London Array
The world’s largest offshore wind farm
The significance of London Array is far greater than the project itself, although this will bring many notable benefits to the UK in terms of clean, carbon free generation.

Maria McCafferty, Chief Executive, RenewableUK
London Array will play a major role in enabling the UK to achieve its carbon dioxide (CO₂) reduction and renewable energy generation targets.

London Array is the world’s first industrial-sized offshore wind farm. When construction is complete, it will be capable of generating up to 630 megawatts (MW) of power – on a level with many conventional power stations. Due to its sheer size and location, London Array is also the UK’s best known offshore wind farm and is frequently referred to by politicians and the press.

A flagship renewable energy project

London Array will pioneer the UK’s journey in building offshore wind farms on a much larger scale than ever before. As part of the Government’s Round 2 offshore wind development programme, London Array is seen as a forerunner to forthcoming Round 3 projects which, in total, will deliver up to a massive 25 gigawatts (GW) of power.

The wind farm occupies an area of 100km² in the outer Thames Estuary between the Kent and Essex coasts, in waters up to 25m deep. It includes 175 turbines capable of generating enough power for over 490,000 homes¹ whilst displacing more than 925,000 tonnes of CO₂ a year.²

Using undersea cables, the power generated by the turbines is carried to a new onshore substation at Cleve Hill, near Graveley on the north Kent coast. From here, the power is fed into the existing 400 kilovolt (kV) electricity network.
Project history

The London Array project began in 2001, when a series of environmental studies in the outer Thames Estuary confirmed the area was a suitable site for a wind farm. Two years later, in December 2003, The Crown Estate gave us an option for a 50 year lease for the site and cable route to shore.

There are several reasons why this location was chosen. Its main advantages include:

- High wind speeds.
- A range of workable water depths.
- Nearby ports to enable construction, operation and maintenance.
- Suitable ground conditions.
- A readily accessible high voltage network connection.
- Local power demand. South-east England has the UK’s highest electricity demand, and the proximity of the wind farm will reduce transmission losses.

We had to overcome a number of challenges before construction could start, including:

- Ensuring the marine environment and the wind farm can exist together.
- Assessing how to build an offshore electricity network and how to feed the power into the national transmission system when it comes to shore.
- Sourcing the specialist materials needed to build the wind farm.
- Appointing staff and contractors with the right skills and experience.
- Planning how to construct and operate the wind farm without interfering with shipping, fishing and aviation.
- Obtaining planning consents and licences.

By 2007, all the necessary permissions and licences were in place. The project team then spent two years developing the wind farm and planning how to address both the environment and local community interests.

When complete, London Array will displace more than 925,000 tonnes of CO₂ a year – equivalent to taking more than 289,000 cars off the road.†

Phase One

Phase One involved installing 175 turbines, two offshore substations and the new onshore substation at Cleve Hill, near Graveney. We also laid four undersea export cables with a total length of around 220km, and over 200km of array cabling to connect the turbines to each other and to the offshore substations. Each turbine has an individual capacity of 3.6MW.

Phase One will generate up to 630MW of power in total – enough for over 490,000 homes† or two thirds of all the homes in Kent. It covers an area of 100km², with the turbines placed 650m to 1,000m apart.

Phase Two

London Array has submitted an application to the Department of Energy and Climate Change to seek approval to remove a planning condition and allow Phase Two of the project to go ahead. If approved Phase Two would be capable of generating up to 240MW, giving a combined generating capacity of 870MW.
Cleve Hill substation

In July 2009, construction work started on the onshore substation at Cleve Hill, near Graveney, on the north Kent coast. The onshore substation connects to the offshore turbines via undersea cables. From the substation, the electricity is fed directly into the existing 400kV National Grid transmission network.

The substation’s design was chosen following a design competition in the summer of 2006. The winning entry was submitted by RMJM, a world-renowned firm of architects, and was developed around the concept of a viewing point perpendicular to the substation and almost 1km away on the Saxon Shore Way.

The substation’s main architectural feature is the North Wall. This is 9m tall and made up of a series of exposed aggregate concrete panels and aluminium fins which are designed to reflect movement to people on the Saxon Shore Way.

Connecting the wind farm to the substation

Power is carried from the offshore substations to the onshore substation using large export cables that are buried in the seabed. Each 1m length of export cable weighs over 88kg. When the export cables reach the shore, they’re connected to the new substation through cable ducts that have been installed by drilling horizontally under the sea wall.

Read the latest news on our construction activities at londonarray.com
The foundations – monopiles and transition pieces

Each wind turbine at London Array is placed on foundations consisting of a monopile and a transition piece. A monopile is a long, cylindrical steel tube. For London Array, the monopiles measure up to 68m tall and 5.7m wide, and weigh up to 650 tonnes. We used a hydraulic hammer to hammer each monopile into the seabed, using a process called ‘soft start’, so fish and marine mammals can move away from the noise before it reaches full power.

For Phase One, 177 monopiles were installed – one for each of the 175 wind turbines and two more for the offshore substations. Four vessels, MPI’s Adventure, A2SEA’s Sea Worker and Sea Jack, and Ballast Nedam’s HLV Svanen have been used to install these. Three of these vessels are jack-up barges with extendable legs that lift the deck out of the water to create a stable platform from which we can hammer in the monopiles.

After the monopiles were installed, the transition pieces were lifted onto them and grouted into place. These have ladders and platforms for maintenance access and are painted yellow so they’re clearly visible to ships and aircraft. Due to varying seabed conditions and water depths, the transition pieces weigh between 245 and 345 tonnes and are up to 28m tall.

The turbines

The turbines for Phase One were supplied by Siemens Wind Power and are fitted with Siemens’ new 120m rotor. Each turbine has a hub height of 87m above sea level. The turbines each have three blades and are grey in colour.

To install each turbine, we first assembled the main tower which was lifted into place and bolted onto the transition piece. We then installed the nacelle and hub, which contain the turbine’s main parts including the gearbox, generator and controls. Finally, the three turbine blades were mounted, one at a time, in a horizontal position. When all the parts are assembled, each turbine weighs around 480 tonnes. A2SEA’s Sea Worker and Sea Jack, and MPI’s Discovery were used to install the turbines.

It usually takes 1-2 days to install a complete wind turbine. Each turbine has a total height of around 147m.
The export cables

The export cables run from the offshore substations to the onshore substation at Clevé Hill, near Graveney, where the power feeds into the National Grid. The cables were laid and buried into the seabed using a plough from the cable installation barge ‘Stemat Spirit’. All four cables were installed in continuous lengths of over 50km.

The export cables also hold vital fibre optic wires that are used to communicate remotely with the wind turbines to monitor and control their performance. They’ll also enable us to carry out some maintenance procedures remotely, without having to visit the site.

When the export cables reach the shore, they are connected to the new substation through cable ducts that have been installed by drilling horizontally underneath the sea wall.

Commissioning the wind farm

Each turbine is energised, commissioned and tested individually, and in groups, to make sure they’re working correctly. We’re expecting the whole of Phase One to be commissioned by spring 2013, after which the site will be handed over to the Operations & Maintenance Team.
Operations and maintenance

The wind turbines at London Array will start generating electricity when wind speeds reach 4 metres per second (m/s) or around 7mph. They’ll achieve full power from 13m/s (around 29mph).

For safety reasons the turbines will start shutting down if the wind speed becomes greater than 25m/s – equivalent to a force 9 gale.

The turbines are designed to run for over 20 years, 24 hours a day, 7 days a week. Each turbine will be serviced regularly by our technicians, who will usually travel to the wind farm by boat. If problems or breakdowns occur, we may be able to resolve these remotely using computers in the control room. Otherwise, our technicians will make repairs on site.

We work closely with the local coastguard and other emergency services to make sure we’re well prepared to deal with any unexpected incidents, either at the wind farm site itself, or when our technicians are travelling back and forth.

The Operations & Maintenance base

London Array’s Operations & Maintenance base has been purpose built at the Port of Ramsgate on the east Kent coast, on a 8,000m² site. The facility accommodates around 90 staff and six maintenance vessels. It includes computerised monitoring and control facilities, a workshop, offices and storage facilities.

Navigational safety

Some of the turbines at London Array are fitted with navigation lights and foghorns to warn aircraft and ships of the wind farm’s presence. Radar has also been installed at one of the turbines and, during construction, we established a temporary safety zone around each turbine as it was built. To help protect small boats that may sail near the wind farm, the top of each wind turbine blade will always be at least 22m above the maximum sea height at high tide, even at its lowest position.

Offshore Transmission Owner (OFTO)

Due to new legislation, on completion, London Array’s transmission assets (both the offshore substations, the onshore substation, export and array cables) will be transferred to an independent Offshore Transmission Owner (OFTO).
Environmental Impact Assessments

In 2005, we completed an intensive series of Environmental Impact Assessments. The results are compiled in our Non-Technical Summary, which you can read online at londonarray.com.

Our findings showed that it was possible for us to build the wind farm without causing any major negative impacts on the environment. All the investigations we’ve undertaken since then support this conclusion.

Environmental monitoring and management

Our environmental monitoring programmes will continue throughout onshore and offshore construction. Some programmes will continue throughout the wind farm’s operational life.

The overall aim of these activities is to assess and understand London Array’s potential and actual impacts on a range of key environmental areas including:

- Birds, fish, mammals and benthic (the ecology of the seabed)
- Shipping and navigation
- Coastal processes
- Visual impact
- Boat traffic
- Noise
- Socio-economics.

One of our key environmental initiatives is to protect the Red-throated Diver, a rare species of seabird that over-winters in the outer Thames Estuary. We’re working closely with the RSPB and Natural England to make sure these birds aren’t adversely affected by London Array.
Supporting the local community

Although the wind farm itself will be 20km out at sea, London Array will have a significant effect on the onshore communities in the Cleve Hill and Ramsgate areas. We’re working to involve local people in the project, keep them informed about our progress and help them share in the benefits that London Array will bring to the area.

For full details of our community initiatives and events, and to sign up to our newsletter, visit londonarray.com/community

Our activities and initiatives in the community

The environment
- £200,000 fund for nature conservation established.
- Special measures in place to protect endangered species.
- Over 10,000 trees and shrubs planted at Cleve Hill.

The economy
- Supply chain event held in June 2010 to promote supply chain opportunities to local businesses.
- Construction of the Operations & Maintenance base at Ramsgate was managed by Mansell Construction’s Maidstone office, using local contractors where possible.
- Up to 90 permanent jobs operating and maintaining the wind farm.
- 130 Kent based companies already involved in the project, equating to contract values of nearly £20 million.

The people
- £300,000 community fund established in May 2010, managed by the Graveney and Goodnestone Trust.
- Dedicated Community Relations Team set up to liaise with and support local people.
- Support given to local events, such as the Kent Marine Festival, Ramsgate Week and Kent’s Coastal Week.

The next generation
- 10 year University Bursary Scheme established in 2010 to help fund one local student a year, studying a science or engineering based degree at university for three years.

The schools
- New car park, safety warning lights, crossing and steps for Graveney Primary School.
- Traffic Marshal role funded.
- Annual, index-linked donation of £2,000 made to three schools in the area.
Why we need renewable energy

There are three main reasons why the UK needs to generate more electricity using renewable energy technologies such as wind power:

1. To combat global warming
   It’s now recognised worldwide that traditional, carbon-producing ways of generating energy are damaging our planet. As offshore wind farms like London Array produce little or no carbon, they’ll make a vital contribution to protecting the environment.

2. To keep energy costs down
   North Sea gas fields are starting to run low and we’re now importing more gas into the UK, which is pushing up energy prices. Although offshore wind farms are expensive to build, they’re cost-effective in the long term.

3. To contribute towards a reliable electricity supply
   A third of the UK’s conventional power stations will close over the next 15 years and they must be replaced with reliable ways of producing electricity. Although offshore wind power will play a key role in future energy generation, we can’t rely on it entirely because the amount of electricity produced depends on weather conditions. The best way to ensure a secure energy supply is to create the right ‘mix’ of generation methods, including cleaner fossil fuels, nuclear power and renewable energy sources, such as offshore wind.

Renewable energy targets

London Array will make an important contribution to helping the UK meet its climate change and renewable energy targets. These include:

- Reducing CO2 emissions by 34% by 2020.
- Generating 15% of all energy from renewable sources by 2020. This is a legally-binding EU target.

When complete, London Array will reduce carbon emissions by up to 1.4 million tonnes a year. Phase One alone will enable more than 925,000 tonnes of CO2 to be offset each year, helping to tackle the effects of climate change and global warming.

The power of offshore wind

Offshore wind is one of the most powerful sources of renewable energy. And here in the UK, we have one of the highest offshore wind energy resources in the world, with over 33% of the total European potential – enough to power the whole country three times over. As one of seven countries in the world to have operational offshore wind farms, the UK is well placed to lead in the global development of this exciting new technology.

Offshore wind farms work in the same way as their onshore counterparts, but higher, stronger winds mean they generate more energy. However, it’s more expensive to build and run an offshore wind farm due to the harsh and unpredictable marine environment. Each offshore wind farm project presents unique challenges due to its location and seabed conditions being completely different.

The future of energy generation

The UK Government has recognised that offshore wind power has huge potential and wants the UK to generate 14 gigawatts (GW) of electricity from offshore wind farms by 2020 – enough to power millions of homes. London Array forms part of the Government’s Round 2 offshore wind development programme. In total, 15 projects in different locations off the English and Welsh coasts will generate over 7GW of renewable electricity when Round 2 is completed – equivalent to 7% of the UK’s total supply.*

You can find out more about Round 2 and Round 3 developments at thecrownestate.co.uk

You can read more about the plans for current and future UK offshore wind farm projects at bwea.com/offshore
How an offshore wind farm works

Generating electricity from wind works in a similar way to traditional methods of producing energy, such as coal, oil and gas. However, unlike conventional power stations, wind turbines don’t produce harmful carbon emissions. Each unit of renewable electricity produced by a wind farm replaces one needed from a conventional power station, helping to tackle climate change and global warming.

Offshore wind technology will form a major part of the UK’s energy generation future.

1. Wind turns the blades on each individual wind turbine to generate electricity.
2. Array cables buried in the seabed take the electricity from the wind turbines to the offshore substations.
3. The offshore substations boost the voltage to reduce transmission losses.
4. The export cables from the offshore substations bring the electricity to shore.
5. The cables run underground to our onshore substation at Cleve Hill, where the electricity feeds straight into the high voltage network.
6. The electricity is carried through the local network and the National Grid into homes, businesses and industries.
Main contractors for Phase One

In 2009, we agreed almost €2.2 billion worth of contracts with a number of European suppliers to provide the core components and expertise needed to construct Phase One of London Array. These are:

- **Construction and erection of wind turbines:**
  - Siemens Wind Power
- **Transport, logistics and installation of wind turbines:**
  - Per Aarsleff A/S and Bilfinger Berger Ingenieurbau GmbH
- **Design, construction and installation of foundations:**
  - Per Aarsleff A/S and Bilfinger Berger Ingenieurbau GmbH
- **Design and construction of offshore substations:**
  - Future Energy, a joint venture between Fabricom, Lemants and Geosea
- **Installation of offshore and onshore substations’ electrical systems:**
  - Siemens Transmission and Distribution Limited
- **Design and construction of onshore substation:**
  - Siemens Transmission and Distribution Limited
- **Production of export cables:**
  - Nexans Norway AS
- **Production of array cables:**
  - JDR Cable Systems
- **Installation of all cables:**
  - Visser & Smit Marine Contracting
- **Supply of vessels:**
  - MPI and A2SEA

**DONG Energy – 50% project share**

Denmark-based DONG Energy is a leading European energy group. They procure, produce, distribute and trade in energy and related products across Northern Europe. DONG Energy is a market leader in offshore wind technology and has built around half of the offshore wind farms operating today. DONG Energy is heavily involved in the production and expansion of renewable energy in the UK. The company is involved in building three new major UK offshore wind farms and currently operates the Walney (106.7MW), Gurnfleet Sands (112MW), Barrow (90MW) and Burbo Bank (90MW) offshore wind farms.

[dongenergy.com](http://dongenergy.com)

**E.ON – 30% project share**

E.ON is one of the UK’s leading power and gas companies – generating electricity, and retailing power and gas – and is part of the E.ON group, one of the world’s largest investor-owned power and gas companies. E.ON has been involved in renewable energy since 1991, when they invested in their first onshore wind farm. They now own and operate 21 wind farms in the UK, including the 60MW Scroby Sands Offshore Wind Farm off the coast of Great Yarmouth and the 180MW Robin Rigg Offshore Wind Farm in the Solway Firth. Many more projects are in the pipeline.

[eon-uk.com](http://eon-uk.com)

**Masdar – 20% project share**

Masdar is Abu Dhabi’s multi-faceted renewable energy company, advancing the development and deployment of renewable energy and clean technologies. Backed by the stability and reputation of the Mubadala Development Company, the strategic investment company of the government of Abu Dhabi, Masdar is dedicated to the emirate’s long-term vision for the future of energy. London Array is one of many projects that the company is working on, both in Abu Dhabi and internationally. One of Masdar’s biggest projects is Masdar City, a low carbon, low waste cleantech hub powered by renewable energy.

[masdar.ae](http://masdar.ae)
More information

You can find more information on the London Array project, offshore wind technology and renewable energy in general at the following websites:

- London Array
  londonarray.com
- DONG Energy
  dongenergy.com
- E.ON
  eon-uk.com
- Masdar
  masdar.ae
- RenewableUK
  bwea.com
- The Collaborative Offshore Wind Research into the Environment (COWRIE)
  offshorewind.co.uk
- The European Wind Energy Association
  ewea.org
- The Renewable Energy Centre
  therenewableenergycentre.co.uk
- Department of Energy and Climate Change
  decc.gov.uk
- Carbon Trust
  carbontrust.co.uk
- The Crown Estate
  thecrownestate.co.uk

Contact us

If you have a question or comment about London Array, we’d like to hear from you. You can contact us in the following ways:

Write to us
London Array
7th Floor
50 Broadway
London
SW1H 0RG

Enquire online
You can submit an online enquiry at our website, londonarray.com/contact-us

Our newsletter

To keep up to date with the latest construction developments, as well as projects and events that we’re running in the local community, please sign up to our newsletter. You can subscribe online at londonarray.com

Note: Based on an average annual household energy consumption of 4,370 kWh and site specific data indicating a load factor of at least 39%.

† Carbon calculators are based on 430g CO₂/kWh and site specific data indicating a load factor of at least 39%.

* Source: bwea.com/offshore/faqs

¥ Source: bwea.co.uk/offshore/info

Image courtesy of E.ON