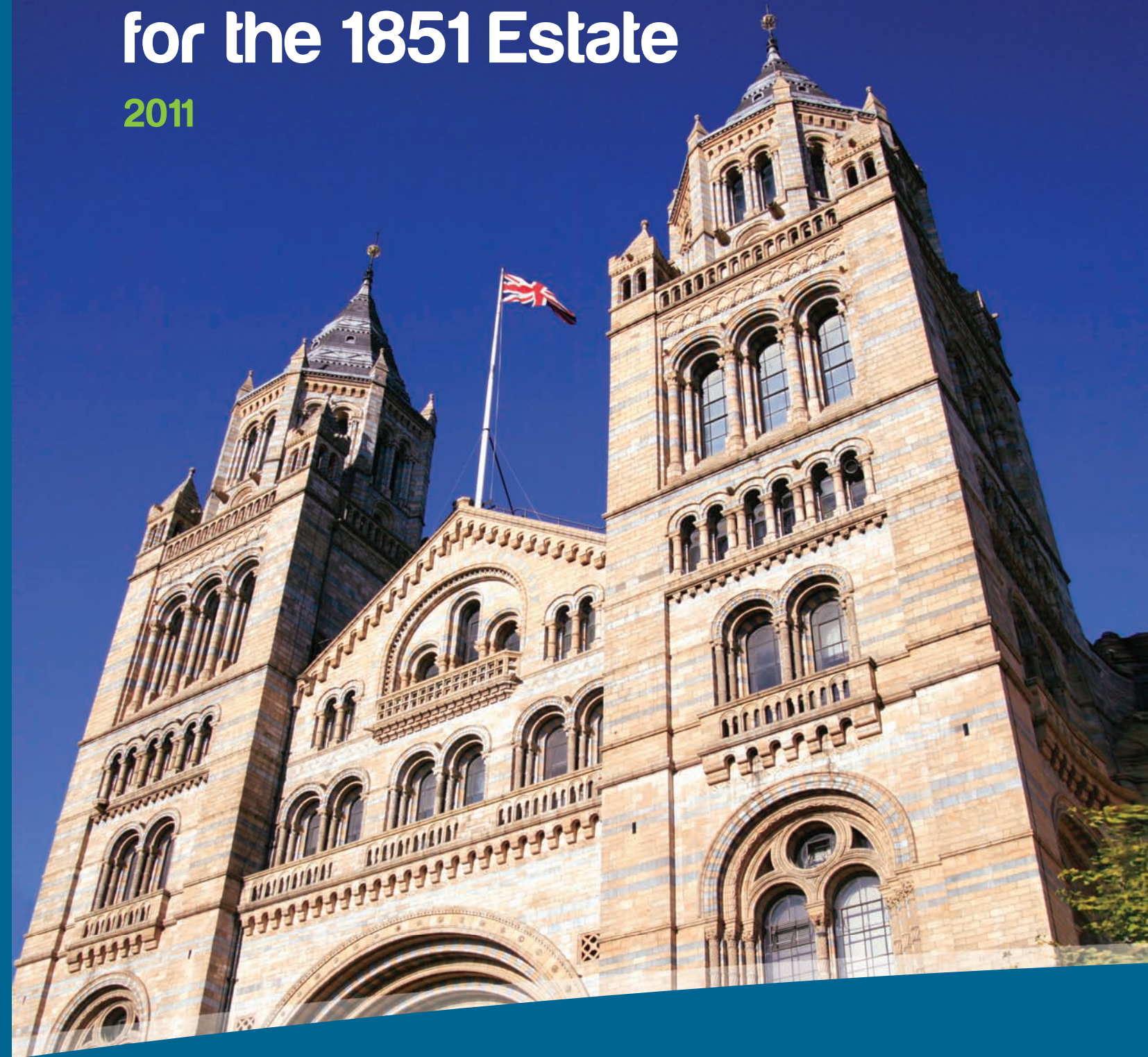


# Carbon Reduction Masterplan for the 1851 Estate

2011



1851 Estate Carbon Reduction Masterplan  
Supported by Cynergin Consultants and Mott MacDonald







# Contents

Introduction - Journey to Zero Net Carbon	1
An award-winning start	2-3
Carbon in the spotlight	4
Projecting into the future	5
The optimum solution	6
The Holistic Solution in action	6
A healthy return on investment	7
A vision for tomorrow	8

“Carbon Neutrality may be defined as achieving “zero net carbon emissions” by balancing the measured amount of carbon released with an equivalent amount sequestered or offset.”

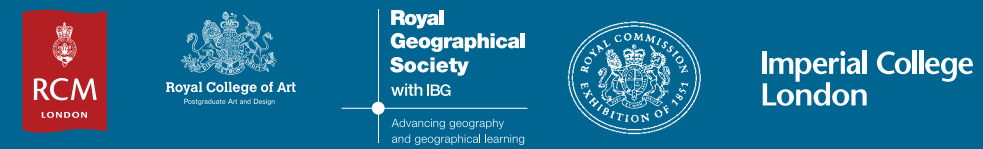
# The 1851 Estate: Journey to Zero Net Carbon

Some of the UK’s most prestigious institutions have joined forces to embark on an inspirational long-term plan to become ‘zero net carbon.’

The organisations involved are the major utility consumers occupying the 1851 Estate (Albertopolis) founded by Prince Albert with the proceeds of the Great Exhibition: Imperial College London, the Natural History Museum, the Science Museum, the Victoria and Albert Museum, the Royal Albert Hall, the Royal College of Music, the Royal College of Arts and most recently, the Royal Geographical Society.

With the worthy vision of becoming a world class zero net carbon (or ‘carbon neutral’) operation, the Estate aims to lower its environmental impact, achieve a healthy return on investment and blaze a trail for society. By tackling the issues of energy efficiency and carbon emissions, these renowned centres of excellence have an important role to play in helping to stimulate the UK’s transition to a low carbon economy.

The plan to cut carbon emissions began in 2005, when the farsighted move was welcomed by the Royal Commission for the Exhibition of 1851. Phase One involved laying the foundations and creating a realistic strategy for the momentous project. This document marks the conclusion of that phase and the commencement of its realisation.





# An award-winning start



## Contributions to 2009/10 emissions from individual institutions

In 2009/10 carbon dioxide emissions from Imperial College London were 57,955 tonnes; from the museums, 21,547 tonnes; from the Royal Albert Hall, 3,820 tonnes; from the Royal College of Art, 1,999 tonnes; and from the Royal College of Music, 1,121 tonnes. Together, this quantity of carbon dioxide gas would fill a cube 359 metres tall.

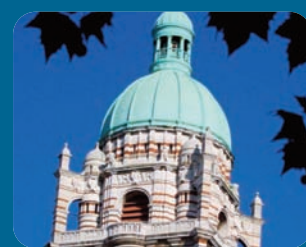


## Laying the foundations

United by a common purpose, the Estate began its journey with five objectives:

- To lay the foundations for achieving a zero net carbon operation
- To establish a mechanism for counting the carbon impact of their operations
- To deliver near-term energy savings and reduction in carbon emissions
- To establish methodologies for the appraisal and reduction of emissions
- To provide an exemplar model for carbon reduction in an urban environment.

All of the organisations have already made steps forward in reducing their carbon emissions and begun to embed a culture of green thinking. The initiative has attracted numerous awards and delivered both financial savings and carbon reductions. It has raised awareness of the gravity of climate change amongst staff, peers and the public.



The Queen's Tower, standing 287 feet high at Imperial College London



The Science Museum - Kensington

## Progress has been swift and considerable, with achievements such as:

- The installation of over 1,000 sub-meters to measure utility consumption
- Development and implementation of an in-depth carbon visualisation tool
- Analysis of the impact of various carbon-producing activities
- Investigation of new technologies with the potential to deliver radical reductions
- Sharing and publication of results and experiences to date
- Production of our Carbon Reduction Masterplan.



Royal Geographical Society Kensington

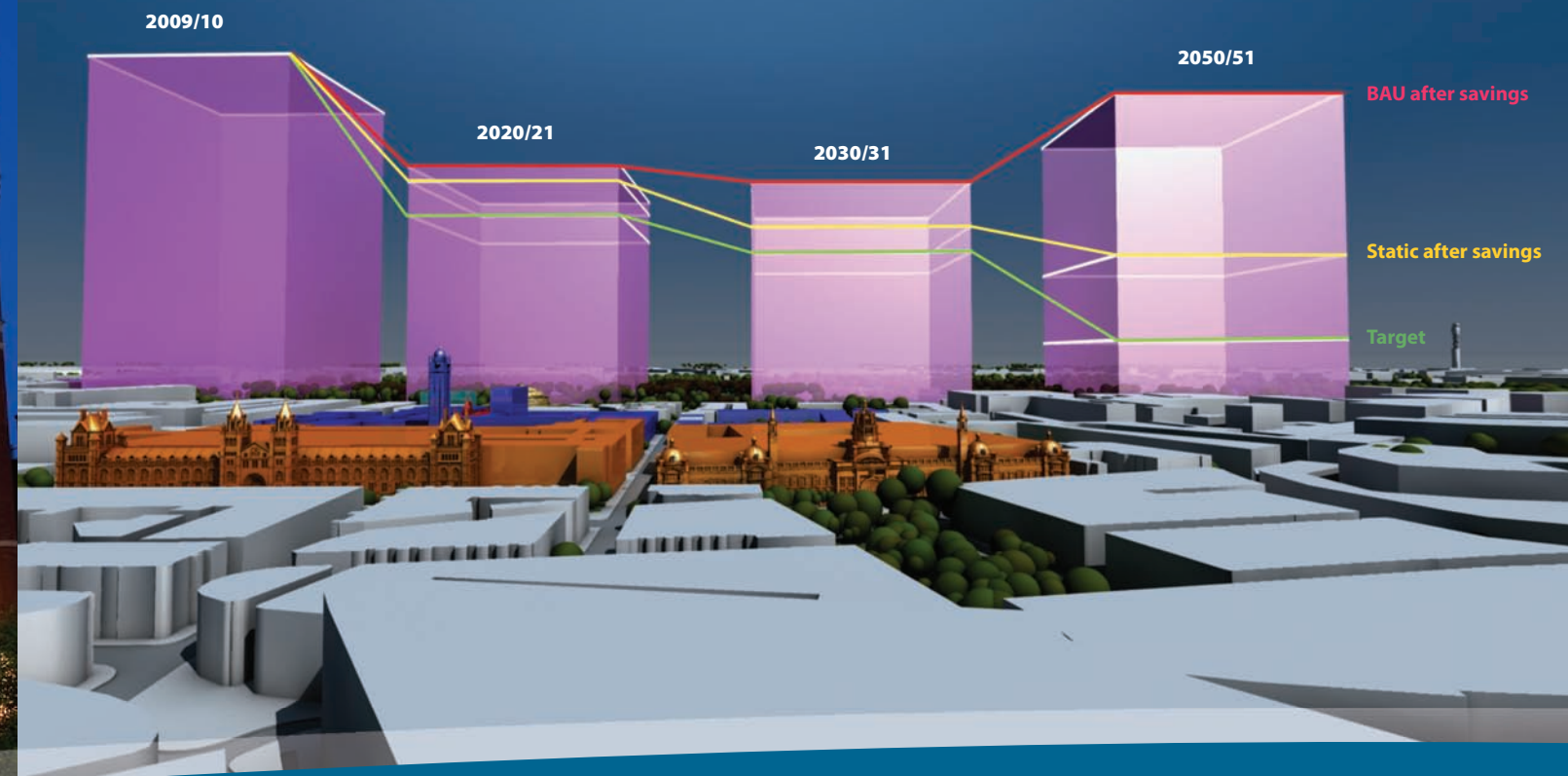
Activities across the Estate have included individual carbon management plans and awareness campaigns, low-energy retrofits, revised working practices and carbon counting for exhibitions and events. An estimated 8,000 tCO<sub>2</sub> per annum of carbon emissions has already been saved.



# Carbon in the spotlight

“The Climate Change Act of 2008 compels the UK to achieve an 80 per cent reduction in carbon emissions by 2050 (from 1990 levels), with an interim target of 34 per cent by 2020.”

## Targets for 2020, 2030 & 2050

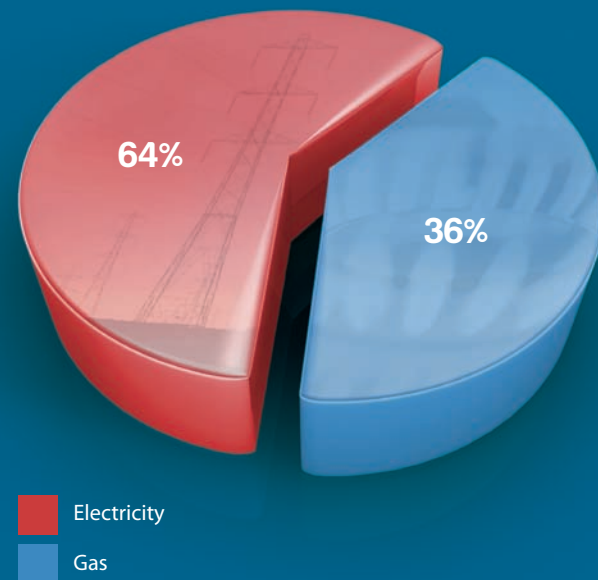


## Tackling climate change

Governments all over the world have pledged their commitment to the race against climate change. Against this backdrop, the 1851 Estate's 2009/10 figures show a combined utility carbon footprint of 86,441 tCO<sub>2</sub>. This is equivalent to roughly five major hospitals and presents a significant challenge if the 1851 Estate is going to play its part in the achievement of the obligations under the Climate Change Act (2008).

During recent years, the UK's Low Carbon Transition Plan (LCTP) has also been brought into play. This strategy for decarbonising the UK's electricity generation and supply calls for 40 per cent of generation to come from low carbon sources by 2020. The LCTP acknowledges that the identified carbon reduction measures will not be sufficient to achieve the Act's 2050 target and that further work must be done to close the gap.

Proportion of emissions from utility consumption



In 2009/10, the Estate had a combined utility carbon footprint of 86,441 tCO<sub>2</sub> of which 36% derived primarily from burning natural gas to generate local heat and hot water and 64% was from grid electricity

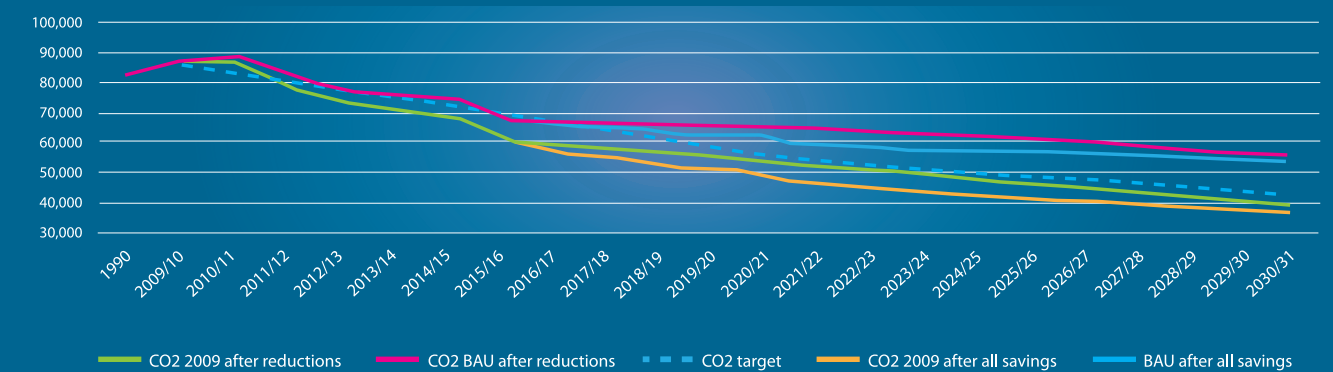
## Projecting into the future

Uncertainty over the decarbonisation of electricity supply and the economic viability of carbon reduction technologies makes it difficult to predict the rate of progress. Intense environmental research and growing global pressure for carbon reduction means that new technologies are likely to become viable along the way.

The Estate believes it is reasonable to set concrete targets for 2020 and 2030, on the route to zero net carbon in the longer term. Each organisation has the added incentive of individual targets laid down by the Climate Change Act.

Trend Analysis shows that Business as Usual (BAU) levels of carbon emissions will still be five times the required target by 2050, after assuming that the LCTP is fully implemented and on time. When these figures are set against tough Government targets for 2020 and 2030, the ever-widening gap between the predicted and desired becomes all too apparent. Additional measures are clearly required to reduce emissions from the 1851 Estate.

Performance against objectives. Comparison of static 2009 and BAU





# The optimum solution

“ If carbon emissions from utility consumption continue to grow at the present rate of 1.4% then the Holistic Solution is the only way to achieve the targets for 2020 and 2030. It is clear that measures must be taken to curtail the rise of energy use to make it at all feasible to hit Government targets and remain on a steady path towards zero net carbon. ”

## Achieving energy reduction

A whole spectrum of options to reduce carbon emissions from the Estate were considered, covering various budgets and approaches. These range from simple no-cost activities to the installation of capital-intensive technologies such as wind, fuel cells and even modular nuclear power plants. Several were rejected due to poor economics, commercial availability or reliability.

The 1851 Estate's preferred option is 'The Holistic Solution', which draws strength from a combination of complementary measures:

- Low cost activities such as carbon awareness campaigns supported by the adoption of a low-carbon culture
- Implementation of various energy demand and carbon reduction measures, including low energy lighting and heating upgrades
- Installation of Aquifer Thermal Energy Storage (ATES) to cut wastage, optimise efficiency and reduce the carbon intensity of heating and cooling.

As these measures underpin and augment one another, The Holistic Solution is expected to provide exponential benefits. The proposed timetable involves a series of phases over the coming decades, starting with the low cost and demand-reduction measures and concluding with the ATES projects from 2016 to 2022.

## The Holistic Solution in action

A realistic view of the carbon reduction achievable with The Holistic Solution can be seen by comparing two scenarios. The first shows zero growth of energy use from 2009, and the second assumes energy use will continue to rise at its current rate (Business As Usual).

If energy use were to remain at 2009 levels, The Holistic Solution would exceed both the interim objectives and the mandatory Government targets on the route to zero net carbon. However, the prospect of maintaining energy consumption at 2009 levels is unlikely, given the inexorable demand for electricity-consuming equipment and appliances.



The Cocoon, inside NHM's most recent building



## A healthy return on investment

There is always a risk of 'optimism bias' when forecasting return on investment. To counter this possibility, a risk and opportunity analysis has been used to adjust for risk and potential bias and calculate a risk-adjusted return on investment. The table below shows the potential financial impacts of various scenarios in which utility prices increase from their current levels. 'Current' uses today's tariffs, whereas 'intermediate' evaluates an immediate and sustained rise of 50 per cent in utility prices and 'high' evaluates a 100 per cent increase respectively.

### Utility Price Scenarios

The table below shows the risk-adjusted Net Present Value (NPV) of the four options under various utility price scenarios.

- **Scenario 1: Baseline (Current) prices:** Utility prices remain at today's level for the length of the model
- **Scenario 2: Intermediate Utility Prices:** Utility prices increase to 50% more than current in 2011 and remain at this level for the life of the model
- **Scenario 3: High Utility Prices:** Utility prices increase to 100% more than current in 2011 and remain at this level for the life of the model.

Risk-adjusted NPV – Utility Price Scenarios			
Option	Current	Intermediate	High
1 No/Low cost	£12,671,627	£17,057,637	£23,888,597
2 Demand reduction	£11,078,460	£20,862,337	£30,646,213
3 ATES only	£11,356,071	£18,760,392	£26,164,714
4 Holistic	£35,106,159	£52,294,356	£69,482,554

### Major assumptions

1. Discount rate of 3.5%
2. Ignores VAT and inflation
3. Current average utility prices: electricity 6p/kWh; gas 1.8p/kWh<sup>(1)</sup>
4. Cost per tonne of carbon dioxide at £30.00

The figures show that a substantial return on investment can be achieved, even without energy prices climbing. However, the returns are likely to be even more dramatic if utility prices increase from the current position. Government plans to increase the cost of carbon dioxide emissions make the likely financial payback even more considerable.

With its blend of promotional, educational, technical and operational initiatives, the Holistic Solution is expected to deliver a wide range of additional benefits over and above the financial and environmental gains:

- Reduced risk of legislative action for failing to meet Government targets
- Improved user experience through improved heating, cooling and lighting
- Raising of morale through involvement in a ground-breaking project
- Maximisation of sponsorship through higher performance than peer organisations
- Enhanced reputation of stakeholders in their community and the world stage.

While somewhat unquantifiable, these secondary benefits will help to change to the face of UK business and endorse the benefits of large-scale environmental initiatives.



# A vision for tomorrow



**Emissions at stake**  
 Adoption of the Carbon Reduction Masterplan will prevent 2,303,047 tonnes of carbon dioxide entering the atmosphere between now and 2050. (Half would be due to decarbonisation of grid electricity). This quantity of carbon dioxide gas would fill a cube over 1 km tall.

## The route to success

The 1851 Estate is more committed than ever to its vision of a zero net carbon future. A preferred option has been identified to work towards this aim, involving a mixture of carbon reduction measures ranging from simple activities to major capital-intensive developments. The Estate has a clear roadmap for how to reach a low carbon future that will meet or exceed Government targets on the long-term route to carbon neutrality.

At current utility prices, the recommended solution would deliver a significant return on investment. This will quickly multiply if utility prices rise significantly.

The next steps along the path to zero net carbon are:

- Endorsement of the preferred option by all stakeholders
- Establishment of a management team to action the plan
- Sharing and promotion of the vision with the general public
- Communication of findings with the UK public sector and potentially worldwide
- Formation and resource of a "Funding Committee" to investigate the availability of the various sources of potential funds, including Treasury capital, grants, subsidies, sponsorship and external finance.

“ All of the organisations on the 1851 Estate are institutions of stature and world-renowned leaders in their fields. This Carbon Reduction Masterplan brings a fresh approach to energy saving and the compelling financial case acts as a powerful impetus to others facing the demanding challenge presented by the UK’s carbon reduction targets. I applaud this initiative which is an exemplar of cooperation between disparate organisations that have come together to share ideas and work towards a fundamental common goal. ”

**Sir Alan Rudge CBE FREng, FRS.**  
 Chairman, Royal Commission for the Exhibition of 1851



The Victoria and Albert Museum



Royal College of Music

