions and waste throughout the value chain. We support development of the circular economy and are seeking opportunities to integrate circular thinking across our product design, supply chain planning and waste management.

In 2016, we committed around $25 million to natural resource efficiency projects to reduce environmental impacts at our sites. These projects are expected to accelerate our resource efficiency performance. They include solvent recovery to make better use of resources and reduce hazardous waste, a novel heat pump system to reduce reliance on natural gas, and numerous resource efficiency works programmes. We plan to invest another $22 million in resource efficiency in 2017 and will ensure all sites have natural resources plans that align with our environmental targets.

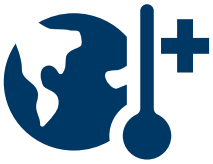
Climate change

Climate change threatens to undermine the last half-century's advances in global health. However, because the actions to mitigate and adapt to climate change have direct and indirect health benefits – from reducing air pollution to improving diet – concerted efforts to tackle climate change actually represent one of the greatest opportunities to improve global health this century[7]. We make it a priority to contribute towards the united global effort that involves business, governments, non-governmental organisations (NGOs) and communities working together. Measuring and reporting emissions, and setting and achieving science-based targets to manage our direct and indirect contribution, are central to our approach.

Climate change poses an increasing risk for our business. Its potential impacts on human health are far reaching – from the consequences of heat waves, poor air quality and the increasing prevalence of disease in flood-stricken communities, to the potential spread of vector-borne diseases and the consequences for food security. The impacts on water and other natural resources make it all the more important we use resources wisely and make the switch to renewable energy, while reducing emissions across our operations and engaging with our supply chain to ensure our suppliers do their fair share.

We are planning work to better understand the full range of regulatory, physical and financial risks and opportunities posed by climate change across our own sites and our supply chain throughout 2017 so we can begin developing an adaptation strategy. We estimate that the most immediate risk to our operations from a changing climate is the availability of water. In 2016, we identified our sites with the greatest exposure to water scarcity where we will prioritise water efficiency projects to reduce our exposure to water risks.

The solutions to climate change have direct and indirect benefits to public health. For instance, the transition to more fuel-efficient vehicles and renewable power not only reduces GHG emissions but also supports disease prevention by reducing local and regional air pollutants that contribute to some of AstraZeneca's priority therapy areas – respiratory, which includes chronic obstructive pulmonary disease.



It is part of our social licence to operate that we reduce our contribution to the conditions for which we are producing life-changing medicines.

[5] Ellen MacArthur Foundation, 2013. Towards the Circular Economy, volume 1. Available at: www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf

[6] http://www.pwc.co.uk/issues/megatrends/climate-change-and-resource-scarcity.html#1

[7] Lancet Report on Climate Change and Health, 2015. https://climatehealthcommission.org/resources

What we set out to achieve	Our approach	What we achieved
Our aim by 2016 was to: Reduce operational GHG footprint by 2% (against a 2015 baseline) to 1,708,335 tonnes CO_2e In 2017, we will continue progressing towards our science-based targets: > Reduce site GHG emissions (energy, F-gas and process emissions, waste incineration) by 23% against the 2015 baseline > Reduce energy consumption by 2% against the 2015 baseline > Maintain road fleet, freight transport and business air travel emissions reduction achieved in 2016 (6%, 13% and 14% respectively) > Freight transport air to sea conversion of 70% by Q4	Move up the GHG hierarchy through energy efficiency improvements at existing and acquired sites Designing efficiency into new sites Pursuing lower-carbon alternatives to fossil fuels and procuring green electricity Improving the fuel efficiency of our sales and marketing vehicle fleet Moving our global freight transport from air to sea Managing our business air travel	Our operational GHG footprint totalled 1,656,917 metric tonnes in 2016, a reduction of 5% against the 2015 baseline Energy-related emissions were down 25% against the 2015 baseline (net of market instruments) Freight transport air to sea conversion of 63%, by tonne per km moved (2015: 54%) Road fleet emissions were down 6% against the 2015 baseline Business air travel emissions reduced by 14% against the 2015 baseline 23% of total energy consumption (58% of imported electricity) was from certified renewable sources in 2016 CDP A List for Climate Change and Supply Chain programmes, and 'A-' score for our role as a supplier DJSI score of 100% for Climate Strategy

Science-based targets and commitments

As a business built on cutting-edge science, we take a scientific approach to setting our climate change targets and we aim to do our fair share of the collective effort needed by industry to mitigate climate change. We are making good progress: in 2016, we were listed on the Climate A List by CDP, the international not-for-profit organisation that drives sustainable economies and represents 827 investors with total assets of $100 trillion. This places us among the top 9% of corporations participating in CDP's climate change programme and recognises our strategy and actions to reduce emissions and mitigate climate change. Our efforts to measure and manage our supply chain footprint also led to our inclusion in CDP's Supply Chain Climate A List, and we received further recognition for our role as a supplier with a score of A minus in CDP's supplier response programme. As of October 2016, AstraZeneca was one of only four FTSE 350 companies to have had its climate change targets approved by the SBT initiative. We also launched our RE100 strategy to source 100% renewable power globally by 2025.

Understanding and managing our carbon impacts

Like most businesses our main GHG emissions arise from the energy we use, travel and transport, process emissions at our facilities and, indirectly, from the activities of our suppliers. An exception to this is our pressurised metered dose inhaler (pMDI) therapy products which form the greatest single contribution to our GHG footprint. The emissions occur during patient use of the devices, which rely on hydrofluoroalkane (HFA) propellants.

Our 2016–2025 strategy uses an extended operational footprint which includes all Scope 1, Scope 2 and our most material Scope 3 emissions sources, including emissions from patient use of inhaler therapy devices.

We use a hierarchical approach[8] to prioritise action for reducing our GHG emissions, based upon the principle of avoiding demand in the first instance then reducing it through efficiency and finally substituting our energy supply with low and zero emission sources.

1 **Avoid**
through major business decisions (by designing efficiency into manufacturing processes and new build projects such as our new Cambridge facility in the UK)

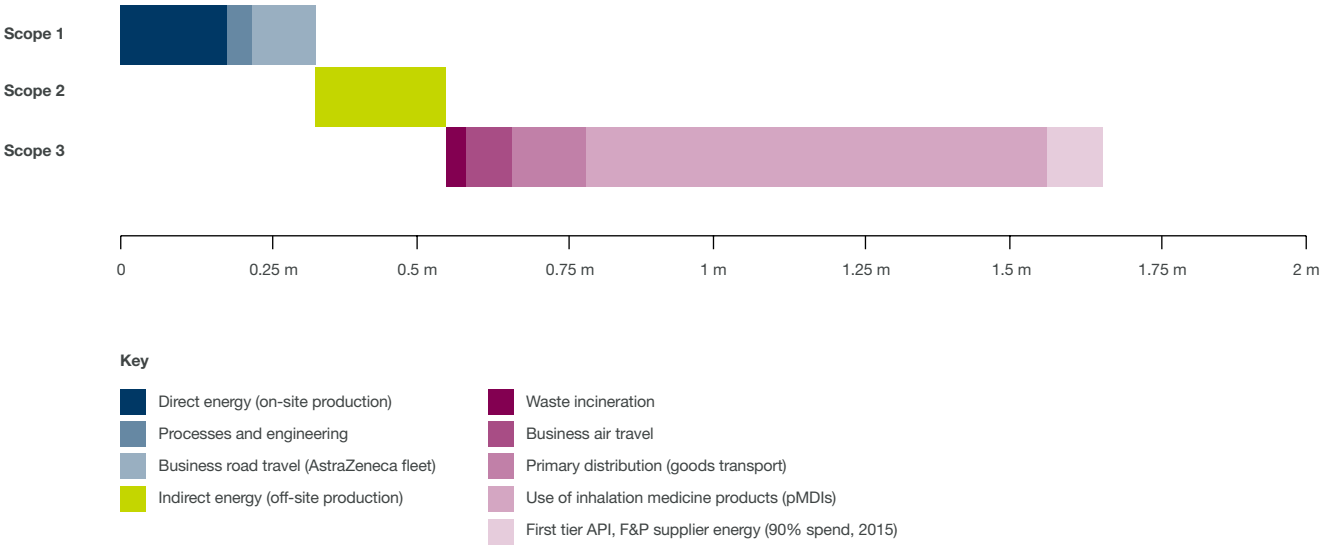
2 **Reduce**
through efficiency and demand management (by improving the fuel efficiency of our road fleet and investing in the energy efficiency of our sites)

3 **Substitute**
in zero/low carbon energy (through our commitment to source 100% renewable power)

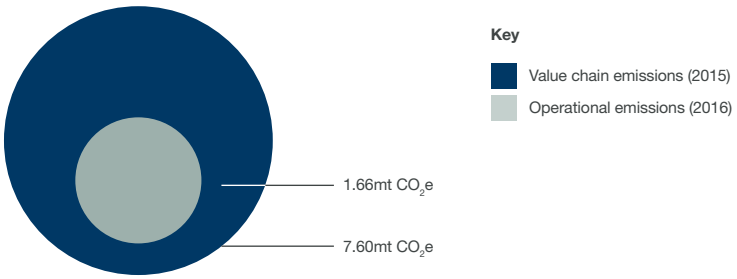
[8] Institute of Environmental Management and Assessment (IEMA) GHG Hierarchy, https://www.iema.net/assets/uploads/Special%20Reports/iema20ghg20report204.10.10.pdf

To help drive business decisions and investments that avoid and reduce GHG emissions, we have committed to set an internal price on carbon. Preliminary work indicates that a value in the region of $80–$90 per tonne CO_2e applied to our Scope 1 and Scope 2 emissions could be what is necessary to enable the achievement of our 2025 targets. Over the coming year, we will refine this value and establish how it is best utilised to influence current and/or future emissions. We will report further on this work in our 2017 update.

Breakdown of our operational GHG emissions footprint by source 2016 (tonnes CO_2e): 1,656,917 CO_2e

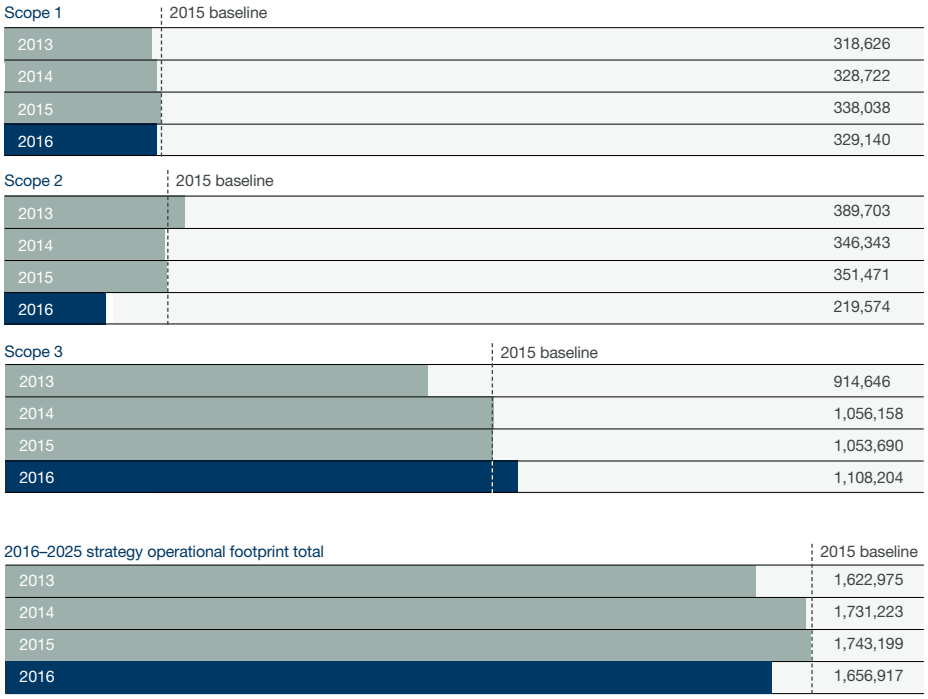


Carbon emissions across our value chain



Our emissions

Operational footprint GHG emissions (tonnes CO_2e)



Scope 1
Combustion of fuel and operation of facilities[9]

Scope 2 (market-based)
Electricity (net of market instruments), heat, steam and cooling purchased for own use[10]

Scope 3 in our operational footprint
Supply chain emissions including:

Upstream emissions from business air travel, primary distribution (freight and logistics), waste incineration, and first tier API and F&P suppliers (>90% of category spend, energy only, one year in arrears)

Downstream emissions from HFA propellants released during patient use of our inhaled medicines

We report in line with the WRI GHG Protocol and as such use dual accounting to report our emissions from electricity, using market and location-based emission factors.

Electricity emissions dual reporting (tonnes CO_2e)

Year	Electricity (market-based[11])	Electricity (location-based[12])
2016	219,574	292,363
2015	351,471	287,903
2014	346,343	290,288
2013	389,703	274,399

Scope 3 emissions

In 2014, we began work to quantify the GHG emissions associated with our entire value chain using the categories outlined in the GHG Protocol Scope 3 Guidance. Some of these sources we deem to be within our sphere of control, such as business air travel, and we have included those in our operational footprint and science-based targets to reduce absolute emissions. Our remaining Scope 3 emissions are estimated based on a mixture of primary and secondary data sources. We report them one year in arrears and our science-based target is intensity based.

For our 2015 Scope 3 emissions calculations, under 10% of data is based on primary data. Our science-based target includes an ambition to increase this amount.

Sources of Scope 3 emissions (tonnes CO_2e)[13]

	Emissions in 2015
Purchased goods and services	5,794,302
Use of sold products	688,653
Downstream transportation and distribution	312,799
Business travel	241,384
Upstream transportation and distribution	203,684
Fuel and energy related (not Scope 1 and 2)	121,435
Capital goods	93,024
Waste generated in operations	30,208
End-of-life treatment of sold products	23,507
Employee commuting	23,337
Upstream leased assets	23,242
Downstream leased assets	956

[9] GHGs from direct fuel combustion, process and engineering emissions at our sites and from fuel use in our vehicle fleet.

[10] GHGs from imported electricity are calculated using the GHG Protocol Scope 2 Guidance (January 2015) requiring the dual reporting using two emissions factors for each site – market-based and location-based.

[11] Market-based factors are more specific to the site and local energy market, taking account of the residual energy mix a site is sourcing power from and any certified renewable power purchased by a site.

[12] Location-based factors are the grid average emissions factor for the country (or subregion in the US) that a site is in.

[13] Three Scope 3 categories were reviewed and deemed not relevant to AstraZeneca: processing of sold products, franchises and investments.

Reducing emissions from our road fleet

We have incorporated fuel efficiency into our fleet selection process since 2010. We operate a 'cap and reduce' system in some markets to reduce the fleet average emissions per km driven. In 2016, we delivered a further fleet efficiency improvement of 3%. Combined with a 3% reduction in km driven, this resulted in a 6% cut in GHG emissions against the 2015 baseline.

Our procurement team works with commercial markets to incorporate lifetime costs into fleet selection decisions, which supports a preference for more fuel-efficient vehicles. All of our regional markets delivered fleet efficiency improvements during 2016: 11% in Japan, 5% in North America, 3% in Europe and 1% in International (rest of world).

We will be going further in 2017: investigating the potential for alternatively fuelled vehicles in our commercial road fleet, such as electric vehicles and plug-in hybrids. We also recognise the air quality impact transportation can have, particularly in urban areas, and we are working to understand our transportation impacts better. We are looking forward to the improved vehicle testing regime that will better reflect real-world driving conditions.

Energy CO_2 emissions from outsourced manufacturing

Energy CO_2 emissions from outsourced manufacturing of APIs and F&P activity amounted to around 96,000 tonnes in 2015, down 12% from the previous year.

We continue to work with suppliers to encourage the setting of appropriate environmental improvement targets, particularly in the area of energy use. For the first time, this source of GHG emissions is included within scope of our operational footprint commitments for 2016–2025.

Energy CO_2 emissions from outsourced manufacturing

	CO_2 from energy use (thousand metric tonnes)			
	2012	2013	2014	2015
AstraZeneca manufacturing sites	349	406	371	407
API category	67	60	33	35
F&P category	51	38	77	61

Towards lower-impact respiratory therapies

Our pMDIs, typically used for the treatment of respiratory conditions such as asthma, rely on HFA propellants. When released, these gases represent 47% of our 2016 operational GHG footprint. While HFAs have no ozone depletion potential and a third or less of the global warming potential than the chlorofluorocarbons (CFCs) they replace, they are still potent GHGs.

In 2016, we included emissions from patient use of pMDI inhaler therapy products in our operational GHG footprint commitments for the first time. We believe we should account for these emissions and find innovative ways to minimise them.

We continue to explore practical opportunities to reduce the climate impact of these devices while fulfilling patient needs, such as by substituting the propellant for an alternative with a lower climate impact. Research is ongoing to assess the feasibility of technologies that could potentially lower the impact of our inhaler technologies.

Our proactive approach to managing the impact of our inhaler therapies puts us in a resilient position regarding new regulatory control such as the 2016 Kigali Amendment to the Montreal Protocol, implementing a global phase-down of HFCs.

Committed to sourcing 100% renewable electricity

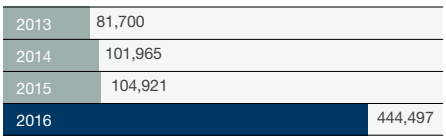
In 2016, we followed through on our 2015 commitment to set out a pathway to source 100% renewable power at our sites worldwide. We publicised our commitment through the RE100 initiative, led by The Climate Group and CDP, which provides a robust quality framework within which to deliver our ambitious plans.

Our commitment is to source 100% renewable power globally by 2025. We have an interim target to achieve 100% renewable power at our US and European sites by 2020. Compared with 2015, our sourcing of certified zero carbon power from renewable sources such as wind and solar quadrupled to 445,000 MWh in 2016 due to some major users transitioning to 100% for the full year: Gaithersburg, Frederick and Philadelphia in the US and Gothenburg and Södertälje in Sweden. This accounted for 58% of our global imported power and puts us on track to achieve both our 2020 and 2025 milestones.

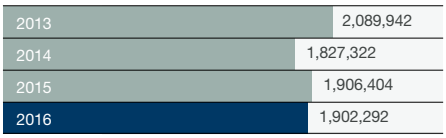
The progress we have made so far has mainly been through 'off-site' solutions including green energy contracts and procuring certificates, for example Renewable Energy Certificates in the US and Guarantees of Origin in Europe. Our commitment has inspired some of our sites to substitute imported energy with on-site renewables such as solar photovoltaics (PV) at Macclesfield in the UK (pictured below) and at Frederick in the US, which will displace almost 2,000 tonnes CO_2e of Scope 2 emissions and 180 tonnes CO_2e of energy supply chain emissions annually. Further on-site projects have been approved in the US and Australia in 2017.

Macclesfield solar panels

Certified renewable electricity (MWh)



Total energy use (MWh)[14]



Reducing our energy consumption

Over our previous strategy period (2010–2015) we reduced our energy consumption by 23% and, in 2016, we set out a target to make a further 10% reduction by 2025. In 2016, our Scope 1 energy consumption reduced by 2% and our Scope 2 imported energy consumption rose by 1%. This resulted in a net reduction of 4,112 MWh. Our priority is to avoid energy demand in the first instance alongside looking for opportunities to reduce our energy consumption and aiming to substitute 100% of electricity use with certified zero carbon renewable electricity by 2025.

Investments in energy efficiency in 2016 included:

> A heat pump at Gothenburg, Sweden: this $3.5 million project utilises novel heat pump technology which is highly efficient and electrifies some of the site's heat demand, potentially displacing over 60% of site natural gas consumption. Coupled with the site transitioning to renewable electricity in 2016, the investment will save approximately 2,700 tonnes CO_2e per year

> LED lighting at Frederick, US: this $0.7 million project will replace all site lighting with highly efficient light-emitting diode (LED) lighting, reducing energy consumption by 1,050 MWh and emissions by 560 tonnes CO_2e

> Purified water production at Södertälje, Sweden: this $0.4 million project replaces water purification equipment with highly efficient alternatives which, in addition to water and waste savings, reduce site energy emissions by 300 tonnes CO_2e per year.

The efficiency benefits of investments made during 2015 and 2016 will be fully realised during 2017.

In 2017, further natural resource efficiency projects will include a combined heat and power (CHP) plant and solar PV plant at Gaithersburg in the US, which will improve the energy efficiency and security of this growing site while reducing costs. Combined with 100% certified renewable electricity imports, the site's energy footprint will be dramatically reduced against the 2015 baseline. Additionally, the utilisation of site-based generation is estimated to displace 680 tonnes CO_2e of energy supply chain emissions annually.

[14] One major site acquisition took place part way through 2015. Our 2015 data has been recalculated accordingly (see page 26).

Responsible use of water

Forty per cent of the world's population currently lives in water-stressed river basins[15] and an estimated 663 million people still lack improved drinking water sources[16]. We recognise the need to ensure water sources are used responsibly and equitably, as a shared public resource. We invest in technology and optimise our processes to reduce water consumption across our operations while ensuring the water we do use is treated to the highest standards before it is returned to the environment.

In 2016, we made it on to the CDP's Water A List. CDP's water score is an indicator of a company's commitment to transparency around its environmental risks and a demonstration of pursuing best practice. As a member of the A List, AstraZeneca has been recognised among the leading 25 companies in the world for water stewardship.

Top 25

AstraZeneca is recognised among the leading companies in the world for water stewardship

What we set out to achieve	Our approach	What we achieved
Our aim by 2016 was to: Reduce water usage by 2% against 2015 levels to 4.13 million m^3 In 2017, we will aim to: Maintain a 4% reduction in water consumption against the 2015 baseline	Completing Water Conservation Plans at our major sites Conducting water audits at our sites to identify water reduction opportunities Investing in water efficiency projects such as water reclamation and reuse Understanding the risk water scarcity poses to our business	In 2016, our water footprint was 3.99 million m^3, a 5% reduction compared with 2015 Audits were completed at two major sites, with three more planned for 2017 We assessed water scarcity at our sites, enabling prioritisation of water efficiency projects in areas of greatest need

[15] OECD, 2015. Principles on Water Governance. Available at: www.oecd.org/gov/regional-policy/OECD-Principles-on-Water-Governance-brochure.pdf

[16] WHO/UNICEF, 2015. Progress on sanitation and drinking water, 2015 Update and MDG Assessment https://www.wssinfo.org/fileadmin/user_upload/resources/JMP-Update-report-2015_English.pdf

Understanding our water-related risks

While all our facilities use water, our sites with the largest water footprints are located in the UK, Sweden and the US. Some of our sites are situated in water-stressed areas, such as our Zhangjiang site in Shanghai, which has recently implemented a project to recycle water via cooling towers and is developing a system for rainwater harvesting.

We have developed a standard methodology to assess water risk at every site. Based on the WRI Aqueduct tool, it has enabled us to broaden our understanding of our water-related risks and identify priorities for investment. During 2016, our major sites completed Water Conservation Plans and we are developing strategies to ensure all sites in water-stressed areas are taking extra steps to mitigate their water risk.

Treatment method

- Off-site wastewater treatment **77.6%**
- On-site wastewater treatment **22.4%**
- Direct to surface water **0%**

Latest site water stress assessment

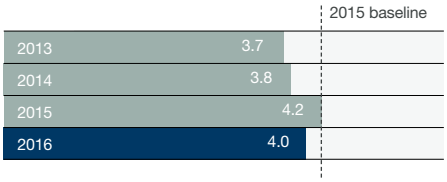
Key:

AstraZeneca water stress rating

High | Medium | Low

1. Sweden Södertälje
2. UK Macclesfield
3. US Gaithersburg
4. US Frederick
5. US Mount Vernon
6. US West Chester
7. China Taizhou
8. UK Alderley Park
9. UK Avlon
10. China Wuxi
11. Sweden Gothenburg
12. China Shanghai Zhangjiang
13. Puerto Rico Canóvanas
14. US Newark
15. India Yelahanka Bangalore
16. US Boston
17. US Wilmington
18. Australia North Ryde
19. France Dunkirk
20. Egypt 6 October City
21. Argentina Buenos Aires
22. UK Speke
23. UK Cambridge
24. Brazil Cotia – São Paulo
25. US Ardea
26. US Philadelphia
27. Japan Maihara
28. Netherlands Nijmegen
29. US Louisville
30. Mexico Lomas Verdes
31. US Westborough

Our water use (million m³)



2015 water use from outsourced manufacturing

The water used in our outsourced API and F&P manufacturing is much less than that used in our own activities. In 2015, our outsourced water footprint decreased 17%.

	Water use (million m³)			
	2012	2013	2014	2015
AstraZeneca manufacturing sites	1.9	2.0	2.9	3.3
API category	0.2	0.4	0.3	0.3
F&P category	0.6	0.6	0.9	0.8

Year	COD of effluent leaving our sites (tonnes)
2013	154
2014	196
2015	210
2016	260

Reducing our water footprint at Gaithersburg, US

In early 2016, a new water reuse system came online at our Gaithersburg site in the US, which houses over 3,000 employees. It is the result of detailed work with consultants, URS Corporation, to identify opportunities to increase water reuse at the site. Following in-depth chemical analysis, we were able to identify three water sources previously sent to drain or sewer use that were of an appropriate composition to be used as cooling tower makeup water:

> Firstly, a volume of groundwater from under the One Medimmune Way that was previously diverted to storm water piping is now diverted to a storage tank and pumped directly into the cooling tower return line (permitted at an average of 37m³ per day)

> Secondly, reverse osmosis reject water that was previously discharged to the sanitary sewer is now collected in a 6m³ tank and pumped to the cooling tower return line

> And finally, condensate water from the air handling units is collected in three small concrete impounds and fed into the makeup water.

The water reuse system is expected to reduce the site's total water footprint by 6%.

Chemical oxygen demand of discharged water

We track and report our total effluent emissions using the standard chemical oxygen demand (COD) parameter. A measure based on COD is more precautionary than a biochemical oxygen demand (BOD) based metric. We measure the COD of wastewater as it leaves our sites. A number of our sites have their own on-site wastewater treatment facilities, while the majority work with downstream municipal wastewater treatment plants.

Both methods are designed to remove most of the COD before the wastewater is discharged to the environment. In 2016, COD of the effluent leaving our sites increased by 24%, largely due to higher levels of activity at biologics sites which release effluent that can be rich in bio-accessible material, which increases aquatic oxygen demand. The majority of this residual COD is removed by offsite wastewater treatment plants.

Responsible waste management

Waste management is key to our environmental protection strategy and waste prevention is our primary goal. It contributes to improving efficiency and reducing our reliance on natural resources. As our production levels continue to grow over the next 10 years, achieving our 10% reduction target is going to be a significant challenge. Finding ways to break the linkage between business growth and waste generation is a key focus area.

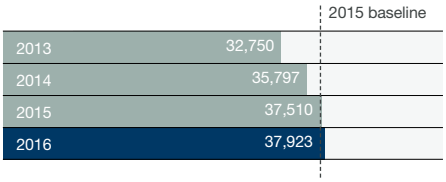
To reduce the amount of waste we produce, we look for opportunities to improve efficiency during our production processes, integrate waste-minimisation considerations into purchasing decisions, and engage our employees to reduce waste. While waste prevention is our top priority, we also seek to maximise treatment by material recycling and avoiding landfill disposal when prevention is impractical.

We characterise waste as either hazardous (such as chemical waste) or non-hazardous waste, as defined by local legislation. The majority of our hazardous waste consists of solvent and aqueous streams from our manufacturing activities. Non-hazardous waste includes general waste, such as paper and plastics, from our facilities around the world.

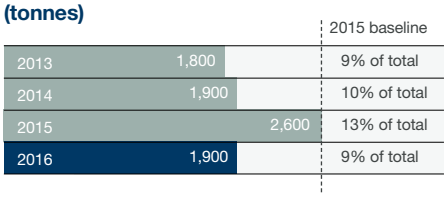
What we set out to achieve

In 2016, we targeted a 2% reduction in waste generation against the 2015 baseline. We failed to achieve this, generating total waste of 37,923 metric tonnes, a 1% increase on 2015. Although we initiated waste-reduction projects, including major investment to enable solvent reuse at our Swedish manufacturing site, these were insufficient to offset the increase in activity across our network.

Total waste (tonnes)



Non-hazardous waste sent to landfill (tonnes)



What we set out to achieve	Our approach	What we achieved
Our aim by 2016 was to: > Reduce waste generation by 2% (against a 2015 baseline) to 36,760 tonnes As similar behaviours and strategies are needed to reduce both hazardous and non-hazardous waste generation, our waste target covers both categories Our aim by 2017 is to: > Reduce waste to 4% below the 2015 baseline > Achieve a 2% increase in our recycle rate against a 2015 baseline	Waste audits and employee engagement at sites worldwide Investing in the recycling and reuse of solvent wastes Promoting responsible end-of-life disposal of our medicines	In 2016, our total waste was 37,923 metric tonnes, a 1% increase from 2015 Our 2016 waste volumes consisted of 44% hazardous waste and 56% non-hazardous waste We achieved a 1% reduction in hazardous waste against the 2015 baseline Non-hazardous waste increased by 3% against the 2015 baseline

Waste from outsourced manufacturing

The waste produced from outsourced manufacturing is comparable to that produced from manufacturing activities on our own sites. In 2015, our outsourced waste footprint remained stable.

	Waste produced (thousand tonnes)			
	2012	2013	2014	2015
AstraZeneca manufacturing sites	29	19	29	32
API category	35	24	23	24
F&P category	5	4	7	7

Note: Outsourced manufacturing data is collected after the year end, so data presented here is for 2015.

In Focus:
How are we supporting the circular economy?

In a circular economy, open production systems in which resources are extracted, used to make products and become waste after the product is consumed are replaced by systems that retain resource value and conserve energy. A circular economy keeps resources in use as long as possible, maximising their utility and minimising waste[17].

In 2015, the European Commission published its action plan for the circular economy which includes proposals for legislation, investment and schemes across the following areas: product design; production processes; waste management; secondary raw materials; plastics; and critical raw materials.

Over the past year, we have taken a leading role in publishing the EFPIA[18] White Paper on Circular Economy which sets out an industry response to the principles underpinning the circular economy and proposals for legislation.

The shift to a more circular economy could bring many health benefits. With improving human health and wellbeing the driving motivation of the pharmaceutical industry, we have an important role to play. For example, by optimising materials and processes to reduce our carbon footprint, we will help to combat climate change – described as the greatest opportunity to advance human health in the 21st century[19].

Transition to a circular economy will require changes throughout the value chain, from product design to new business and market models, from new ways of turning waste into a resource to new models of consumer behaviour. We see this as an opportunity to harness our innovation expertise, drive the efficient use of materials and improve long-term business value. By engaging on this issue now, we believe our industry can help shape future policy decisions to maximise opportunities for the healthcare sector. In 2017, we will initiate a circular economy working group and identify at least two circular economy opportunities to explore for development.

You can find out more in the EFPIA White Paper along with an article by our own experts who helped to produce it.

Sustainable packaging

Packaging plays an important role in protecting our products from manufacturing through to end-use – improving product security and avoiding unnecessary waste. We are constantly investigating new ways to improve the environmental performance of our packaging solutions, reduce the resources they use and minimise the waste they generate.

Our packaging materials include: primary packaging – bottles, caps and blister packs; secondary packaging – cartons; and tertiary packaging – shipping boxes. We focus on:

> Reducing packaging size and materials used

> Switching to materials from recycled or renewable sources

> Using materials that can be easily recycled.

Our SHE Triggers model ensures we consider environmental issues at the earliest possible stage of packaging and device development. We also continuously review our packaging requirements and identify improvements for existing products.

Our global Packaging Strategy continues to include new and improved standards. By the end of the year, all our sites were aligned to new global Pack Standards. We have further consolidated our packaging solutions across the business to reduce and simplify our standard packaging sizes.

[17] EFPIA White Paper on Circular Economy, October 2016: http://www.efpia.eu/uploads/Modules/Documents/efpia-white-paper-on-circular-economy-oct-2016_final.pdf

[18] EFPIA is the European Federation of Pharmaceutical Industries and Associations, of which AstraZeneca is an active member.

[19] Watts et al, 2015. Health and climate change: policy responses to protect public health: www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(15)60854-6.pdf

Responsible disposal of medicines

Poorly disposed of medicines can have an impact on the environment. We work with various other organisations – including authorities and stakeholders across the supply chain – to raise public awareness of the safe disposal of medicines; one such example is the EU Medsdisposal campaign.

In 2016, we developed a PIE animation that describes the routes of medicines into the environment, which highlighted the problems of improper disposal. It aims to educate people about the importance of completing their course of medicine and returning unwanted medicines to a pharmacy. We contribute to collection schemes in a number of countries including Canada, France, Spain and Portugal.

We work to maximise the efficiency of our product forecasting and logistics to reduce product waste and its associated financial and environmental costs. Where product waste cannot be avoided, we render it safe through incineration.

Reducing packaging size: Respule 18 pack

One of the best ways we can cut our resource use, waste, emissions and associated costs is by reducing the size of our packaging. In 2016, we completed a project at our North Ryde site in Australia to optimise carton space utilisation in our Respule 18 pack. By eliminating excess space in cartons, we were able to reduce packaging material and increase the density of products packed into each pallet, also cutting freight and associated emissions. Key outcomes and benefits of the project include:

> 17% increase in pallet density

> 42% reduction in CO_2 emissions

> 23 tonnes of carton/board waste previously sent to landfill avoided

> 7 pallets less packed per batch, resulting in cost savings in excess of $650,000 per annum in freight alone

> Reduced complexity where it doesn't add value for the patient.

Biodiversity

As well as being vital to the health of our planet, natural biological resources are a valuable source of medicines. AstraZeneca is committed to promoting biodiversity on the land it manages by identifying, implementing and reviewing appropriate actions at a local level to reduce its impact and create sustainable ecosystems. Appropriate management and sustainable use of biodiversity on our sites contributes to a great place to work and enhances general wellbeing.

Protecting biodiversity at our sites

Although our land holdings are relatively small, we manage our sites to support sustainable ecosystems and encourage wildlife for the benefit of our employees and local communities. We actively support the principles of the Convention on Biological Diversity and we continue to apply best practice, actively managing biodiversity on our sites through local biodiversity action plans. These plans set out locally specific actions to conserve and enhance native habitats, create and maintain refuges for flora and fauna, and preserve links with the surrounding environment via green corridors of uninterrupted habitat.

We have assessed our potential local biodiversity impacts at all of our major sites. As a result, 25 sites are implementing bespoke biodiversity action plans, including all major fully operating sites over five hectares. In 2016, we joined the Wildlife Habitat Council to provide independent evaluation and accreditation of our site biodiversity actions plans.

Grasslands for the Future

Since pre-settlement times, native prairie ecosystems have declined by 99% in Indiana. Our Mount Vernon manufacturing site in Posey County, Indiana, is a 500-acre campus located in a rural area. It is traversed by a 4.4-mile stretch of a tributary of the Ohio River. Historically, much of the site was used for agriculture which negatively impacted on native habitats. In 2012, we decided to stop agricultural use of the land and launched Grasslands for the Future, a project to restore 250 acres of native prairie grassland. We began by restoring a 20-acre area – removing non-native and invasive species and hydro-seeding with a native grasslands mix that was developed in collaboration with the Wesselman's Nature Center. The site is monitored bi-annually to ensure that the native plants are successful and to remove non-native invasive species as the need arises. We hope to restore more of the area in the coming years.

Nagoya Protocol and use of resources in product research

At AstraZeneca, we sometimes use natural biological resources to help deliver life-changing medicines. When we do, we recognise our responsibility to access and use this material in a transparent and fair way.

The Nagoya Protocol is a binding international Protocol agreed in 2010 with the objective of fairer 'access and benefits sharing' from the research use of the planet's genetic resources. It aims to conserve global biodiversity, foster trust and create mutual benefits and opportunities. Now enforced in over 90 countries, the Nagoya Protocol ensures local people benefit from the materials and knowledge they share.

Where we use such genetic resources in product R&D, we acknowledge our responsibilities under the Nagoya Protocol. Our failure to meet the requirements could mean years of wasted work, as research can be stopped and, in certain countries, products' patent rights challenged, leading to delays, restrictions and reputational risks.

Where we wish to harvest a genetic resource that falls within the scope of the Nagoya Protocol, we make sure that we have established Prior Informed Consent and Mutually Agreed Terms with the country of origin before we access the material. We record this in a due diligence process.

To support our businesses and ensure compliance, we operate an effective and simple governance structure. The Nagoya Protocol governance team helps guide projects through the complexities of the international protocol and we have developed processes and tools, such as the 'Nagoya Sourcing eTool', to ensure our researchers carry out due diligence before using genetic resources. In 2016, we also developed an animation to explain the requirements of the Protocol to our employees.

The UK Department for Business, Energy & Industrial Strategy has used our approach as an example to help other companies in our industry sector develop their own processes.

Valuing natural capital

In 2016, we joined the Prince of Wales at the Cambridge Institute for Sustainability Leadership's (CISL's) Natural Capital Leaders Platform. The Platform is a global network of companies committed to managing their impacts and dependencies on natural resources. It aims to develop practical approaches to help business understand, value, measure and manage its impacts and opportunities related to the natural environment. We are exploring the value that Natural Capital Assessments might bring to our business decisions by integrating the financial impacts of our investments that are associated with natural capital into our financial analysis. We will report on the outcomes of our trial in 2017.

Environmental compliance

Our many business operations are subject to a wide range of laws, rules and regulations relating to environmental protection. Failure to comply with these could adversely affect our licence to operate, damage our reputation, cause harm to people or the environment, and lead to fines or other penalties. It could also lead to interruption of production that may negatively impact on patient access, so ensuring we comply with the relevant regulations wherever we operate is a top priority.

Registration, Evaluation, Authorisation and restriction of CHemicals (REACH)

REACH is a European Union regulation which aims to provide high-level protection to human health and the environment from exposure to hazardous substances.
It ensures manufacturers and importers take responsibility to understand and manage the risks associated with their use. The principles and objectives of REACH are consistent with AstraZeneca's core Values. We ensure continuous compliance with REACH requirements via our robust governance process, including internal auditing and supplier assessments. We request our suppliers to provide information on the presence of substances of very high concern in packaging materials and devices. We also provide safety data sheets for all AstraZeneca substances supplied to third parties, to ensure effective risk assessment and safe use throughout the supply chain.

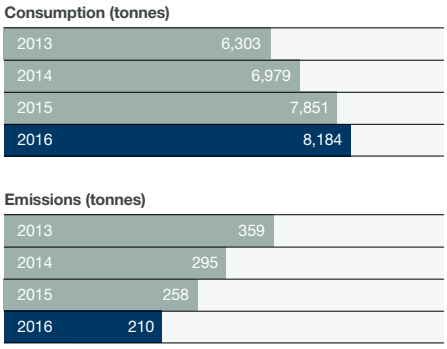
Balancing the risks and opportunities of nanotechnology

AstraZeneca takes an active interest in any new and emerging technologies that may provide benefits to patients, including nanotechnology. We maintain a watching brief on the impact of nanotechnology to our future business strategies. We are aware of the societal, safety, health and environmental concerns regarding the use of nanomaterials and nanotechnology systems. We continue to monitor the scientific landscape as nanomaterials are developed for emerging data that suggests any increased hazards from their use. We believe that the hazard and risk assessment of nano-based medicinal products can be performed under existing regulatory policies. If additional hazards or risks are identified that would support new regulatory guidelines specific for nanomaterials, we will support such measures. We are committed to supporting the efforts of governmental and regulatory bodies in having an open dialogue on the use and potential risks of these materials.

Reducing emissions of solvents

Emissions to atmosphere of volatile organic compounds (VOCs) result from API manufacturing processes due to the use of organic solvents, and from R&D activities. We employ a range of technologies to minimise these emissions from our operations and we can demonstrate ongoing reduction in recent years.

Solvent (VOC) consumption and emissions from AstraZeneca sites



Environmental compliance performance

We have robust processes that are designed to avoid unplanned environmental incidents arising from our operations. Where such incidents do occur, we thoroughly investigate the causes, identify actions to prevent re-occurrence in the future, and share the learning across our organisation.

Environmental compliance summary

	2013	2014	2015	2016
Prosecutions[20]	0	0	0	0
Enforcement actions[21]	2	1	1	1
Regulatory warnings/alerts[22]	6	4	6	5
Other environmental compliance matters[23]	14	7	4	9
Significant environmental violations[24]	0	1	1	0
Financial penalties relating to above ($)	7,000	33,000	14,000	1,000

[20] Prosecution: Successful or pending legal action taken in a civil or criminal court against AstraZeneca.

[21] Enforcement action: Any formal administrative or judicial enforcement proceeding, notices of violation, or similar action by a regulator that requires the company to do, or not do, something.

[22] Regulatory warning/alert: Any formal written warning or alert received from a regulator stating that the company is in violation of an applicable SHE requirement, which if not corrected or repeated could incur prosecution or enforcement action.

[23] Other environmental compliance matter: any less significant environmental compliance matter not included above.

[24] Significant environmental violation: those that result in a fine >$10,000.

Pharmaceuticals in the environment

Pharmaceuticals enter the environment and trace levels are measured in rivers, lakes, soils and occasionally drinking water. Societal concerns about pharmaceuticals in the environment (PIE) are likely to continue as patient access to medicines and population levels increase, resulting in a greater environmental burden. As a responsible innovator, we need to understand the environmental risks of our products in order to proactively manage them and we are committed to providing scientific leadership on PIE.

Concerns over the impacts of PIE have been recognised by the United Nations Environment Programme and the World Health Organization within its Strategic Approach to International Chemicals Management, where Environmentally Persistent Pharmaceutical Pollutants has been included as an emerging policy issue. We aim to lead our industry in understanding and mitigating the effects of PIE. As a minimum, we are committed to ensuring effective environmental management of our products from pre-launch through to product end-of-life.

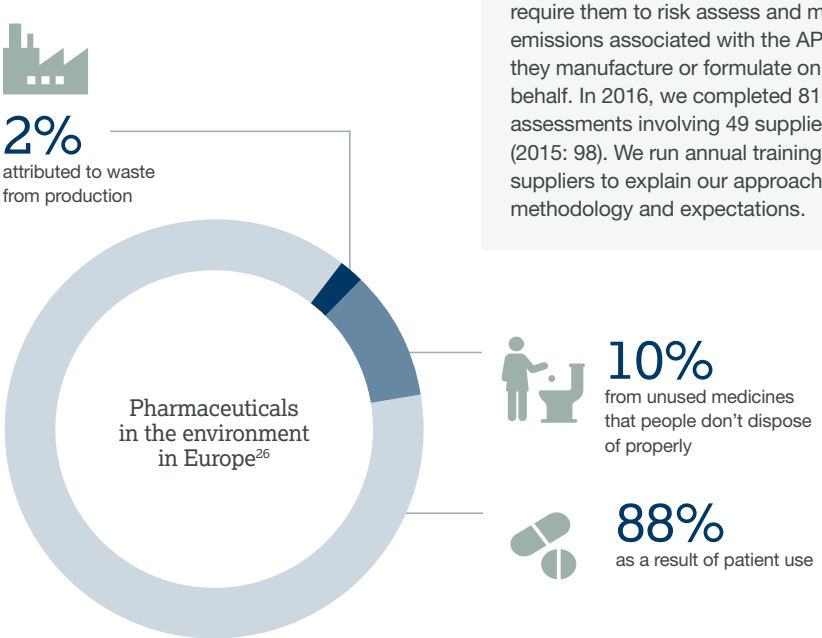
Assessing our impacts

To understand the potential impacts of our medicines on the environment, we conduct an environmental risk assessment (ERA) prior to the approval of a new medicine. We do this by generating environmental fate and toxicity data according to international standards. The specific studies required are defined in guidance established by the European Medicines Agency (EMA) and the US Food and Drug Administration (FDA). In 2016, we submitted regulatory ERAs for all products that were within the scope of these EMA and FDA regulations.

While we have a prospective ERA at the point of registration, there is no regulatory requirement to review the ERA or to monitor for potential adverse effects in the environment once a product has been launched. To ensure we understand the global environmental impacts of our APIs once in use we conduct EcoPharmacoVigilance[25] (EPV). Our EPV process reviews emerging science and literature, looking for new information that might change the way we assess the environmental risks associated with our APIs. If reliable and relevant data are published that demonstrate our existing environmental effects data may not protect the environment, we revise our safe discharge limits accordingly. This helps to ensure that we have up-to-date science-based targets for our PIE-based work around the globe. We also collate any measured environmental concentrations that have been published and compare these to our safe concentrations so that we can understand the accuracy of our regulatory ERA.

How do pharmaceuticals get into the environment?

The majority of pharmaceuticals get into the environment through patient excretion and wastewater effluents, but they can also enter the system during pharmaceutical manufacture and through inappropriate disposal of medicines by patients. In 2016, we created an animation to explain in simple terms the risks associated with PIE and what we are doing to manage them.



Safe discharges of APIs

While waste from production is only a small proportion of the PIE burden, it is the part we as an industry can deal with directly, and we take responsibility for doing so. Although there are limited regulatory requirements, we set safe discharge concentrations called Environmental Reference Concentrations (ERCs) and Maximum Tolerable Concentrations (MTCs). The ERC and MTC approach[27] is based on established environmental quality standard methodology and takes into account indirect exposure of fish-eating mammals and humans, as well as aquatic wildlife (e.g. algae, invertebrates and fish). These values must not be exceeded in our manufacturing discharges to the aquatic environment and we apply them to the waste from our own production sites and those of our key suppliers.

We established ERCs and MTC values for 49 of our APIs (2015: 45) and have a rolling programme to confirm compliance. In 2016, all our worldwide manufacturing sites demonstrated compliance with our ERC and MTC criteria for these products.

To reduce impacts through our supply chain, we share our ERC and MTC methodology with key suppliers and require them to risk assess and manage emissions associated with the APIs they manufacture or formulate on our behalf. In 2016, we completed 81 ERC assessments involving 49 suppliers (2015: 98). We run annual training for suppliers to explain our approach, methodology and expectations.

[25] Holm et al (2013) Ecopharmacovigilance in Practice: Challenges and Potential Opportunities. Drug Safety Volume 36, Issue 7, pp 533–546.

[26] http://ec.europa.eu/health//sites/health/files/files/environmentstudy_environment.pdf

[27] Murray-smith et al (2012) Managing emissions of active pharmaceutical ingredients from manufacturing facilities: An environmental quality standard approach. Integrated Environmental Assessment and Management, 8: 320–330.

Managing the global risks of PIE

Recognising that regulatory guidance on the requirement to conduct an ERA are currently restricted to North America and Europe, we have instigated a project to understand the fate and behaviour of APIs in Emerging Markets. We are focused on those markets with less developed wastewater treatment infrastructure and different water use and reuse patterns. In 2016, we published a review of the relevance of existing ERA frameworks for low and middle income countries[28]. This review highlighted significantly different wastewater and water reuse patterns in many of these markets that are not captured under current regulatory frameworks and the lack of terrestrial environmental ecotoxicology and fate data for APIs used in water-stressed areas. We are currently exploring the key outcomes of this review in our ongoing PIE-related research work.

Intelligent assessment of PIE

At the start of 2015, a €10 million research project between several pharmaceutical companies and the European Commission called Intelligent Assessment of Pharmaceuticals in the Environment (iPiE) was initiated under the Innovative Medicines Initiative. The project aims to develop screening tools for use both earlier on in drug development and for older medicines, including animal alternatives, to identify environmental risks without the need for *in-vivo* testing.

Key deliverables from AstraZeneca in 2016 supporting our iPiE and animal welfare commitments include:

> A fish reporter assay (animal alternative as a fish embryo) that can detect chemicals that bind to the oestrogen receptor element to help identify potential endocrine-disrupting chemicals[29]

> An in vitro fish gill cell assay to identify chemicals with high rates of uptake from water into fish, as these would be at increased risk of exposure and concern. The assay can also identify chemicals that are excluded from uptake and that are of low risk[30]

> Development and validation of quantitative adverse outcome pathways to help predict the impact of pharmaceutical exposure on environmentally important populations where drug targets are conserved[31].

What science can do

Tackling the global threat posed by antimicrobial resistance

To tackle the environmental aspects of the threat posed by antimicrobial resistance (AMR), we are co-funding research that aims to develop and validate new regulatory protection goals for AMR development in the environment. As part of our commitment to the Industry AMR Road map shared with the United Nations General Assembly in September 2016, we are developing an approach to identify minimum selective concentrations for AMR development in the environment with a focus on macrolide and beta-lactam antibiotics. These projects will help establish safe environmental levels for antibiotics entering the environment as a result of drug production and patient use. Initial data from these projects indicates that a holistic approach to the environmental management of antibiotics that includes both the human and environmental protection goals is required.

Leading the industry

AstraZeneca chairs the ERA working group and sits on the governance team of the EFPIA PIE task force. In this role, we advocate the implementation of an Eco-Pharmaco-Stewardship (EPS) approach to human medicinal products that includes the development of an extended ERA model, responsible effluent management, and research to help identify and prioritise the environmental issues associated with innovative or legacy medicinal products. We are championing EPS and the extended ERA model to regulatory stakeholders on behalf of the wider pharmaceutical industry. In 2016, we also coordinated the industry response to the EMA ERA concept paper that will form the basis for the future revision of this regulatory guideline.

We invest in a proactive environmental research programme that collaborates with leading universities and academic scientists. In 2016, we co-sponsored several research projects that support around 14 PhD students and four post-doctoral scientists across a wide range of cutting-edge projects.

Together, we aim to:

> Identify risks associated with the presence of PIE and potential mitigation options

> Understand whether the therapeutic targets of our medicines are present in wildlife, and the potential for impacts on non-target wildlife populations

> Reduce key scientific uncertainties within our ERAs

> Develop tools and techniques to assess environmental risks posed by emerging and innovative medicines e.g. nano-based medicines and biologic-based therapies

> Address the global environmental risks posed by PIE, especially in Emerging Markets where there are different standards of water management and novel exposure scenarios

> Understand the relationship between the environmental dimension of AMR and resistance in the clinic.

To maximise the benefits of our research, we typically publish over 10 scientific manuscripts every year. These are publicly accessible and peer reviewed before publication in scientific literature. We also provide numerous external scientific presentations to share our research.

We aim to be transparent with our environmental data, making it available to independent scientists on our webpage.

[28] Lees et al, 2016. Pharmaceuticals in soils of lower income countries: Physico-chemical fate and risks from wastewater irrigation. Environment International. 94: 712-723.

[29] Green et al (2016). High-Content and Semi-Automated Quantification of Responses to Estrogenic Chemicals Using a Novel Translucent Transgenic Zebrafish. Environmental Science and Technology. 50 (12): 6536-6545.

[30] Schnell et al (2016). Procedures for the reconstruction, primary culture and experimental use of rainbow trout gill epithelia. Nature Protocols. 11: 490-498.

[31] Margiotta-Casaluci et al (2016). Internal exposure dynamics drive the Adverse Outcome Pathways of synthetic glucocorticoids in fish. Nature Scientific Reports. 6:21978.

About our environmental protection reporting

Scope of consolidation

Unless otherwise specified, all SHE data reported covers all AstraZeneca business activities worldwide, regardless of their function (manufacturing, research and development or commercial sites and administrative headquarters) for the period 1 January 2016 to 31 December 2016.

Environmental data is reported for all sites with the following exceptions.

Energy, waste and water information is not required from:

> Sites occupying leased or rented properties where these services are provided as part of the site's rental agreement

> Sites with fewer than 50 permanent staff (AstraZeneca employees and contractors).

Ozone-depleting substances, F-gas and solvent use and emission data is required from all sites whenever the consumption thresholds stated in the Ozone-depleting substances and F-gases section below are exceeded.

In addition to reporting activities on site, our reporting requirements extend to:

> The safety and health impacts of activities undertaken by all AstraZeneca staff managed from the site. This includes sales representatives and any staff working from home

> The SHE reporting of the impact of any ancillary facilities that are under the control of site management but not within the boundary of the main site, for example associated office accommodation or warehouse premises.

Regular review of data is carried out to ensure accuracy and consistency. This has led to slight changes in the data for previous years. None of the changes are statistically significant. The data quoted in this report is generated from the revised data.

Changes in scope

Changes in AstraZeneca's business (new sites, site closures, transfers of activity) between 2015 and 2016 have been analysed according to our Global Safety, Health & Environment Performance Data Recalculation Procedure to assess our business's performance on a scope that is comparable from one period to the next. Our SHE Strategy baseline data for 2015 is adjusted as necessary for each SHE performance metric.

One major site acquisition took place part way through 2015. Our 2015 data has been recalculated accordingly as shown in the table below.

	Recalculated 2015 baseline	Actual 2015 performance
Scope 1 and 2 GHGs (tonnes CO_2)	689,509	658,749
Energy (MWh)	1,906,404	1,818,926
Waste (tonnes)	35,510	34,585
Water (m^3)	4,209,867	3,989,005

In our new strategy period, we have included two new sources of GHG emissions in our 'operational carbon footprint' scope for the first time:

> The energy used by our globally managed first tier suppliers

> Emissions from patient use of pMDI inhaler therapies.

Reporting methods for the calculation of our operational carbon footprint are under constant review to ensure they reflect the latest GHG calculation techniques and the criteria set out by the Greenhouse Gas Protocol Corporate Standard. In 2016, we implemented improved reporting methods for: electricity (at our sites and our first tier suppliers); business air travel; and freight and logistics (see Reporting methods for details). These methods were retrospectively applied to the 2015 baseline data and subsequently the 2014 and 2013 data to allow a four-year comparison.

Reporting guidelines and procedures

To ensure the uniformity and reliability of indicators used across our business, AstraZeneca has a mandatory Global SHE Performance Reporting Procedure as part of its overall SHE Policy documentation framework. This document specifies the standard methodologies to be used for SHE performance reporting across the business including definitions, methodological principles and calculation formulae.

We standardise our SHE performance data collection from all sites with the use of the TrackWise Enterprise Quality Management software. This system has inbuilt formulae and emissions factors to ensure consistency in calculation of performance metrics. Our local SHE specialists input data from their sites into TrackWise quarterly. This process is used to gather 100% of our safety, health and site-based environmental performance data.

Non-site-related environmental performance data covering GHG emissions from product use, business air travel, freight and logistics, and first tier suppliers is collected from relevant global business functions. All data submitted is checked by specialists from the global SHE team to ensure data quality. In addition, our global internal SHE audit programme incorporates further detailed checks on data submitted and a third party provides assurance of key performance data presented in our Annual Report.

Reporting methods

Ozone-depleting substances and F-gases
Total consumed and emitted amounts of Ozone-depleting substances and F-gases must be reported if the total consumed or emitted amount is greater than 1kg for the reporting quarter.

Solvents
Total consumed and emitted amounts of solvent must be reported across three solvents categories (non-halogenated, halogenated dichloromethane and halogenated other) if the total consumed of any one solvent type is greater than 100kg for the reporting quarter. Site data can be ascertained through emission monitoring or estimated on the basis of mass balance. The classification of a solvent (or VOC) is based on EU regulations.

Waste
Construction waste is excluded from our waste data. The method of waste disposal is determined and reported by our waste contractors. The distinction between hazardous and non-hazardous waste is made according to local waste management legislation.

Water
Water volumes used are determined using regular meter readings. Non-contact cooling water (water used solely for cooling purposes which is abstracted and returned directly to the environment with no deterioration or changes in chemical properties) is excluded. One site utilised this type of water in 2016. Before this water source was used, the site completed an environmental impact assessment which determined the process had negligible effect on the thermal properties of the water body. The use of non-contact cooling water at this site is controlled by environmental permit.

The breakdown of water use by source should be treated is estimated as our sites name only their primary water source.

We have a Global Standard governing the assessment of water scarcity across our sites and supply chain network. This provides guidance for the interpretation of the WRI's *Aqueduct* tool and the implications of local factors which may mitigate the water scarcity assessment.

Energy
Site energy and fuel consumption is determined using utility bills based on site meter readings. Sites report imported, exported and generated power, including any from certified low and zero carbon sources. As part of the transition to sourcing 100% renewable power globally, an internal procurement guideline has been developed to ensure any renewable power projects and/or certificate purchases meet certain quality criteria in line with the RE100 commitment.

GHG emissions and scopes

Emissions
Conversion factors must be used to calculate the GHG emissions associated with AstraZeneca's activities. The methodology applied is dictated by the activity, as follows:

Energy: 'Location' factors for electricity have been derived from the International Energy Agency (IEA) and USEPA eGRID (Sub-region) databases. 'Market' factors for electricity have been derived from the IEA, US Center for Resource Solutions, EU RE-DISS II databases and where available directly from electricity suppliers. All electricity factors are updated annually. All other fuels and emission sources use factors from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

ODS, F-gas and solvents: 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Waste incineration: 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Road fleet: Each market (country) discloses average CO_2 per km of its fleet and distance driven quarterly.

Business air travel: UK Defra GHG factors applied according to distance travelled (short/medium/long-haul) and seat class, including radiative forcing. Factors are updated annually.

Freight and logistics: UK Defra GHG factors applied according to mode (air, sea, road), distance travelled (short/medium/long-haul – air freight only), including radiative forcing (air freight only). Factors are updated annually.

Product emissions from pMDIs: Factors from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories are applied according to production volumes of our pMDI devices that contain HFA propellants and HFA content per device.

Supply chain emissions associated with our operational carbon footprint: Sometimes referred to as 'well-to-tank' fuels, are calculated using UK Defra GHG factors and are updated annually.

Supply chain other: The remaining emissions sources not covered by the above are estimated based upon procurement spend sub-categories using a globally recognised database. This is conducted one year in arrears.

Scopes
We follow the GHG Protocol Corporate Standard definitions to assign our emissions sources into one of three scopes:

Scope 1: GHGs from direct fuel combustion, process and engineering emissions at our sites and from fuel use in our vehicle fleet.

Scope 2: GHGs from imported electricity, heat and steam. Electricity emissions are calculated using the GHG Protocol Scope 2 Guidance (January 2015) 'market-based' factors net of market instruments.

Scope 3: GHG Protocol Scope 3 categories: purchased goods and services; capital goods; fuel- and energy-related activities; upstream transportation and distribution; waste generated in operations; business travel; employee commuting; upstream leased assets; downstream transportation and distribution; processing of sold products; use of sold products; end-of-life treatment of sold products; downstream leased assets; franchises; and investments.