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Sustainability Appraisal Scoping Report Cards: East Inshore and Offshore Marine Plans

The following Report Cards set out the key baseline data and trends for the inshore and offshore east marine plan areas (as shown in Figure 1). Each topic considered on these Report Cards corresponds to a tab in the database, namely:

- Biodiversity
- Cultural Heritage
- Geology
- Seascape and Landscape
- Water
- Communities, Health and Wellbeing
- Economy
- Climate
- Pollution

For further information on the sources of the data used, please see appendix A – Baseline database.

Figure 1: Overview of the inshore and offshore east marine plan areas

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Biodiversity - Protected Sites and Species

Protected Sites and Species: Key baseline issues and key trend data

- Marine protected areas (MPAs): Sustainable Development Goal (SDG) 14 states that a target of 10% of the world's sea area should be protected as MPAs by 2030, while the Oslo and Paris Conventions (OSPAR) set the goal of establishing a network of MPAs across the North-East Atlantic. MPAs can be important biodiversity reservoirs, providing habitats for species at risk from overfishing and acting as buffers for climate-related stress. Whilst currently only approximately 3% of global seas are protected, the UK has taken a leading role with 23% of UK waters are protected (Biodiv_330).
- MPAs in the east marine plan area include:
    - special protection areas (SPA): Flamborough and Filey Coast SPA; Greater Wash SPA; Humber Estuary SPA; The Wash SPA; North Norfolk Coast SPA; Outer Thames Estuary SPA; Breydon Water SPA; Minsmere-Walberswick SPA; Alde-Ore Estuary SPA; Deben Estuary SPA; and Gibraltar Point SPA (Biodiv_125).
    - special areas of conservation (SAC): Alde, Ore and Butley Estuaries SAC, Southern North Sea SAC, Haisborough, Hammond and Winterton SAC, North Norfolk Sandbanks and Saturn Reef SAC, The Wash and North Norfolk Coast SAC, Inner Dowsing, Race Bank and North Ridge SAC, Humber Estuary SAC, Flamborough Head SAC, Dogger Bank SAC (Biodiv_126).
    - marine conservation zones (MCZ): Cromer Shoals Chalk Beds MCZ; Kentish Knock East MCZ; Orford Inshore MCZ; Holderness Inshore MCZ, Holderness Offshore MCZ; Markham's Triangle MCZ (Biodiv_501 to Biodiv_507).
- The Cromer Shoal Chalk Beds MCZ abuts the North Norfolk coast and is one of the most ecologically significant marine protected areas for chalk habitats in the UK and Europe (Geol_118).
- European protected species (EPS) are those listed in Annex IV of the Habitats Directive. It is an offence to kill, injure, capture or disturb EPS. All cetacean species, leatherback turtles (*Dermochelys coriacea*), all wild birds, grey seals (*Halichoerus grypus*), seahorses - spiny (*Hippocampus guttulatus*) and short-snouted (*Hippocampus hippocampus*), and Atlantic sturgeons (*Acipenser oxyrinchus oxyrinchus*) are all EPS found in UK waters (Biodiv_130).
- The area of MPAs (out to 12 nautical mile limit) increased, by almost 69% to 1.7 million hectares in the 5 years to 2018. A large contributor to this has been the designation of inshore MPAs under the European Birds and Habitats Directives (Biodiv_343).
- Terrestrial protected sites and species, although not in the marine plan area, could be affected by the development of marine plans in adjacent or nearby areas. This may be particularly relevant for sites designated for dune, cliff or other coastal features and species above Mean High Water Springs (MHWS), or nearby freshwater sites or species (Biodiv_254).
- Marine development (including offshore renewables), manufacturing (including aggregate extraction) and fishing have the potential to adversely affect MPAs (Biodiv_253; Economy_204; Economy_206).

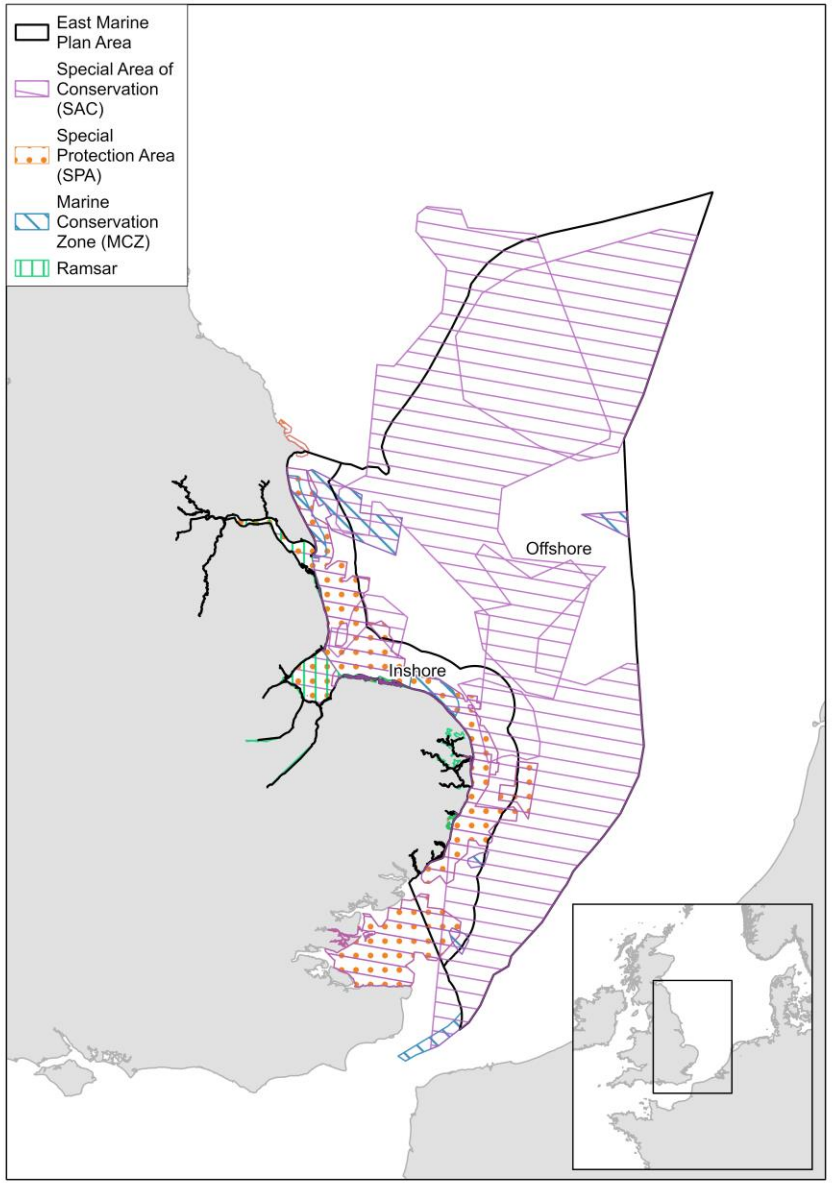

Figure 2: Biodiversity Contains European Environment Agency (EEA), Marine Management Organisation (MMO), Natural England and Joint Nature Conservation Committee (JNCC) Data © EEA, MMO, Natural England and JNCC Copyright and database right 2024. Reproduced with permission of the Marine Management Organisation, Ordnance Survey and UK Hydrographic Survey.

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Biodiversity - Benthic and Inter-Tidal Ecology

Benthic and Inter-Tidal Ecology: Key baseline issues and key trend data

- The European nature information system (EUNIS) is a database collated from a variety of sources, which can be used for habitat classification, as well as a source of information on habitats and species. Habitat distribution can be viewed on EMODNET map viewer https://emodnet.ec.europa.eu/geoviewer/ (Biodiv_359). Benthic habitats in the east marine plan area are dominated by circalittoral mixed or coarse sediments grading to sandy sediments, including sand banks with increasing distance offshore. The combination of habitats types are more complex at a localised level.
- Coastal waters in the east marine plan areas support a broad diversity of habitat types, including:
    - estuaries characterised by intertidal flats which include salt-marshes and mudflats, and which are rich in wildlife, and significant reclaimed freshwater marshes protected by earth-bank river walls (Biodiv_462); The Wash is an example of a large coastal embayment within the east marine plan area, which is fed by multiple rivers and has extensive intertidal flats (Geol_63). The Humber Waters marine character area is the second largest coastal plain estuary in the UK bounded by intertidal mud and sand flats and saltmarsh (Landscape_58);
    - broads, including fen and drains. The Broads National Park includes around 1700 ha of open fen, the largest expanse in lowland England. The creation of turf ponds can be used to restore fen habitat (Biodiv_570);
    - chalk seabed, such as that protected with the Cromer Shoals Chalk Beds MCZ, which typically increases in surface relief with increasing distance from shore, and chalk generally being replaced by sediment by 1.5 km from shore. Chalk substrata has been observed to support much greater diversity than clay substrata and habitats with greater complexity (eg with gullies and cobbles);
    - coastal lagoons, areas of shallow seawater which develop at low tide and may develop as brackish, full saline or hyper-saline water bodies. Coastal lagoons often contain a variety of rare and important species, such as tentacled lagoon worm (*Alkmaria romijni*), lagoon cockle (*Cerastoderma glaucum*), and lagoon sand shrimp (*Gammarus insensibilis*) (Biodiv_606). Suffolk Coastal Waters marine character area is recognised for its coastal lagoon habitats (Landscape_54);
    - small areas of kelp habitat. The area has historically held 21km2 of *Laminaria hyperborea*; currently, it holds 74km2. The study shows however that it has the potential for a further 2.16km2 to 5.41km2 to be restored. The east inshore marine plan area has historically held 113km2 of *Saccharina latissima*. Currently, it holds 31km2, however it does not have any potential for restoration however (Biodiv_516);
    - localised and very patchy *Sabellaria* reefs found in Haisborough, Hammond and Winterton SAC, Inner Dowsing, Race Bank and North Ridge SAC and North Norfolk Sandbanks and Saturn Reef SAC (Biodiv_528);
    - seagrasses which are underwater plants that form meadows on shallow sediments. Seagrasses provide co-benefits of improving water quality, providing a habitat for economically valuable fish, and increasing biodiversity (Biodiv_562). Small pockets of seagrass exist on the Norfolk coast, near to Wells-next-the-Sea and Blakeney (Biodiv_560).

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Biodiversity - Benthic and Inter-Tidal Ecology

Benthic and Inter-Tidal Ecology: Key baseline issues and key trend data

- Damage to the chalk within Cromer Shoal Chalk Beds MCZ, which is considered an irreplaceable marine habitat (NECR474), through pressures such as ‘grating’ has been observed, as a result of pots, anchors and ropes (Geol_118, Geol_119). However, damage to chalk as a result of pots, anchors and ropes is not yet scientifically proven to be significant; there is an ongoing natural change study to assess the impact (Geol_132).
- Non-licensable activities can have an impact on biodiversity. For example, dog walking and non-motorised land vehicles can disturb bird nesting sites, coasteering can disturb seabirds and seals at sensitive times, and anchoring can disturb seagrass and chalk habitats (Biodiv_567). Impact minimisation can occur through alternative actions such as eco-mooring (Biodiv_611).
- Good Environmental Status (GES) has not yet been achieved for sublittoral rock and biogenic habitats. The achievement of GES is uncertain for intertidal and soft sediment habitats.
- Poor and declining conditions of saltmarsh and mudflat habitats are being caused by land reclamation, erosion, and 'coastal squeeze' (Geol_90) while it is predicted that coastal squeeze and habitat loss will be accelerated by continued sea level rise (Geol_70) (Geol_60). As demonstrated on the National Coastal Erosion Risk Map, the majority of the preferred management options for coastal erosion from the shoreline management plans in the east marine plan area are 'hold the line', particularly at Bridlington, Hornsea and Felixstowe, while the preferred management option is managed realignment along the Norfolk coastline (eg: Cromer). Lowestoft incorporates a mixture of both management options. There are large sections of no active intervention at Hollesley Bay, and between Flamborough and Withensea (Geol_47).
- Marine restoration is important for improving water quality, improving flood defences, improving nature's ability to sequester carbon and support biodiversity, for example:
    - saltmarsh restoration provides a sustained sink for atmospheric CO_2, with a sequestration rate of 0.24MtCO_2e/yr (Climate_146), however, restored saltmarshes are believed to have a lower sequestration ability than natural saltmarshes however (Climate_144);
    - seagrass restoration provides a sustained sink for atmospheric CO_2, with an estimated sequestration rate of 0.02MtCO_2e/yr (there is uncertainty surrounding this however) (Climate_145).

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Biodiversity – Fish and Shellfish

Fish and Shellfish: key baseline issues and key trend data

- Good Environmental Status (GES) for fish in the Greater North Sea is measured by the abundance and demography of fish, populations that are not significantly affected by human activities indicate healthy populations. By 2018 demersal fish communities were recovering from over-exploitation in the past, but GES had not yet been achieved in the Greater North Sea (Biodiv_533; Biodiv_559; Biodiv_475; Biodiv_479).
- There has been an overall decline in mean maximum length for both demersal and pelagic species in the Greater North Sea, which implies that the proportion of vulnerable species (large or slow-growing species with late maturity) is declining (Biodiv_480 and 482).
- A number of marine character areas in the east marine plan area are recognised for their important fish spawning and nursery habitats; including Dogger Bank and Dogger deep water channel (Biodiv_322 and 323) while high intensity spawning grounds for a range of fish species exist across the east marine plan area (Biodiv_494, to Biodiv_497).
- There is currently no assessment to evaluate status of cephalopods within the UK Marine Strategy. However, existing data from ICES DATRAS database indicate trends of loliginid squids (using mean landings between 2019 and 2021 as surveillance indicators of GES) should be above the long-term historic average (Biodiv_471). Levels of common squid (*Loligo vulgaris*) are stable (biodiv_470) and mean landings of common cuttlefish (*Sepia officinalis*) in the North Sea between 2019 and 2021 are above long-term historic average (Biodiv_477).
- High exploitation levels of commercial shellfish stocks including edible crab (*Cancer pagarus*) and lobster (*Hommarus gammarus*) occur in the east marine plan area (Biodiv_512; Biodiv_529; Biodiv_530).
- A number of declining/threatened elasmobranch species are known to be present within the east marine plan area (Biodiv_128; Biodiv_541; Biodiv_555).
- Further data is required relating to the presence, patterns and pressures on diadromous fish in the east marine plan area (Biodiv_303; Biodiv_511).
- Fishing pressure on stocks includes fishing above sustainable levels, discards, bycatch. This affects different stocks in different areas (Biodiv_195; Biodiv_193).
- Further work is required to address the potential long-term impact of light pollution on commercial fish species and marine life in general. Considering the stress aspect of such physical factors, together with other physical stressors (eg noise) and chemicals, the cumulative health impacts need to be addressed for marine life in coastal regions (Biodiv_333).
- Further work is required to inform potential for electromagnetic fields impacts on fish which may affect food foraging, migration, navigation (Biodiv_237).
- Climate change related storm surges, sea level rise, coastal erosion and ocean acidification collectively have the potential to increase the complexity of chemical mixtures, which may impact on marine life and contaminate UK fisheries and seafood supplies (Biodiv_332; Biodiv_196; Biodiv_191).
- In the UK, new fishing opportunities could arise due to increased abundances of warm-water species (eg bass(*Dicentrarchus labrax*)), while cold adapted species (eg cod (*Gadus morhua*)) may move northward or decline in their abundance within UK waters. Ocean acidification could also damage shellfish stocks (Biodiv_334).
- The east inshore marine plan area historically held 12km2 of European native oyster (*Ostrea edulis*), and the offshore marine plan area held 9km2. Currently, neither areas hold significant numbers of the species, and native oyster beds are considered as one of the most threatened marine habitats (Biodiv_517).
- Wilder Humber Seascape 2030 is a project that aims to reintroduce half a million native oysters to the Humber Estuary. These native oysters are grown and monitored on Yorkshire Wildlife Trust's established native oyster farm at Spurn Point before being released into the estuary (Biodiv_604). Oyster restoration provides ecosystem services such as improving water quality, improving flood defences, improving nature's ability to sequester carbon and supporting biodiversity.

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Biodiversity – Marine Megafauna

Marine Megafauna: key baseline issues and key trend data

- Cetaceans in the Northeast Atlantic are partially meeting Good Environmental Status (GES) for cetacean biodiversity (assessed against a target for population size). Population levels have been stable since 2012 (Biodiv_486).
- The UK has achieved its aim of GES for grey seals (*Halichoerus grypus*) in the Greater North Sea, however harbour seals (*Phoca vitulina*) in the Greater North Sea have not yet achieved GES (Biodiv_537).
- On the east coast, hotspots of density for both UK seal species are patchily distributed out to ~100 km from the coast. In the east marine plan area, hotspots are evident along the western and southern fringes of the Dogger Bank, which appears to be an important feature in the region, potentially influencing seal foraging distribution. Grey seals in this area are increasing exponentially; their deployment locations include The Wash, Donna Nook and Blakeney Point (Biodiv_514)
- Burrowing megafauna habitat occur on plains of fine mud from the shallow subtidal to the deep sea. These muds are heavily bioturbated by burrowing megafauna species such as decapod crustaceans and may include conspicuous populations of sea pens. Burrowing megafauna communities are recognised as a priority habitat of conservation importance in the UK and internationally, as they support a rich fauna of smaller animals by acting as a source of food and nursery areas for many fish species. The main threats faced by burrowing megafauna habitat are physical disturbance (trawling) and organic pollution. The largest known occurrences of burrowing megafauna habitat exist are in the North Sea. Restoration success however depends on the reduction of trawl fishing effort (Biodiv_572).
- Cetaceans provide ecosystem benefits. Larger cetaceans, in particular large whales that migrate long distances, enhance marine primary productivity by fertilizing ocean waters with iron-rich faeces and circulating (“pumping”) micronutrients that influence the biogeochemistry of the marine ecosystem. Their large biomass also represents an important and stable repository for carbon dioxide (a greenhouse gas) and, upon death, their carcasses contribute to biodiversity and carbon sequestration on the ocean floor (Biodiv_527; Biodiv_544). Smaller cetaceans (dolphins, porpoises, and small toothed whales) could provide top-down (eg, direct predation and risk effects) and bottom-up effects (eg, translocation of nutrients within and across ecosystems), but also behaviour-mediated processes where these predators can facilitate access to resources to other predators or modify the physical properties of habitat (eg, bioturbation) (Biodiv_608).
- Impulsive sound sources have been observed to cause temporary displacement of small cetaceans (eg harbour porpoise (*Phocoena phocoena*)), increased physiological stress in some fish species (eg European seabass (*Dicentrarchus labrax*)), and developmental abnormalities in invertebrate larvae. While effects on individual animals have been shown for a number of species, there is uncertainty over whether and how the effects of sound on individuals are translated to the population or ecosystem scale (Biodiv_348).
- The increasing presence of offshore wind developments and other activities such as oil and gas exploration and production contributes to underwater noise pollution, both individually and cumulatively (Biodiv_355). Loud impulsive noise has the potential to cause permanent displacement of small cetaceans. Studies have not been able to determine if animals that are returning to areas do so to their previous numbers. Even where areas have been recolonised, it is not clear if these are the same animals returning or new animals moving into the area. The significance of such disturbance to individuals and at the population level is not fully understood (Biodiv_605).
- The achievement of GES for underwater noise in the UK is uncertain. Research and monitoring programmes established since 2012 have provided an improved understanding of the impacts of sound on marine ecosystems (Biodiv_565).

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Biodiversity – Non-indigenous species

Non-Indigenous Species: key baseline issues and key trend data

- Several invasive non-native species (INNS) are known or suspected to be present within the east marine plan area (eg acorn barnacle (*Balanomorpha*), slipper limpet (*Crepidula fornicata*), pacific oyster (*Crassostrea gigas*), asian shore crab (*Hemigrapsus sanguineus*) (Biodiv_207; Biodiv_551, 552 and 553). Zebra mussels (*Dreissena polymorpha*) are a particular issue in the Norfolk Broads, where native mussels are being smothered by the invasive species and prevented from feeding or moving (Biodiv_568). Slipper limpets are known to outcompete bivalves and prey on spat (Economy_553). The distribution of slipper limpets is expanding northwards from the south and have been recorded as far north as Spurn Point (Economy_246).
- Further potential INNS have been identified at risk of impacting waters in the east marine plan area (Biodiv_208; Biodiv 238; Biodiv_240).
- The UK has not yet achieved its aim of Good Environmental Status for non-indigenous species (NIS). Our ability to detect new non-indigenous species has improved but there has been no significant change in the number of new records of non-indigenous species made between 2003 and 2014 (Biodiv_564).
- Invasive species can have a range of impacts on the marine environment through competition with native species for habitat or food or may prey directly on native species. Invasive species may bring disease or parasites or may act as parasites on native species, which may not be well-adapted to defend against them. These impacts can affect individuals or act at a population level, with knock-on impacts to marine food webs and ecosystems (Biodiv_247).
- The proliferation of invasive non-native species can also prompt unwelcome changes in the wider ecosystem that climate change might further exacerbate. Quagga mussels (*Dreissena bugensis*) are an example of a successful invader. These filter feeders multiply at such a rate that they strip phytoplankton and nutrients from freshwater systems, significantly altering the food web and habitat. They also block pipes and filters, causing problems that water companies must pay to resolve. The zebra mussel, a similarly invasive species, is now widespread across England (Biodiv_312).
- Aquaculture may lead to the escape of invasive species that interact with native shellfish. Aquaculture of native species may also affect wild populations through, for example production of pseudofaeces, smothering of benthic habitats and through competition for habitats and food (Biodiv_250).
- INNS need to be stopped at source via biosecurity and other means. Once a species has been introduced its incredible difficult to reduce its spread let alone eradicate it from an area (Biodiv_550).
- Monitoring and management of invasive species on the coast of the UK and Republic of Ireland poses significant challenges (Biodiv_249; Biodiv_257 and 258).

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Biodiversity – Ornithology

Ornithology: key baseline issues and key trend data

- The MMO collaborated with Natural England to fund the Seabird Mapping & Sensitivity Tool which aimed to map seabird densities in all English waters, as well as indicating constraints for offshore renewables (Biodiv_294).
- Marine birds in the Greater North Sea are not achieving Good Environmental Status for marine bird biodiversity. Population levels have been declining since 2012 (Biodiv_489) with widespread threats to food and habitat availability identified (Biodiv_546).
- The fourth census of the UK and Republic of Ireland's internationally important populations of breeding seabirds was published in 2023. Eleven of the 21 species, where confidence in their trends could be established, have declined by over 10% since the previous census (1998-2002). However, the picture looks more positive for the breeding populations of five species which have increased by over 10% (Mediterranean gull (*Ichthyaetus melanocephalus*), roseate tern (*Sterna dougallii*), northern gannet (*Morus bassanus*), razorbill (*Alca torda*) and great skua (*Stercorarius skua*)) and a further five have remained stable (sandwich tern (*Thalasseus sandvicensis*), common tern (*Sterna hirundo*), great cormorant (*Phalacrocorax carbo*), common guillemot (*Uria aalge*), black guillemot (*Cepphus grylle*)) (Biodiv_329).
- Many of the nature conservation sites present within the east marine plan area are designated, at least in part, for the protection of seabird colonies (Biodiv_121).
- Climate change is considered to be one of the primary causes of seabird declines, through indirect effects such as changes in prey availability and abundance, and through direct effects such as increased mortality from the increasing frequency and intensity of extreme weather events. These processes will interact with current drivers such as unsustainable fisheries, pollutants, marine renewables and disease. Overall negative relationships between temperature and the productivity of seabirds has been shown for kittiwakes, fulmars and puffins, as well as common tern, Arctic tern (*Sterna paradisaea*) and little terns (*Sternula albifrons*) (Biodiv_325). 'Nesting hotels' have been built in Lowestoft, to compensate for declining species numbers (Biodiv_569).
- Habitat suitability around the UK for seabirds is projected to shift northward over the next century and birds' distributions may shift with changing conditions. Declines in European ranges are also predicted – with Leach's storm petrels (*Hydrobates leucorhous*) and Arctic skuas (*Stercorarius parasiticus*) projected to come close to or reach UK extinction by 2100 (Biodiv_326).
- Seabirds undergo their moult whilst out on the water. During this time, they are completely flightless and therefore their ability to move out of the way of danger is restricted. Some species, such as razorbills and guillemots, will stay with their young on the water during this time – should they become separated due to disturbance, the juveniles' chance of survival is significantly reduced (Biodiv_352).
- Avian flu is circulating in breeding seabirds around our coasts and has caused significant mortality in some species. The primary means of transmission in wild birds is through saliva and nasal secretions but can also be transmitted by predation of sick birds; from faeces/guano in and around nests and on resting areas close to nests; and possibly via shared freshwater bathing areas. Monitoring the numbers of dead seabirds and their species will help guide decisions on where to conduct future monitoring of breeding birds (Biodiv_571).
- Poor status, coupled with reducing environmental headroom for SPA designations, means that marine developments will increasingly be restricted from the designated sites and the buffer distances around them in order to prevent additional disturbance/displacement of bird populations. This is particularly relevant for over-wintering species, such as the red-throated diver (*Gavia stellata*) (Biodiv_609).
- The Wash is considered as one of the UK's most important inter-tidal wetland sites nationally. At peak times, The Wash can hold between 400,000 to 450,000 waders and wildfowl. Internationally, The Wash is important for 16 species of birds: pink-footed goose (*Anser brachyrhynchus*), dark-bellied Brent goose (*Branta bernicla bernicla*), shelduck (*Tadorna tadorna*), pintail (*Anas acuta*), oystercatcher (*Haematopus ostralegus*), ringed plover (*Charadrius hiaticula*), golden plover (*Pluvialis apricaria*), grey plover (*Pluvialis squatarola*), lapwing (*Vanellus vanellus*), knot (*Calidris canutus*), sanderling (*Calidris alba*), dunlin (*Calidris alpina alpina*), black-tailed godwit (*Limosa limosa islandica*), bar-tailed godwit (*Limosa lapponica*), curlew (*Numenius arquata*), and redshank (*Tringa totanus*) (Biodiv_610). Climate change is leading to a substantial shift in the distribution of waders however; there is clear evidence of a south-westward to north-eastward shift in the centres of abundance of some wader species (Biodiv_255).

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Cultural Heritage

Cultural Heritage – Key baseline issues

- The east marine plan area contains, or has the potential to contain, prehistoric heritage assets (from both prior to and after the Late Glacial Maximum); coastal sites and structures; heritage assets (eg the wrecks of ships and boats); and aviation assets (eg air crash sites). Heritage assets in marine plan areas include both designated and non-designated assets ranging in significance to include assets of national and international importance (Cultural_87).
- There are numerous scheduled monuments, listed buildings and registered parks and gardens, including in estuaries and tidal rivers within the east inshore marine plan area (Cultural_78, Cultural_79).
- Coastal conservation areas on the Historic England Heritage at Risk 2023 Register include Lowestoft North, Great Yarmouth Seafront, The Kasbah (Lincs), Happisburgh, Central Sea Front at Cleethorpes, and Bridlington Quay (East Riding)) (Cultural_161).
- Heritage assets comprise the wrecks and hulks of ships and boats, together with related wreckage and debris lost from vessels and/or associated with landing sites, navigational hazards, anchorages, sea routes and important historic naval battles, such as the Anglo-Dutch wars, or the Spanish Armada (Cultural_90).
- There are 4 protected wrecks (Dunwich Bank, Lady, Alice Kenlis, Xanthe and The Seagull) within the inshore east marine plan area (Cultural_80).
- Aviation heritage assets in marine plan areas comprise air crash sites and associated wreckage dating from the Twentieth Century. There are two broad categories: civilian aviation heritage assets and military aviation heritage assets. Military aviation heritage assets are much more numerous because of the First and particularly the Second World War, though military air crashes in peacetime (during training, for example) have also been relatively common. Military air crash sites are automatically protected under the Protection of Military Remains Act 1986 (Cultural_91).
- There are 4 Ministry of Defence military protected wrecks within the east marine plan area (Exmoor, Vortigen, Umpire and Amphion (Cultural 82).
- The east coast war channels are carefully defined routes swept of mines along the east coast of England which were maintained during the First and Second World Wars. These remains represent an important component of the historic character of the east marine plan area (Cultural_135).
- Under The United Nations Convention on the Law of the Sea it is not possible for a state party to designate heritage assets in the offshore east marine plan area, this does not indicate an absence of significant heritage assets: non-designated heritage assets of equivalent significance to designated heritage assets are likely to be present in the offshore area, as recognised by the UK Marine Policy Statement (Cultural_168).
- Previously unknown but highly significant heritage assets continue to be discovered in the east marine plan area. In addition, some heritage assets that are already known prove to have much greater significance than might have been assumed (Cultural_98). Extensive prehistoric evidence is being revealed through seabed development. Coastal prehistoric archaeological evidence of international importance is found on the coast of East Anglia (eg Happisburgh, Norfolk). The coastal exposures around Happisburgh continue to reveal evidence of the earliest humans in northern Europe, with several sites dating from 900,000 to 500,000 years ago. The site has a remarkable concentration of early Stone Age sites that have all been discovered since 2001; the oldest of these sites, known as Happisburgh Site 3, is an ancient river channel dating to either 850,000 or 950,000 years ago (Cultural_158).
- Climate change is having a direct impact on heritage assets on shorelines and in intertidal areas and may be having indirect impacts on submerged material through biological, chemical and physical changes (geology / water quality) (Cultural_106, Cultural_113).
- Heritage assets can be harmed by changes to their setting, such as development. Where a development proposal will lead to less than substantial harm to the significance of a designated heritage asset, this harm should be weighed against the public benefits of the proposal including, where appropriate, securing its optimum viable use (Cultural_143).
- Over £3.8 million (£3,804,193) of Coastal Revival Fund has been awarded to 92 successful projects between 2018 to 19 around England's coast that aimed to help bring coastal areas' 'at risk' heritage and community assets back into economic use (Cultural_162). Twelve projects were relevant to the east marine plan area, including the restoration of Hopton Ruined Church in Great Yarmouth (£22,000), the creation of Cleethorpes Cycle Hub (£50,000) from a previously vacant listed building, and the development of South Lowestoft Seafront Regeneration Framework (£25,000), among others (Communities_64).

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Cultural Heritage

Cultural Heritage – Key trend data

- For heritage assets in the vicinity of marine plan areas, marine plans could have an important role in supporting positive strategies on - for example - place-making, seascape, employment, health and wellbeing, regeneration, recreation, and marine tourism. Equally, marine plan policies that do not take into account heritage assets in the vicinity of marine plan areas could undermine or detract from such social and economic benefits (Cultural_93, Cultural_129). Nature conservation measures (eg designation of marine protected areas for benthic and ornithology interest etc.) may have implications for access to heritage assets and/or the conduct of archaeological investigations (Cultural _107).
- Marine planning represents an opportunity to manage the historic and natural environment together in a holistic and strategic manner across all plan areas, given the commonality of issues and impacts that may arise from natural or anthropogenic change (including adverse impacts from tourism and recreation activities, development of offshore renewables, and climate change) (Cultural_130).
- East Coast Flyway is on a tentative list of UK sites that are being considered for inclusion on the World Heritage List. If included, this site will be classed as a world heritage site in the next 5-10 years (Cultural_165).
- Marine mineral extraction, which often targets prehistoric rivers under the North Sea, has a high likelihood of encountering and potentially impacting archaeological material. For example, archaeological discoveries (Palaeolithic flint artefacts and Pleistocene mammalian remains) from exposures of the Cromer Forest-bed Formation at Happisburgh, have recently been found in this area (Cultural_169).
- The new Marine Management Organisation Marine Case Management System requires proponents to complete assessment against marine plan policies when submitting marine licence applications. This has led to an increase in recognition of heritage assets, their condition and available data (Cultural_166).

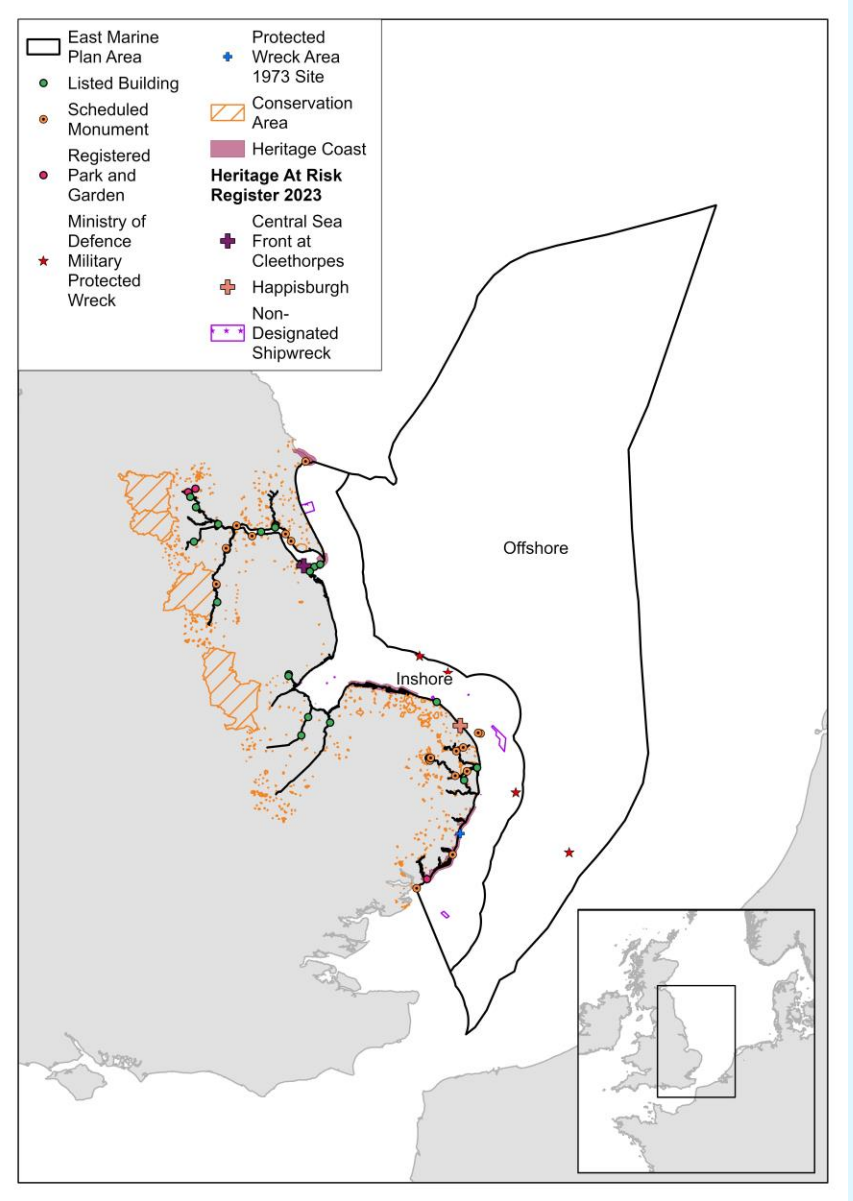


Figure 3: Cultural Heritage

Marine Management Organisation

Geology, Substrates and Coastal Processes

Geology, Substrates and Coastal Processes – Key baseline issues

- From the coast the seabed shelves are fairly consistent out to the 50m depth contour with the gentlest profile off Skegness and steepest off Lowestoft. The bathymetry off Flamborough Head in the very north of the east marine plan area is also relatively steep. Water depth only reaches 100m or more in isolated locations, such as the Markham's Triangle Marine Conservation Zone (MCZ)(Geol_51).
- Broadscale topographic and bed-form features within the inshore and offshore east marine plan areas include subtidal sediment banks, shelf mound/pinnacles and shelf troughs (Geol_58).
- The bedrock in the inshore east marine plan area is dominated by chalk and mudstone bedrock (Geol_54).
- Sediments include: subtidal coarse sediment, subtidal mixed sediments, subtidal sand, peat and clay exposures, intertidal sand and muddy sand, and subtidal coarse sediment (Geol_52).
- Dogger Bank is a very large shoal area in the central North Sea with water depths less than about 30m extending east from Flamborough Head. It is shallowest in the south western part where water depths are only 15m and is largely composed of thick (estimated 40m) of glaciolacustrine clays deposited adjacent to glacial ice during the last glaciation (Geol_62). The sandbank features of Dogger Bank are considered irreplaceable (Geol_120).
- The Dogger Bank marks a subdivision of the North Sea basin between a northern part where bathymetry declines smoothly towards the shelf edge at about 200m depth; and a shallower southern basin with a maximum water depth of about 50m (Geol_116).
- Cromer Shoal Chalk Beds MCZ is one of the most ecologically significant marine protected areas for chalk habitats in the UK and Europe (Geol_118).
- The southern north sea sedimentary basin covers the inshore and offshore east marine plan areas (down to Lowestoft). There are significant gas fields within this basin, mainly located in the offshore east marine plan area (Geol_53).
- The Norfolk Banks are a group of sandbanks off the coast of north east Norfolk, aligned sub-parallel to the modern coastline, the southern end of sandbanks may be shore-connected (Geol_64).
- In the inshore east marine plan area, the southern North Sea coast of the UK generally comprises low-lying land that alternates with soft glacial rock cliffs. From Flamborough Head to the Humber, cliffs cut into Pleisotcene glacial deposits. From the Humber to the Wash, cliffs are generally low-lying and cut into sandy deposits. East Anglia generally has cliffs cut into Pleistocene glacial, fluvial and marine deposits, interspersed with areas of saltmarsh. There are some outcrops of bedrock within the east marine plan however, such as cretaceous chalk at Hunstanton (Geol_127).
- The geology of the east marine plan area makes it vulnerable to flooding and coastal erosion (Geol_117).
- The Wash is a large coastal embayment on the east coast of England which has extensive intertidal flats around its margins and a number of large sandbanks within it. These banks are aligned parallel to the sides of the embayment and to the dominant tidal current directions in and out of the embayment. Most of these banks are partially exposed at low tide (Geol_63).
- In the east marine plan area there are the The Anglian and The Humber River Basin Management Plans (Geol_50).
- As demonstrated on the Shoreline Management Plan (SMP) Explorer, in the east marine plan area there are the following SMPs: SMP3 Flamborough Head to Gibraltar Point; SMP4 Gibraltar Point to Hunstanton; SMP5 Hunstanton to Kelling Hard, SMP6 Kelling Hard to Lowestoft; and SMP7 Lowestoft to Felixstowe (Geol_49).
- As demonstrated on the National Coastal Erosion Risk Map, the majority of the preferred management options for coastal erosion from the shoreline management plans in the east marine plan area are 'hold the line', particularly at Bridlington, Hornsea and Felixstowe, while the preferred management option is managed realignment along the Norfolk coastline (eg: Cromer). Lowestoft incorporates a mixture of both management options. There are large sections of no active intervention at Hollesley Bay, and between Flamborough and Withensea (Geol_47). Managed realignment can be controversial but in specific circumstances it can be economically and environmentally justified and provide sediment to the nearshore area which may assist sustainable management of the wider coastline (Geol_61).
- The largest saltmarshes can be found in The Wash and Humber Estuary. It has been established that saltmarsh restoration provides a sustained sink for atmospheric CO2. Saltmarshes have an estimated carbon stock of 48MtCO2e in the UK, with a sequestration rate of 0.24MtCO2e/yr (Climate_146). Restored saltmarshes are believed to have a lower sequestration ability than natural saltmarshes, however, they can also improve water quality, improve flood defences and support biodiversity (Climate_144).

Marine Management Organisation

Geology, Substrates and Coastal Processes

Geology, Substrates and Coastal Processes – Key baseline issues

- The east inshore marine plan area contains 18 Geological Conservation Review (GCR) sites representing coastal geomorphology within the plan area (Geol_55).
- The GCR contains coastal sites along the inshore east marine plan area's coastline that represent the Cretaceous period (including Trimingham, Sheringham, and Hunstanton), Jurassic period (including Chapel Point, Anderby Creek) and Palaogene period (Geol_48).
- There are opportunities for underground coal gasification off the Yorkshire coast (Geol_82).
- Damage to the chalk within Cromer Shoal Chalk Beds MCZ, which is considered an irreplaceable marine habitat (NECR474), through pressures such as 'grating' has been observed, as a result of pots, anchors and ropes (Geol_118, Geol_119).
- The presence of hard coastal defences, such as seawalls, has led to 'coastal squeeze' of intertidal sediment habitats in some locations (Geol_73).

Geology, Substrates and Coastal Processes – Key trend data

- Coasts are likely to experience increased erosion rates due to sea-level rise and increased storm events (Geol_88). Local and regional factors, including coastal management strategy, are also important (Geol_74) and where the coast is protected by engineering structures coasts are generally experiencing a steepening of the intertidal profile (Geol_76).
- It is estimated that in low-lying coastal regions of England at least 40 to 100 hectares of saltmarsh are being lost every year and it is predicted that 'coastal squeeze' and habitat loss will be accelerated by continued sea level rise (Geol_70) (Geol_60). Poor and declining conditions of saltmarsh and mudflat habitats are being caused by land reclamation, erosion, and 'coastal squeeze' (Geol_90).
- Coastal management and flooding is a growing issue in the east marine plan area as the impacts of climate change become more severe (Geol_124). Areas of the plan area with soft actively eroding cliffs are experiencing significant impacts on communities, such as Happisburgh, Hemsby, Kessingland, and Orford Ness. Over the last 20 years, 34 homes have been lost in Happisburgh because of coastal erosion (Geol_128).
- Predicted coastal erosion rates are variable along the east marine plan area coastline. The stretch of coast from Bridlington to Hornsea has high predicted rates of erosion; by 2055, it is predicted that more than 50m of the coastline will have eroded if no active intervention is in place, which is the current method of coastal management. Predicted erosion rates are lower along the stretch of coastline from Great Yarmouth to Lowestoft, with rates falling below 50m (with intervention); hold the line is the current method of coastal management in this area (Geol_129).

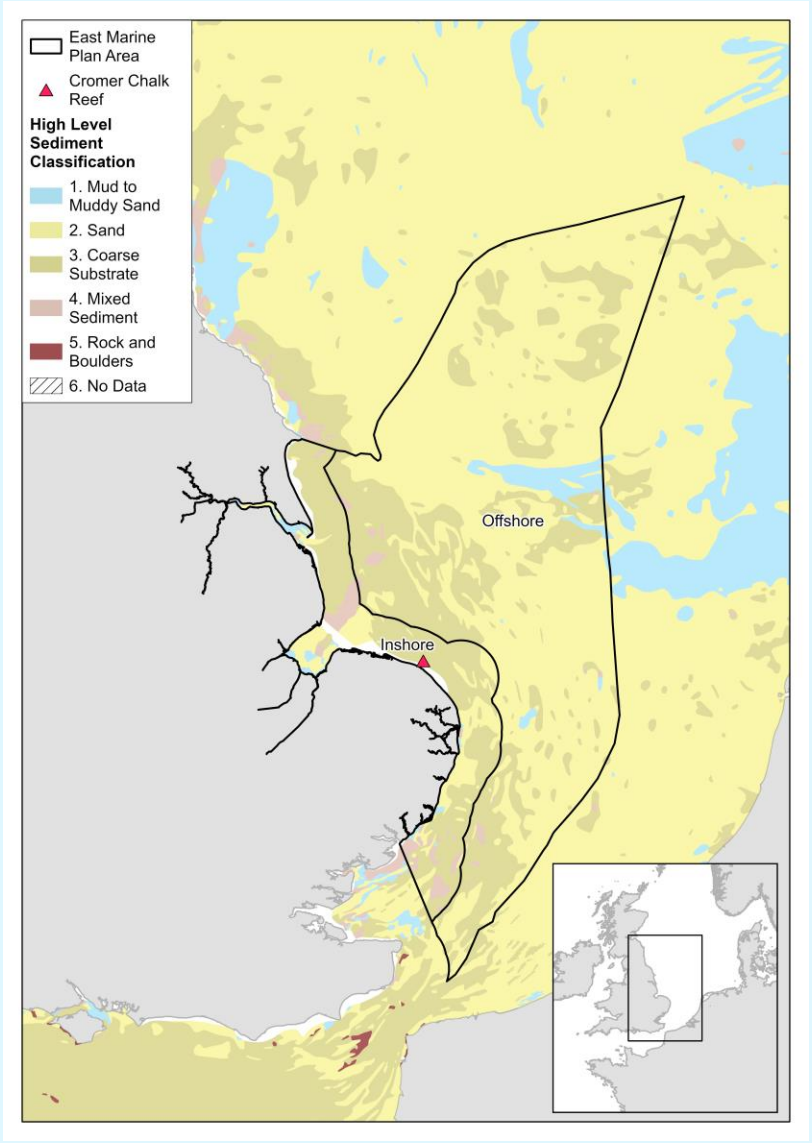


Figure 4: Geology, Substrates and Coastal Processes

Marine Management Organisation

Seascape and Landscape

Seascape and Landscape – Key baseline issues

- 'Seascape' reflects the relationship between people and place and the part it plays in forming the setting to our everyday lives (Landscape_21; Landscape_42). It encompasses landscapes with views of the coast or seas and coasts and their adjacent marine environment with cultural, historical and archaeological links with each other (Landscape_1; Landscape_29).
- A series of marine character areas (MCA) have been identified by Natural England within the east marine plan area:
    - Dogger bank, Dogger Deep Water Channel, East Midlands Offshore Gas Fields, East Anglian Shipping Waters, Holderness Coastal Waters, Humber Waters, East Midlands Coastal Waters, The Wash, Norfolk Coastal Waters and Suffolk Coastal Waters (Landscape_49; Landscape 50; Landscape_55 to 63).
- All marine plan areas have overlapping designations that affect the coast and these include national parks, national landscapes and heritage coasts (Landscape_19) including:
    - national landscapes: Suffolk Coast and Heaths and Norfolk Coast. The Lincolnshire Wolds are adjacent to the plan area (Landscape_51).
    - The Broads National Park (Landscape_52);
    - heritage coasts of Suffolk, North Norfolk, Spurn head and Flamborough Head (Landscape_53)

Seascape and Landscape- Key trend data

- There is a need to effectively balance the need to expand/maintain port and harbour activity with those of the environment and potential social impacts such as on the seascape (Landscape_35)
- East Coast Flyway is on a tentative list of UK sites that are being considered for inclusion on the World Heritage List. If included, this site will be classed as a world heritage site in the next 5-10 years (Landscape_24).
- The Department for Environment, Food & Rural Affairs's new action plan for protected landscapes includes plans to strengthen legislative duties, form a collaborative Partnership for Better Outcomes for People and Nature, boost financial support for protected landscapes and source/provide long term sustainable funding (Landscape_65).

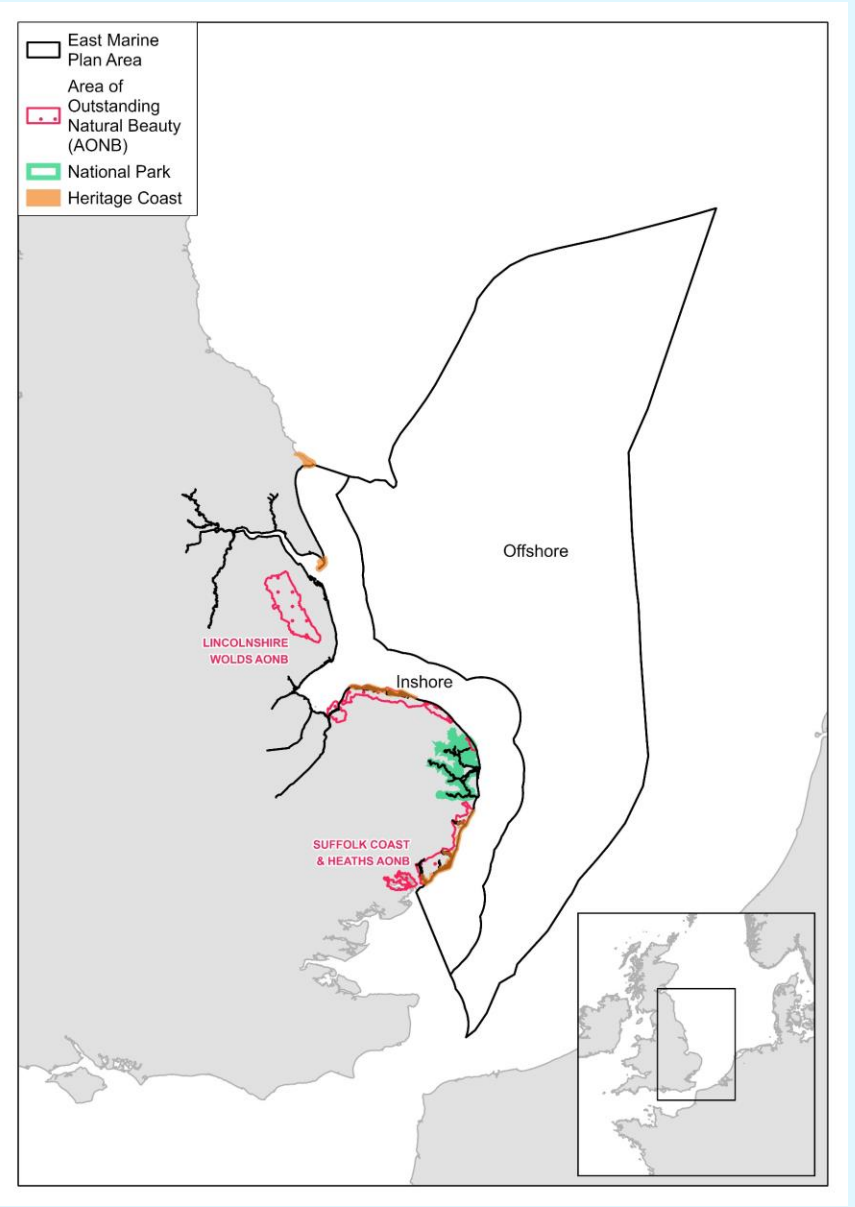


Figure 5: Seascape and Landscape Contains European Environment Agency (EEA), Marine Management Organisation (MMO), Natural England and Joint Nature Conservation Committee (JNCC) Data © EEA, MMO, Natural England and JNCC Copyright and database right 2024. Reproduced with permission of the Marine Management Organisation, Ordnance Survey and UK Hydrographic Survey.

Marine Management Organisation

Water: Tides & Currents; Water Temperature & Salinity

Tides and currents – Key baseline issues

- The east marine plan area has a tidal range of between 1 to 4 m (Water_20).
- Surface currents close to the coast orient north to south; before changing direction off the Suffolk coast to a northerly direction as they meet waters moving northwards through the English Channel. A circular surface current exists off Norfolk over the Dogger Bank sandbanks.
- Water circulation and waves vary on daily to interannual timescales but have shown no significant trend over the past decade (Geol_45).
- At the coast, annual mean significant wave heights in the east marine plan area are 0.75m to 1.25m. Just offshore, these reach 1.5m. Moving further offshore wave heights reach up to 1.75m. In the winter, the wave power is far greater than during the summer (Water_89).
- Surfing is an important sport in the east marine plan area, and it occurs at various beaches in the inshore area. Any pressures that cause hydro- morphological changes could affect the integrity of the surfing breaks (Pol_155).

Tides and currents – Key trend data

- Sea level rise and storminess will impact upon hydrological impacts and could exacerbate the impacts of tides and currents for risk to coastal areas (Water_155).

Water temperature and salinity – Key baseline issues

- For the Southern North Sea in the east marine plan area, salinity is controlled by a balance of freshwater supply from the surrounding catchments in the UK and northern Europe and by changes in the transport of Atlantic origin water through the Dover Strait and from the north. Two stations are available in the southern North Sea, one near Felixstowe (England) and Helgoland (Germany), which both demonstrate high interannual variability, experienced a notably fresh period in the 1980s, and show no clear trend since they recovered to a more typical salinity in the 1990s (Water_75).

Water temperature and salinity – Key trend data

- Sea surface temperature around the UK generally shows a significant warming trend of around 0.3 degrees per decade over the last 40 years. Compared to 1982–1998, the annual number of marine heatwaves increased around the British Isles by an average of four events per year in the period 2000–2016. (Water_95).
- Warming is indicated in all regions during all seasons and in all areas. The UK Climate Predictions 2009 (Lowe *et al.*, 2009) indicate that the seas in all of the UK regions will continue to increase in temperature. In the surface waters, the temperature is predicted to increase by between 1.5-3.5 degrees (relative to the 1961-90) by the 2080s (Water_29).
- There is considerable uncertainty regarding future salinity. Most 21st Century projections suggest UK shelf seas, and the adjacent Atlantic Ocean, will be less saline than present, driven by ocean circulation changes in response to climate change (Water_98).
- Changes to water temperature and salinity could impact commercial fisheries as the range and distribution of many marine species will be affected (Water_42, Biodiv_134), as well as aquaculture due to a rise in disease and infection, and nuisance invasive non-native species. Changes in water temperature may also increase the numbers of people involved in recreational fishing and visitors to coastal area, as well as allow more ships to use Arctic shipping routes with benefits to ports (Water_47).

Marine Management Organisation

Water: Marine Litter

Marine Litter – Key baseline issues

- Marine litter, including (macro) litter, microplastics and nanoplastics, is found across all parts of marine, coastal and estuarine areas, including on the sea surface, in the water column, on the seabed and on beaches (Water_24).
- Marine litter is generated from 80% land-based sources, including sewage related debris and other items disposed of (eg cigarettes, glass, metals, clothes, plastics etc); and 10% discarded fishing gear (eg lost nets) (Water_34).
- Marine litter is comprised mainly of synthetic material and is found in oceanic water and as sediments on beaches (Water_24). Marine litter can accumulate in certain areas dependent upon currents and winds (Water_25), however there has only been limited surveying of this. Other challenges include issues with abandoned lost or discarded fishing gear (Water_11).
- Seabed litter has been surveyed at only a few sites and data is sparse, which limits the possibilities for an assessment of changes in quantities of litter over time or between regions. The available data indicates that there is a generally low, but variable, abundance of litter on the seabed ranging from 0 to 17 items per hectare (Water_45).
- The east marine plan area is believed to hold between 0-49.6 pieces of litter per km2 (Water_80).
- The Great Ouse catchment has generally low levels of microplastic contamination (mean 0.5 MP/m^3), though a small number of samples did have concentrations >5 MP/m^3. The most frequently detected polymers were polypropylene, polyethylene and polyester, with polyester being more prevalent in the smallest size fractions. Tidal river samples tended to detect other polymers more frequently than freshwater river samples. Microplastic concentrations and polymer composition varied considerably over time.
- Amounts of marine litter in the Oslo and Paris Conventions (OSPAR) maritime area remain high, although there has been a statistically significant decrease in plastic litter on beaches in most OSPAR regions and a decrease in floating litter in the North Sea (Water_80).
- The Marine Conservation Society's Beachwatch programme reported that, based upon beaches included in the programme, 35% of litter on beaches came from beach users, 14% from fishing activities and up to 40% of litter items remain unassigned each year, either because they are too small or too weathered to identify a source, or because they could have come from a number of sources. Around 70% of beached marine litter is plastic (Water_18).
- In the UK alone, during its recent Great British Beach Clean the Marine Conservation Society found 718 pieces of litter for every 100m stretch of beach surveyed. Of this, rubbish from food and drink made up at least one fifth (Water_54).
- Over 71% of harbours and marinas surveyed in the UK reported that their users had experienced entangled propellers, entangled anchors, entangled rudders and blocked intake pipes and valves. The total annual cost of removing litter from 34 UK harbours was estimated at approximately £236,000; based on this, it was estimated that marine litter costs the ports and harbour industry in the UK approximately £2.1 million each year (Water_57).
- Compared to shorelines there is less data from the seabed or the sea surface. In the North Sea, data from seabed trawls indicate extensive plastic litter on the continental shelf (Water_60).
- The main risks to marine life include entanglement of, and ingestion by, marine species and transport of non-indigenous species. Impacts have been particularly recognised on marine mammals, seabirds and turtles (Water_44).
- Plastics in seawater are dominated by 6 classes: polyethylene, polypropylene, polyvinyl chloride, polystyrene, polyurethane and polyethylene terephthalate. They are normally synthesised from fossil fuels. Most marine litters that are plastics are made of polyethylene and polypropylene (Water_40).
- It is estimated that 1.3 million tonnes of microplastics enter our ocean every year, 11% of the overall amount (Water_90).
- Studies estimate that micro particles from tyres make up 5-10% of microplastics deposited in the oceans, with well documented impacts for marine wildlife and the food chain (Water_52).

Marine Management Organisation

Water: Marine Litter

Marine Litter – Key trend data

- Levels of marine litter are considered problematic in all areas where there are systematic surveys of beached litter density. It is thought that beached litter density has almost doubled between 1994 and 2007 (Water_17).
- Microplastics in seawater in eastern Atlantic and the North Sea have been measured between 0.01 to 0.32 cm3/m3, however there are no reliable estimates. Even if all sources of plastic were to immediately stop, the number of microplastics would continue to increase due to fragmentation (Water_40).
- It is predicted that there will be a 3-fold increase in the amount of plastic in the sea between 2015 and 2025, with the full implications still unknown (Water_61).
- The UK has not achieved its aim of Good Environmental Status for marine litter. Measures to tackle marine litter need longer to take effect (Water_73).

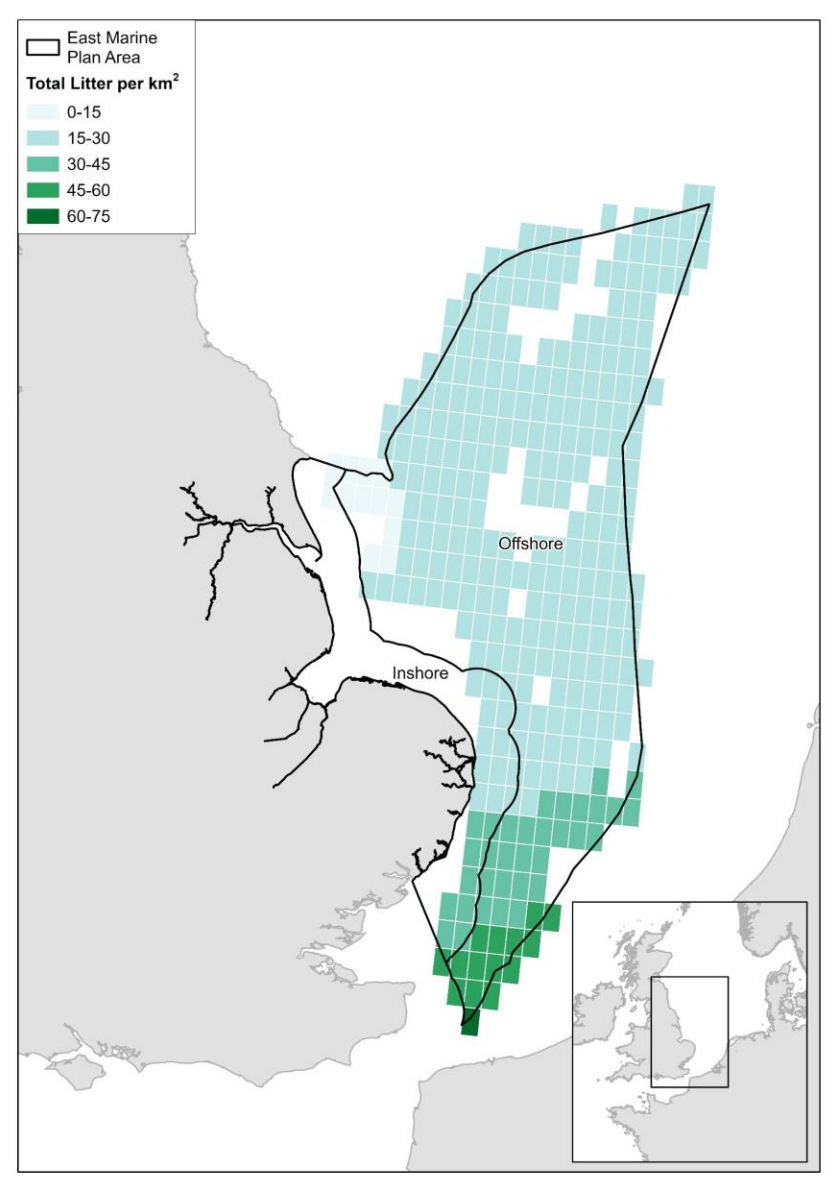


Figure 7: Marine Litter

Marine Management Organisation

Communities, Health and Wellbeing

Communities, Health and Wellbeing – Key baseline issues

- The maritime industry reported that the sector supported 220,000 jobs in 2017 (Communities_106).
- Approximately 3,151 direct UK jobs have been created in the manufacturing, construction, operation and maintenance of offshore wind turbines. An estimated 7,000 indirect jobs have also been created along the offshore wind supply chain (Commuities_29, Communities_30, Communities_32).
- Coastal areas provide physical health and wellbeing benefits to communities through coastal walking and outdoor swimming (Communities_34, Communities_59), as well as mental health and wellbeing benefits (Communities_59). There are 4 areas of heritage coast in the east marine plan area for people to explore, these being Suffolk, North Norfolk, Spurn head and Flamborough Head (Cultural_85).
- Coastal communities have aging populations. In 2020, 23.8% of the population in large seaside towns were aged 65 or over, and 29.6% of the population in smaller seaside towns (Communities_68).
- Many coastal communities comprise sizeable or growing numbers of older people with significant care needs. This places an increased demand on health and social care services. Increasing likelihood of more frequent and more severe extreme weather events and coastal flood risk due to climate change may mean health, social care and emergency services lack the resilience to cope with demands when a major flood or other extreme weather event occurs (Communities_36).
- Health and wellbeing issues are more prevalent in coastal communities (Communities_7, Communities_17, Communities_96).
- Deprivation (including income, education and employment) is more prevalent in coastal communities, such as Hessle and North Ferriby (Communities_8, Communities_14). In the UK, two in every three (67%) of the coastal towns are in the higher income deprivation category compared with just over one in every three (36%) non-coastal towns. Along the east coast of England (encompassing the regions of East of England, East Midlands, Yorkshire and The Humber and North East) the share of coastal towns in the higher income deprivation category is particularly high at 85% (39 towns out of 46) (Communities_113).
- Jobs numbers have grown in coastal economies. Job security and pay is variable however and is dependent on the coastal sector. For example, jobs related to the tourism economy tend not to be well paid and are frequently part time (Communities_15), whereas jobs relating to the net zero economy tend to be higher paid and more productive (Communities_119).
- There is a need to encourage training, skills and education to improve employment prospects and understanding of environmental issues in the marine environment (Communities_71).
- Access to estuarine, coastal and marine areas, both physical (adequate footpaths and slipways) and interpretative (signage, information boards) in the east marine plan area is spatially variable. For example, along the east marine plan area coastline the King Charles III England Coast Path from Cromer to Great Yarmouth is open and accessible, however the path from Lowestoft to Felixstowe it is not yet open, creating accessibility issues in this area (Economy_313). The Broads Authority has created an integrated access strategy to improve access links between land and water areas, and local facilities and visitor destinations (Communities_121).
- Improvements to coastal access links should also help to relieve pressure on internationally designated sites and improve recreational opportunities (Communities_121).
- Plan-making should support strong and healthy communities and living environments which: make physical activity easy to do; supports the reduction of health inequalities; considers the local health and wellbeing strategy; and encourages healthy lifestyles including opportunities for sport and recreation (Communities_37, Communities_73). Plan making should also aim to achieve a balance between the costs and benefits that tourism brings to coastal communities, such as increased revenue, infrastructure development, protection of the natural environment, second home ownership, house prices, community cohesion, character, population structure and control of tourism development (Communities_38).
- There is a need to support coastal communities, through enhancement of existing local employment opportunities and or diversification into new and emerging activities. This should include maximising the existing skills and knowledge and providing integrated terrestrial marine diversification opportunities (Communities_78). For example, improvements in digital connectivity can capitalise on changing nature of work (eg working from home/hybrid working) to make coastal living more attractive to young professionals (Communities_120).
- Three Local Enterprise Partnerships are adjacent to the east marine plan area (Communities_25).

Marine Management Organisation

Communities, Health and Wellbeing

Communities, Health and Wellbeing – Key trend data

- In 2020, 336.5 people were employed within the British marine aggregates industry. This has reduced since 2014, when 408.5 people were employed. Numbers of office staff in 2020 were 56.5 representing a 5% reduction compared to 2019 (59.5). Sea staff have reduced from 351 in 2014 to 280 in 2020. (Communities_26, Communities_27).
- In 2022, over 32,000 people were employed within the offshore wind industry across the UK. Over 17,000 of these were considered as direct employment (solely in offshore wind), and almost 15,000 as indirect employment (supply chain companies which manufacture products for the offshore wind industry as well as goods for other sectors). With reference to the nine official regions of England, the east marine plan area falls into the Yorkshire and Humber region, Midlands region and East of England region, which combined account for 24.6% of these jobs.
- It is estimated that the offshore wind industry will employ 104,400 people in the UK (56,300 direct jobs and 48,100 indirect jobs) by 2030.
- The Carbon Trust has estimated that there could be as many as 68,000 UK-based marine renewables (wave and tidal) jobs by 2050 (Communities_108).
- There are existing issues of isolation of coastal towns due to lack of infrastructure, transience and ageing populations. Deprivation relating to income and employment in coastal communities may continue in the future. However, efforts are being made to address these issues through the funding of projects via the Coastal Community Fund.
- The Coastal Communities Fund Round 5 awarded £50.8m funding to 47 projects across England, with the east of England being awarded just under 10% of this across 5 projects. Greater Lincolnshire Local Enterprise Partnership was awarded £370,000 for the Future Proofing Coastal Tourism Sector project. King's Lynn and West Norfolk Borough Council was awarded £679,047 to enhance existing facilities and create more opportunities for leisure craft. Southwold Town Council was awarded £995,000 to deliver new office space (the Enterprise Hub) for small and micro businesses. Suffolk County Council was awarded £414,763 for a comprehensive Heritage Activity and Events Programme, focused on Suffolk's historical archives. Suffolk Coastal District Council was awarded £950,000 to construct an iconic café and restaurant destination on Felixstowe's South sea front. (Communities_51-56).

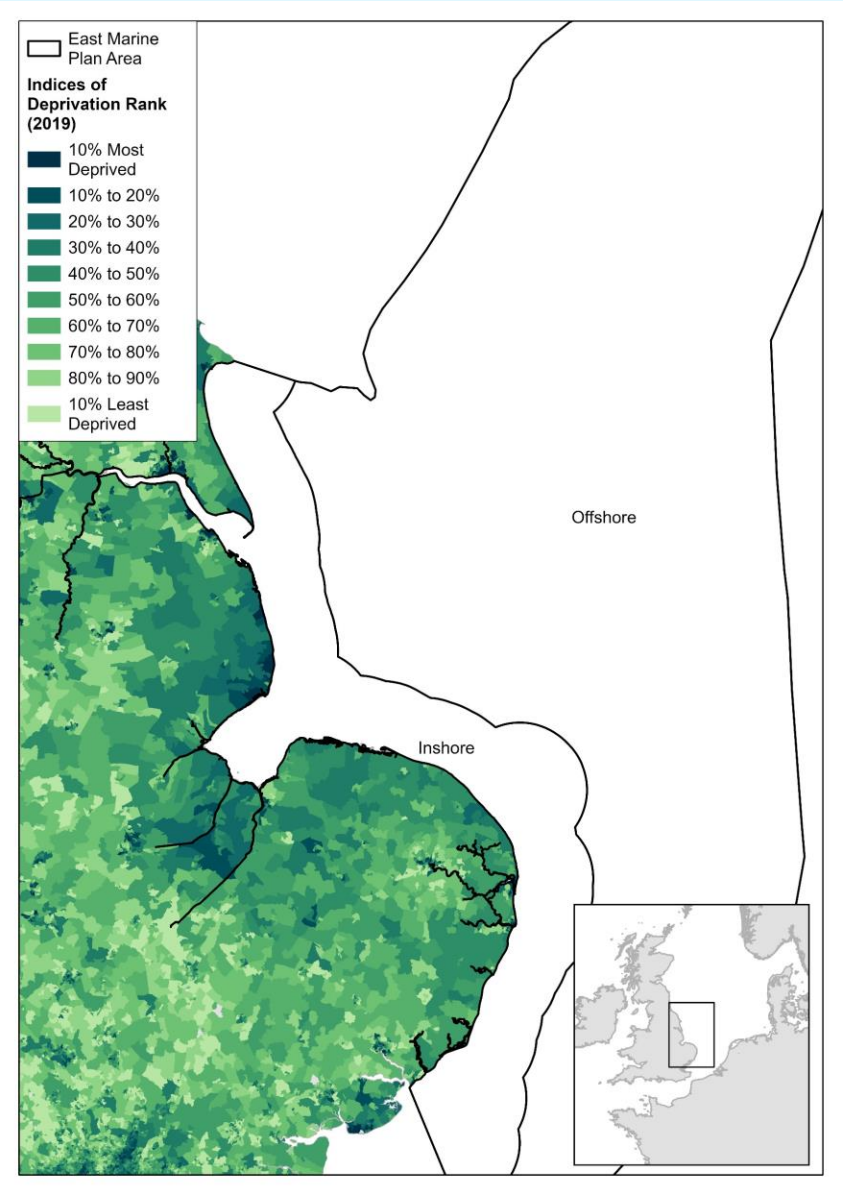


Figure 8: Communities, Health and Wellbeing

Marine Management Organisation

Economy: Ports and Shipping

Ports and Shipping – Key baseline issues

- The UK port industry is the second largest in Europe, handling almost 500 million tonnes of freight each year, as well as over 60 million international and domestic passenger journeys. The UK ports sector is also estimated to directly employ around 101,000 people (Economy_124).
- The east marine plan area has 66 ports, which account for 12% of all English ports (Economy_121).
- There are 53 major ports in the UK, of these 6 are in the east marine plan area: Goole, Rivers Hull and Humber, River Trent, Hull, Felixstowe, Grimsby and Immingham. Of these major ports, Felixstowe and Grimsby and Immingham are regularly classed as some of the busiest ports in the UK (Economy_119).
- The east coast ports of the Humber and the Wash provide clear corridors of vessel activity. Routes into the North Sea connect to the Baltic states and ferry routes connect to the Netherlands from the Humber (Economy_128).
- Maritime 2050 aimed to establish 10 freeports as national hubs for global trade and investment across the UK, to promote regeneration, for job creation and as hotbeds for innovation (Economy_332). Two of these freeports have been developed completely or partially within the east marine plan area: Humber Freeport and Freeport East (Felixstowe and Harwich) (Economy_410).
- In 2022, the total tonnage of freight moving through major UK ports was 458.9 million tonnes, a 5% decrease relative to 2019 (Economy_241).
- Environmental impacts from the ports and shipping sector can be through accidental pollution from ships in the course of navigation or lawful operations, pollution caused by unlawful operational discharges by ships, such as oil, waste or sewage, or physical damage caused by groundings or collisions. Other pressures on the environment from shipping and ports relate to noise, airborne emissions and the introduction and spread of non-indigenous species (transported on the hulls of ships or in ballast water) (Economy_160).
- Shipping is an essential and valuable economic activity for the UK. There are significant movements of ships around the UK coast and into and out of UK ports serving the UK's economic interests. As highlighted by the 2011 Marine Policy Statement, there are also significant levels of passing traffic, for example through the English Channel and other ships freely using the navigable seas adjacent to the UK (Economy_161).
- Non-International Maritime Organization designated navigation routes are not fixed. For a number of reasons, navigation routes will vary in both position and traffic density over time. A particular navigation route that might be identified as a constraint during the planning-phase of an offshore windfarm could become redundant by the time that development would be due to progress into the offshore construction-phase (Economy_318).
- Red-throated divers (*Gavia stellata*) are sensitive to non-physical (noise and visual) disturbance by both commercial and recreational activities including, but not limited to, shipping. It is found that the larger the vessel, the greater the expected disturbance distance (Biodiv_573).

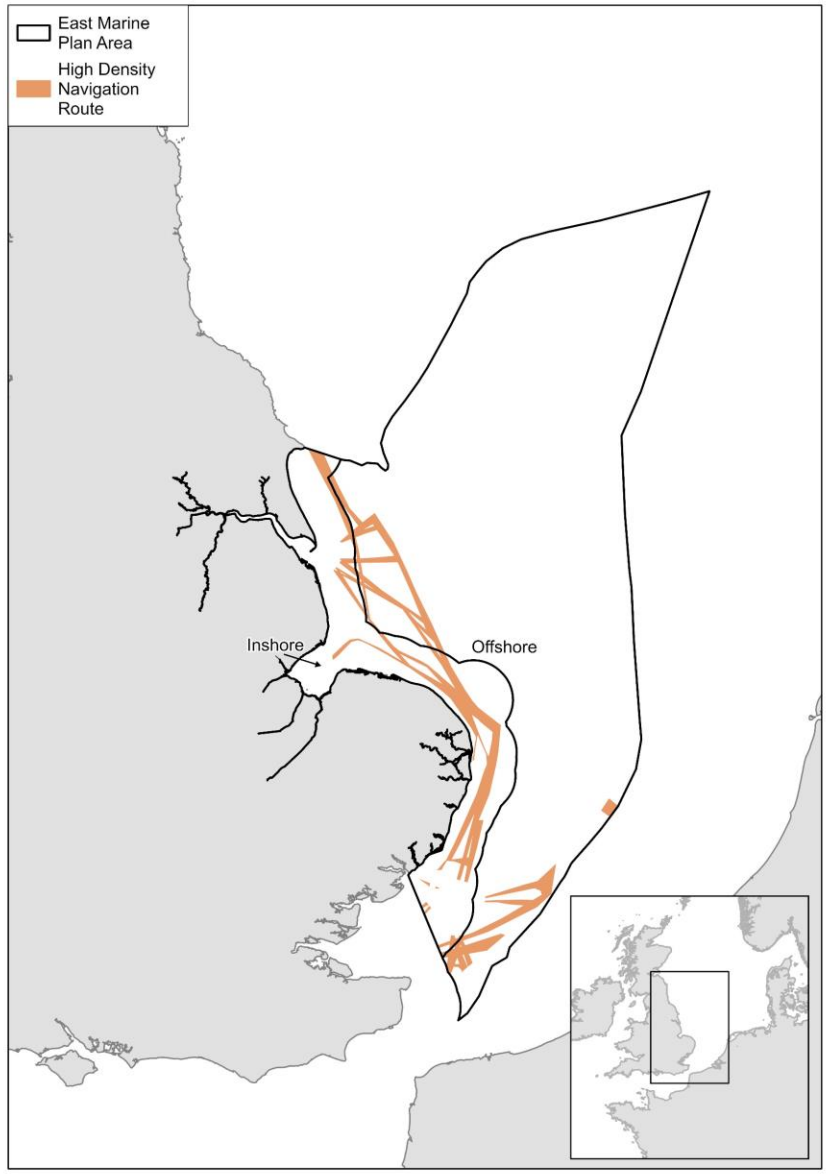


Figure 9: Ports and Shipping

Marine Management Organisation

Economy: Ports and Shipping

Ports and Shipping – Key issues trend data

- There are plans for several thousand offshore wind turbines in farms of ever-increasing size and increasing numbers of wave and tidal energy installations. There are also an increasing number of aquaculture sites and a trend towards establishing such sites in deeper water than was traditionally the case. These developments, as well as the restrictions associated with areas designated for marine conservation, will add further complexity to our already challenging coastal waters. As highlighted in 2030 - Navigating the Future (General Lighthouse Authorities, 2018), over the period of this strategy there is likely to be a continuing reduction in available sea room and the various national marine spatial plans around the United Kingdom are likely to further influence the free movement of shipping. These many factors are increasing the pressure on shipping and mariners and constraining the sea area available (Economy_306).
- Ports have a vital role in the import and export of energy supplies, including oil, liquefied natural gas and biomass, in the construction and servicing of offshore energy installations and in supporting terminals for oil and gas pipelines. Port handling needs for energy can be expected to change as the mix of our energy supply changes, particularly as renewables play an increasingly important part of our energy supply. Ensuring security of energy supplies through our ports will be an important consideration and ports will need to be responsive both to changes in different types of energy supplies needed (and to the need for facilities to support the development and maintenance of offshore renewable sites) and to possible changes in the geographical pattern of demand for fuel, including with the development of power stations fuelled by biomass within port perimeters.
- Smart ports will be a critical part of the smart cities to which they belong, reducing polluting emissions from UK ports, and generating new business opportunities for the UK's port operators. By 2050, ports will be multi-modal, connected, intelligent distribution hubs, playing a major role in growing the UK's technological expertise and manufacturing capability alongside their historic role in supply chains (Economy_279).
- The proposed green shipping corridor route that passes from Antwerp-Montreal is likely to pass through the east marine plan area (Economy_423).

Marine Management Organisation

Economy: Fisheries and Aquaculture

Fisheries and Aquaculture– Key baseline issues

- In 2022, the UK fishing industry comprised 5,541 fishing vessels, of which 4377 were under 10m in length (targeting inshore stocks) and 1,163 were over 10m in length (targeting inshore and/or offshore stocks) (Economy_236).
- The majority of marine aquaculture consists of shellfish farming, particularly mussels and pacific oysters (*Crassostrea gigas*). Other species include scallops and native oysters (*Ostrea edulis*) (Economy_103, Economy_104).
- In 2021, demersal fish accounted for 21% of the total value of UK fish catches, while shellfish and pelagic fish accounted for 19% and 60% respectively (Economy_327).
- The east marine plan area contains around 115 main seafood processing hubs, focused across the Humber and East Midlands (Economy_417).
- There are 15 registered shellfish production sites located in the east inshore area (Economy_107). This equates to 9.1% of the east inshore marine plan area being utilised for shellfish production. No areas of the east offshore marine plan are used for shellfish production (Economy_105).
- Hull and the Humber have the greatest number of fish processing units in England, employing over 3000 people (Economy_118).
- Fishing appears to be most important in Bridlington and Grimsby when considering historical and current fishing communities (Communities_48).
- Interactions between fishing activity, marine developments, and their consequent impacts on fish stock and the environment are complex and need to be considered in marine planning (Economy_198).
- A complex, unclear and challenging marine licensing process has been stated as a significant barrier for new aquaculture developers (Economy_421).
- MSPACE modelling analyses identify climate change refugia, areas where resilience to climate impacts are found. These areas are limited in extent but could be capitalised upon as part of climate smart planning for conservation, fisheries and aquaculture (Economy_462).
- Instances of poor water quality from increased storm events and the use of combined sewer overflows is having an impact on shellfisheries (Economy_464).

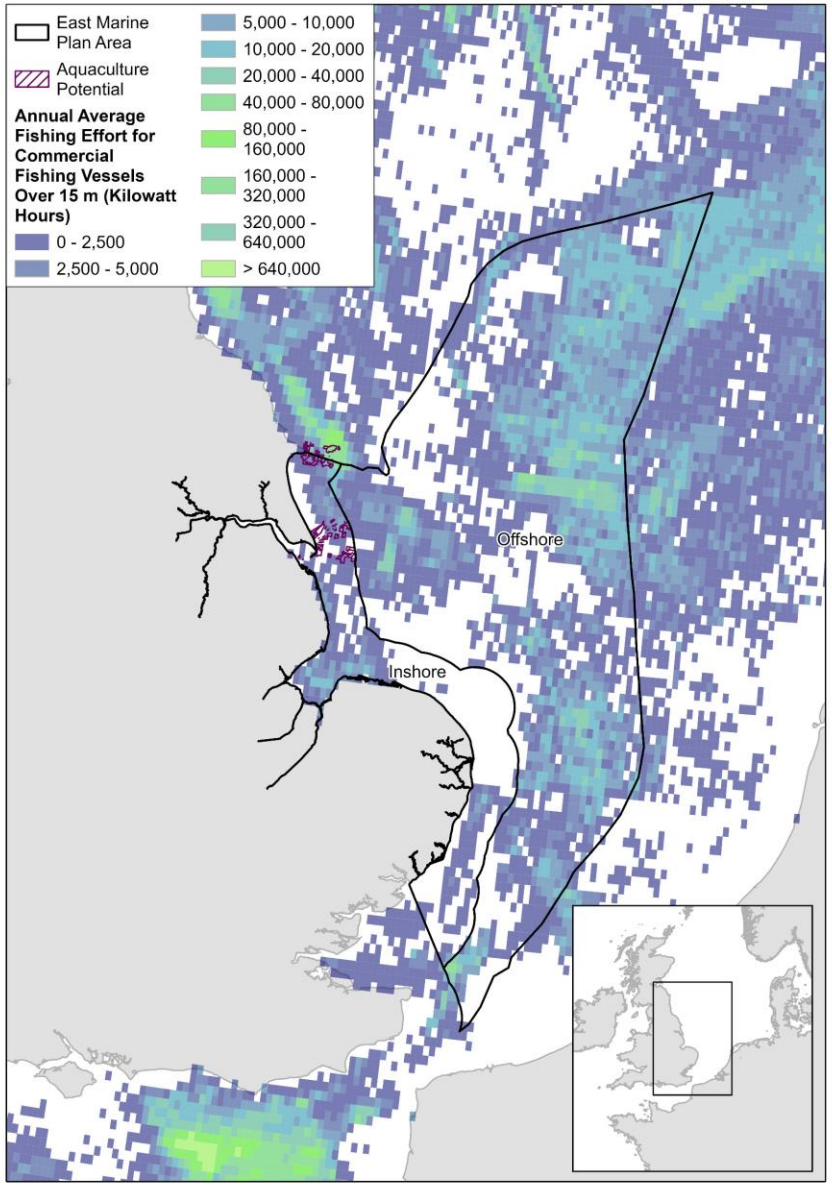


Figure 10.1: Fishing and aquaculture

Marine Management Organisation

Economy: Fisheries and Aquaculture

Fisheries and Aquaculture– Key trend data

- At the national level, recent trends in aquaculture production in England have been static or declining (Economy_217).
- In 2022, UK vessels landed 640,000 tonnes of sea fish with a value of £1.04 billion. Compared to 2021, this is a decrease of 2% in quantity, however an increase in value of 13%. The increase in value is mainly driven by higher fish prices (Economy_327).
- Landings into the UK by foreign vessels in 2022 was 19,000 tonnes, which compared to 2021 represents a 4% reduction (Economy_327). Non-UK fleet fishing includes Dutch, Danish, French, and Belgian vessels (Economy_111).
- Landings abroad by UK vessels also decreased to 245,000 tonnes, a reduction of 5% (Economy_327). Demersal fish accounted for 21% of the total value, while shellfish and pelagic fish accounted for 19% and 60% respectively.
- In 2022, 10,000 people across the UK were employed as fishermen. This is a reduction of 2,100 fishermen in the last ten years. There has been a further 3% decline in the number of fisherman, between 2021 to 2022 (Economy_236).
- Seafood 2040, predicts that seafood consumption could increase by 75% by 2040, from 1.15 portions to 2 portions per person per week. This could create £4.6bn in additional sales (Economy_307).
- Declines in fisheries due to overfishing and the implementation of the quota system under the Common Fisheries Policy (CFP) has made fishing as a livelihood and way of life difficult in recent years (Communities_40).
- Under climate change scenarios sea temperature rise and changes in fluvial inputs may increase frequency of occurrence and concentration of marine pathogens or harmful algal blooms in shellfish, leading to economic losses (Economy_187).
- The UK has achieved its aim of Good Environmental Status for contaminants in seafood (Economy_413). Concentration of specified contaminants in fish and other seafood caught or harvested for human consumption in UK seas do not exceed safety levels set in Regulation (EC) No 1881/2006 (Economy_385).
- Allocated zones for aquaculture have been suggested for use within the aquaculture industry, whereby zones are designated for aquaculture use and developers bid for the space, rather than the current policy of having more passive areas that have been identified as potentially suitable (Economy_422).
- There are possibilities for the co-location of industries, such as multi-trophic aquaculture (salmon (*Salmo salar*) and shellfish such as mussels), new aquaculture systems and restoration of species (eg seaweed, seagrass, native oysters (*Ostrea edulis*)), and with marine energy installations. Unsustainable aquaculture management and increasing competition for space may create impacts with other industries (Economy_164).
- The English Aquaculture Strategy aims to achieve a ten-fold increase in aquaculture production volume to around 90,000 tonnes by 2040. Planned growth included mussels, which aims to achieve an eight-fold increase in production volume. There is large growth planned for macroalgae, however as this is a very new industry, limited knowledge is currently a barrier to achieving significant growth (Economy_428).

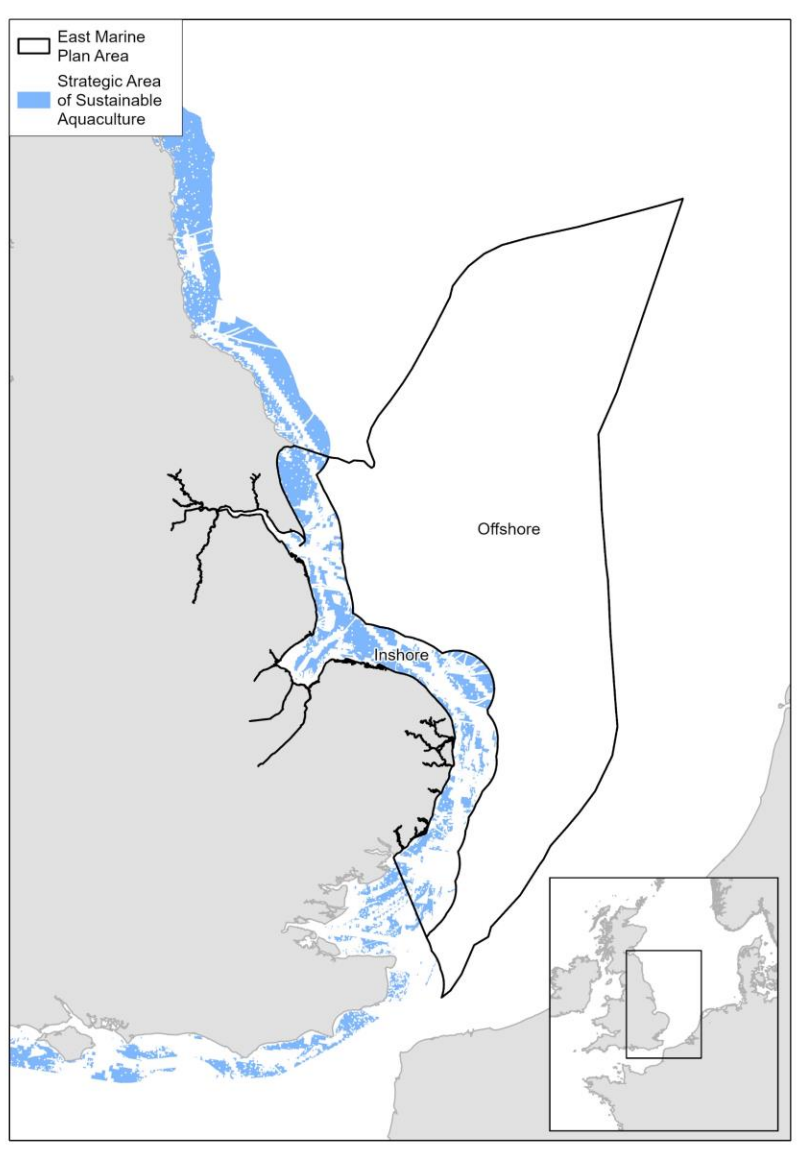


Figure 10.2: Fishing and aquaculture Please note, some of the areas not classed as strategic areas of sustainable aquaculture contain existing marine infrastructure.

Marine Management Organisation

Economy: Leisure/Recreation and Tourism

Leisure/Recreation and Tourism – Key baseline issues

- In 2019, coastal tourism across the UK supported some 210,000 tourism related jobs (Communities_107).
- Participants in marine and marine-related coastal recreation activities are estimated to spend £6.25 billion per annum in coastal economies of the UK. The most significant expenditures are associated with coastal walking (£2.3 billion), leisure time at the beach (£2.3 billion), sea angling (£0.6 billion) and boating activities (£0.5 billion) (Economy_258).
- The UK leisure, superyacht and small commercial marine industry is now comprised of nearly 6,300 marine businesses and generated an estimated £3.4bn across all sectors between 2020 and 21, directly contributing over £1.24bn of gross value added (direct) to the UK economy and supporting over 36,000 employees (Economy_112).
- Recreational marinas in the east marine plan area include Brentford Dock, Brundall, Burgh, Great Yarmouth, Hoo, Royal Norfolk and Southwold, Suffolk, Tidemill, Waveney River, and Wisbech (Economy_149).
- The east marine plan area includes a number of Royal Yachting Association marinas, and general recreational boating areas (including cruising routes, sailing areas and racing areas); these extend through to the offshore area (Economy_147).
- The sea can provide a variety of tourism and recreational opportunities including visiting the beach, walking, pleasure boating, sailing, recreational diving (including diving on wrecks), sea angling, kayaking and surfing, as well as exploration of underwater and coastal heritage assets. The coast also provides inspiration for a range of artistic and cultural activities and food-based tourism. There is also growing interest in eco-tourism and wildlife experiences. All these activities can generate a considerable amount of income for the economy and can be a mainstay for many coastal towns, supporting their quality of life. These activities will be enhanced by a well-managed and healthy marine environment, attractive and well-maintained beaches, seashore and clean bathing water (Economy_171).
- Instances of poor water quality from increased storm events and the use of combined sewer overflows is having an impact on leisure and tourism on the coast by making the conditions for activities such as scuba diving unsuitable (Economy_185).
- The east coast of England was the third most visited coast in the UK in 2019. The south west coast was most popular with 39.4% of visits, followed by the south east with 22.1% of visits, and then the east with 11% (Economy_252).
- The King Charles III England Coast Path is a new national trail officially opened in areas of the coastline in 2020. This is the world's longest managed and waymarked coastal path in the world, stretching for almost 3,000 miles/5,000 kilometres. The following sections are open to the public (as of March 2024): Tilbury to Southend-on-Sea; Southend-on-Sea to Wallasea Island; Burnham-on-Crouch to Maldon; Maldon to Salcott; Hopton-on-Sea to Sea Palling; Sea Palling to Weybourne; Hunstanton to Sutton Bridge; and Cromer-Great Yarmouth (Economy_313).
- In 2019, coastal tourism made an important contribution to overall tourism in England. It supported some 210,000 tourism related jobs and contributed £13.7bn to the economy (Economy_170).
- Tourism can offer a number of benefits and costs to individuals and local communities. There is a need to achieve a balance between the costs and benefits that tourism brings to coastal communities, such as increased revenue, infrastructure development, protection of the natural environment, second home ownership, house prices, community cohesion, character, population structure and control of tourism development (Communities_38, Communities_89).

Marine Management Organisation

Economy: Leisure/Recreation and Tourism

Leisure/Recreation and Tourism – Key trend data

- The COVID-19 pandemic had a significant impact on coastal tourism. Pre-pandemic there was an estimated £13.7 billion annual tourism spend. In 2020, there were only 95m trips and day visits leading to a £7.64bn loss in tourism spend. In 2021, there were only 44m trips and day visits (-23% on pre-pandemic), leading to a £5.15bn loss in tourism spend (Economy_257).
- In the marine and leisure sector, there is continued opportunity for growth in 'blue tourism' but this will require requisite infrastructure: at marinas to drive commercial endeavours; more widely to develop training facilities to allow mariners to learn new skills; at harbour fronts and in coastal communities to facilitate other recreation activities such as powerboating, surfing and sailing; and general improvements to access to nature in order to support businesses (Economy_281).

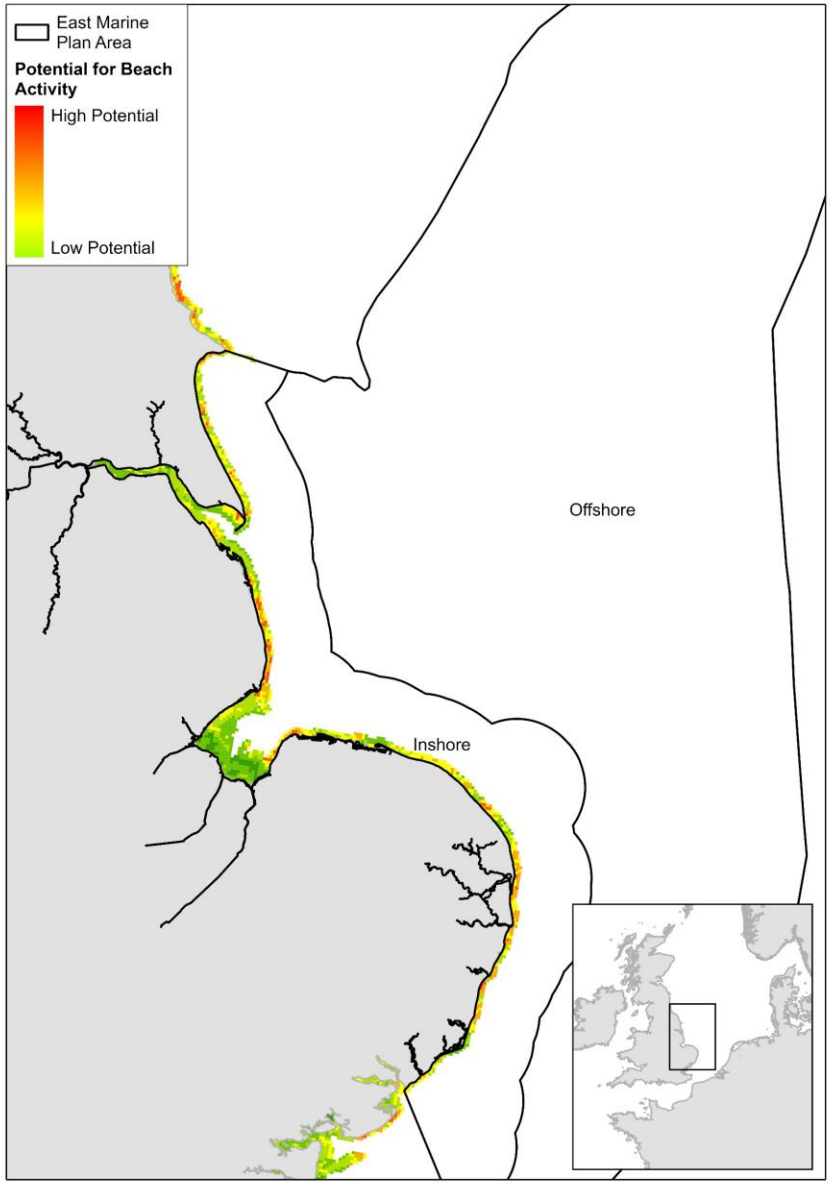


Figure 11: Leisure, recreation and tourism

Marine Management Organisation

Economy: Marine Manufacturing and Seabed Assets

Marine Manufacturing and Seabed Assets – Key baseline issues

- The marine manufacturing sector encompasses marine systems, equipment, design, manufacturing, engineering and architecture. The UK's marine manufacturing sector is recognised globally for its skills and expertise in building naval vessels and submarines, high-end leisure ships, marine equipment systems for international shipping and autonomous systems (Economy_415).
- As of 2022, the UK has 7,440 MW of interconnection with other nations. In 2021, electrical imports came from France (52.7%), Belgium (24.3%), the Netherlands (15.1%), Norway (4.8%) and the Republic of Ireland (3%). The majority of the UK's exports were to the Republic of Ireland (58.9%), followed by France (35.5%), Belgium (3.3%), and the Netherlands (1.9%) (Economy_223).
- The length of cable in the east marine plan area is 617km in the inshore and 2304km in the offshore (Economy_101)
- The length of pipelines in the east marine plan area is 358km in the inshore and 1832km in the offshore (Economy_102).
- Submarine telecommunication cables carry more than 95% of the world's international traffic including telephone, internet and data, as well as many services for the UK's local communities, major utilities and industries. The transatlantic cables landing in the UK carry more than 70% of Europe's transatlantic internet traffic (Economy_135).
- The UK Government has established a new offshore electricity transmission regime to help ensure that the substantial investment required to connect offshore generation projects to the onshore grid is delivered in a cost-effective manner to maximise the benefits to consumers and renewable energy developers. In addition, potential new sub-sea cabling to reinforce and better connect certain sections of the onshore grid is a key part of supporting the growth of renewable and low carbon generation (Economy_136).
- The east marine plan area has ship repair industries, for example in Lowestoft (Economy_143).
- Current major cable landfall sites present in the east marine plan area include Bacton, Theddlethorpe and Easington (Economy_142).
- The Viking Link interconnector was made live at the end of 2023. The interconnector connects the British electricity network to Denmark and at full capacity can transport enough electricity to power up to 2.5 million UK homes (Economy_418).

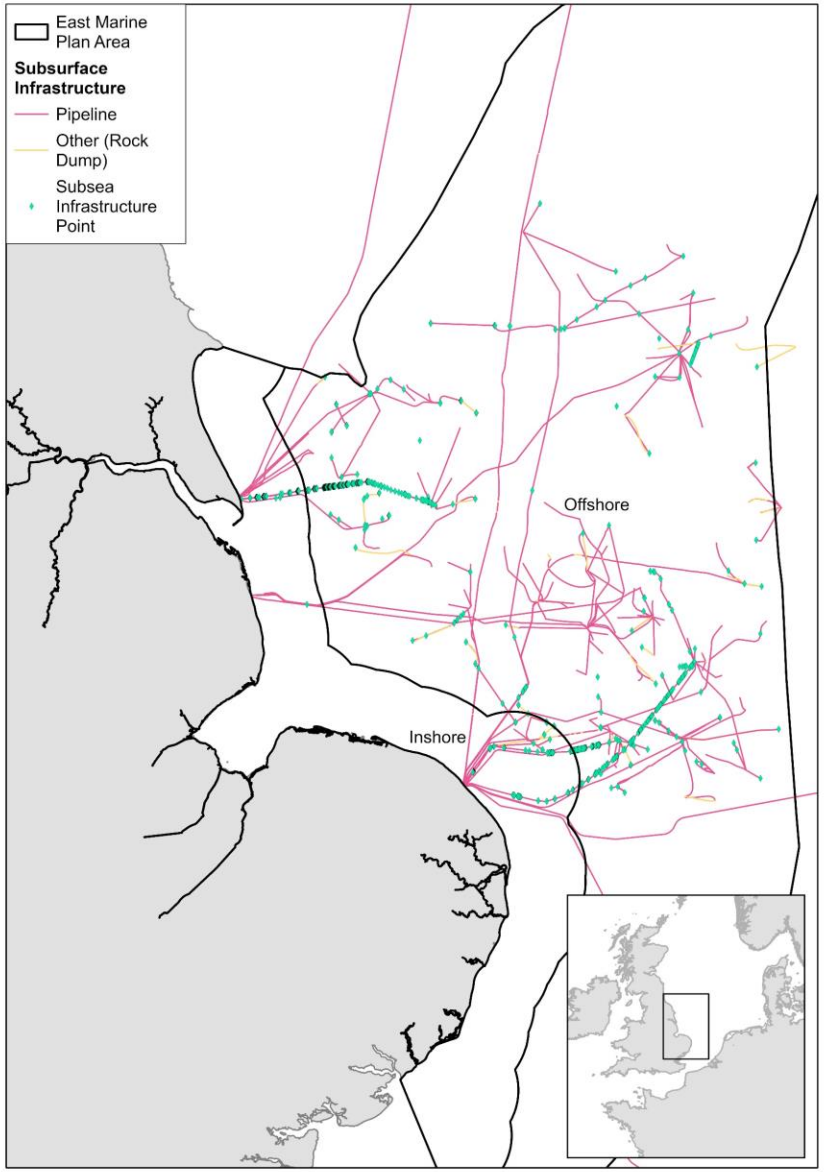


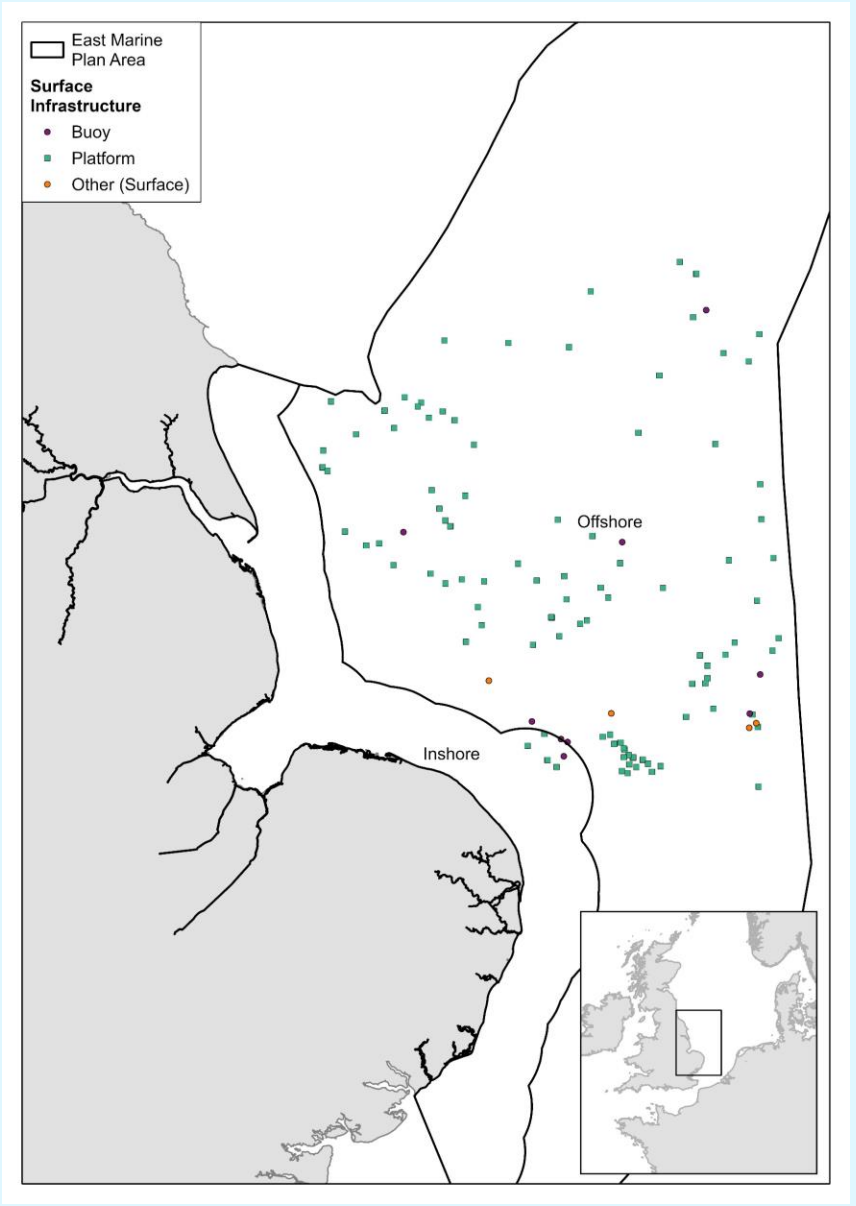
Figure 12.1: Seabed assets (Subsurface) Contains European Environment Agency (EEA), Marine Management Organisation and The Crown Estate Data © EEA, MMO and The Crown Estate Copyright and database right 2024. Reproduced with permission of the Marine Management Organisation, Ordnance Survey and UK Hydrographic Survey. Contains Public Sector Information licenced under the Open Government Licence V3.0 and data licenced under The Crown Estate Public Data Licence V1.0' '

Marine Management Organisation

Economy: Marine Manufacturing and Seabed Assets

Marine Manufacturing and Seabed Assets – Key trend data

- Between 2010 and 2021, electricity imports to the UK increased almost ten-fold to 28.7 TWh, while electricity exports remained broadly level with exports of 4.2 TWh in 2021. Since 2010, electricity imports' share of the UK's electricity supply has increased, up from 2% in 2010 to 9.1% in 2021. In 2020, the Government set an ambition of 18 GW of interconnector capacity by 2030, with new interconnectors set to connect the UK to Germany and Denmark (Economy_222).
- On a UK-wide level, interconnector capacity is forecast to increase. This suggests that the growth in renewable energy generation and the increase in interconnection capacity could result in the UK becoming a net exporter of electricity by the end of this decade with significant increases in exports and reductions in imports by 2030 (Economy_224).



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Marine Management Organisation

Economy: Aggregate Extraction / Defence

Aggregate Extraction– Key baseline issues and trend data

- Marine sand and gravel extraction makes a crucial contribution to meeting the nation's demand for construction aggregate materials (Economy_138). In 2023, 18.8 million tonnes of marine sand and gravel were produced in total, of which 13.5 million tonnes was landed in England and Wales for construction (Economy_384).
- Land-based and marine-based construction aggregate resources are unevenly distributed, and many regions are heavily dependent on supplies from other areas (Economy_167). Over half of the extracted marine-won aggregate by weight comes from the east marine plan area (Economy_108).
- Three production regions exist within the east marine plana area, these are the East Coast, Humber and Outer Thames. These regions account for 29 dredging licenses and 3 dredging applications. These licenses allow 18.35 million tonnes to be extracted annually. The applications could increase the permitted tonnage by 1.65 million tonnes if approved. Material dredged from production licences in the east marine plan area is delivered to wharves in Humber, Ipswich, the Thames River, Blyth, Tyne and Tees (Economy_375).
- The east marine plan area contains 660km2 of licensed extraction area, of which 63.9km2 was dredged in 2022 (Economy_97).
- In 2019, 12,074,000 tonnes of aggregate and aggregate minerals were sold in the east marine plan area (Economy_98). This included limestone/dolomite and sandstone aggregate minerals (Geol_109).
- There is the potential that overall marine aggregate demand in England, Wales and Scotland will increase to 323 million tonnes per year by 2035. Any significant increase to aggregate extraction will be dependent upon adequate port infrastructure to support any increases (Economy_456).
- One method to help manage coastlines and to protect or restore estuarine and coastal habitats is to use sediment that is dredged from the seabed. To make this change will require more active strategic planning, with more integrated management and licensing processes, at the national, regional and local scales. (Economy_455).

Defence– Key baseline issues and trend data

- Defence activities that utilise the marine environment, directly or indirectly, in support of operational capability are diverse but include operational vessels and aircraft, His Majesty's naval bases, surface and sub-surface navigational interests, underwater acoustic ranges, maritime exercises, amphibious exercises, coastal training ranges and coastal test and evaluation ranges (Economy_139).
- Sea training is carried out within defined military practice and exercise (PEXA) training areas. PEXA covers 15% of the east inshore area and 46% of the east offshore area (Economy_95).

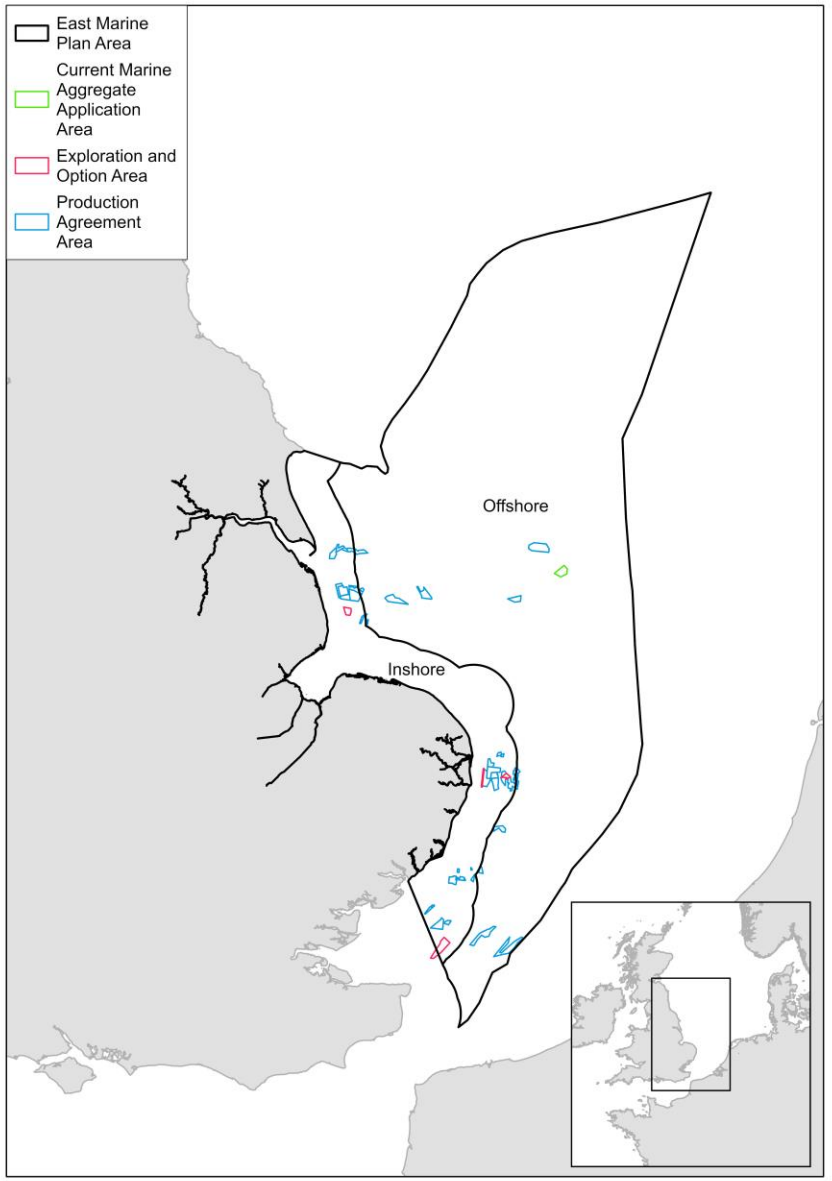

Figure 13: Seabed assets

Economy: Energy Generation and Infrastructure Development

Renewables – Key baseline issues

- The east marine plan area supports over 50% of England's current offshore wind capacity (Economy_383).
- The east marine plan area has the following operational offshore wind farms: Scroby Sands (60MW), Greater Gabbard (504 MW), Galloper (353MW) East Anglia ONE (714 MW), Sheringham Shoal (317 MW), Humber Gateway A (219 MW), Centrica (Lincs) (270MW), Race Bank (570MW), Inner Dowsing (97.2MW), Lynn (97.2MW), Westermost Rough A (210MW), Triton Knoll (857MW) and Dudgeon (402 MW). Extensions are being carried out on Sheringham Shoal and Dudgeon (Economy_114). The Hornsea Development Zone is in the east offshore area. Hornsea 1 (1218MW) and Hornsea 2 (1320 MW) are operational, with Hornsea 3 almost being ready for development (2.9GW) (Economy_114).
- In April 2022 the government set an ambition to deploy up to 50 gigawatts of offshore wind capacity in the UK by 2030, with up to 5 gigawatts to come from floating wind (Economy_377).
- Red-throated divers (*Gavia stellata*) are sensitive to non-physical, (noise and visual) disturbance by both commercial and recreational activities, including offshore wind farms. In the Greater Wash, displacement distances of up to 8km from offshore wind farms were recorded (Biodiv_573).
- A renewable energy plant has recently been granted permission for development within the east marine plan area, on the coast of Lincolnshire. The plant will export 80MW of renewable energy to the National Grid, created from advanced thermal conversion using energy from waste. The process will refuse derived fuel, which consists of pre-processed non-recyclable household waste. The plant will power 206,000 homes (Economy_459).

Renewables– Key trend data

- The technology to enable wave and tidal energy generation in the east marine plan area is at an earlier stage of development than offshore wind. However, it is anticipated that the amount of wave and tidal energy being generated will increase beyond 2020 (Economy_178).
- The capacity for offshore wind in the east marine plan area will increase over the next few years. Around 6.68GW worth of offshore wind developments are in pre-application stage. The following offshore wind developments are currently in/awaiting construction (Economy_114): The East Anglia Array consisting of East Anglia TWO (900MW), East Anglia THREE (1200MW), East Anglia ONE North (800MW); Hornsea 3 (2.9GW); Sofia (1400MW); and Dogger Bank Wind Farm (3.6 GW) consisting of Dogger Bank A (1.2GW), B (1.2GW) and C (1.2 GW) and should be completed by 2026. It will be capable of powering up to 6 million homes annually (Economy_409). Once Dogger Bank Wind Farm and Hornsea 3 are developed, the east marine plan area will hold a combined offshore wind farm capacity of over 12.6 GW (Economy_114).
- As part of Offshore Wind Leasing Round 4, The Crown Estate may proceed with the plan on the basis of a derogation due to the inability to rule out adverse effects on two of the protected sites forming part of 'the national site network' (Flamborough and Filey Coast SPA due to the potential impact on the kittiwake feature and the Dogger Bank SAC due to the likely impact on the sandbank feature of that site). However, this will reduce the environmental headroom in and around existing marine protected areas, resulting in potentially significant implications for other marine activities (Economy_457).

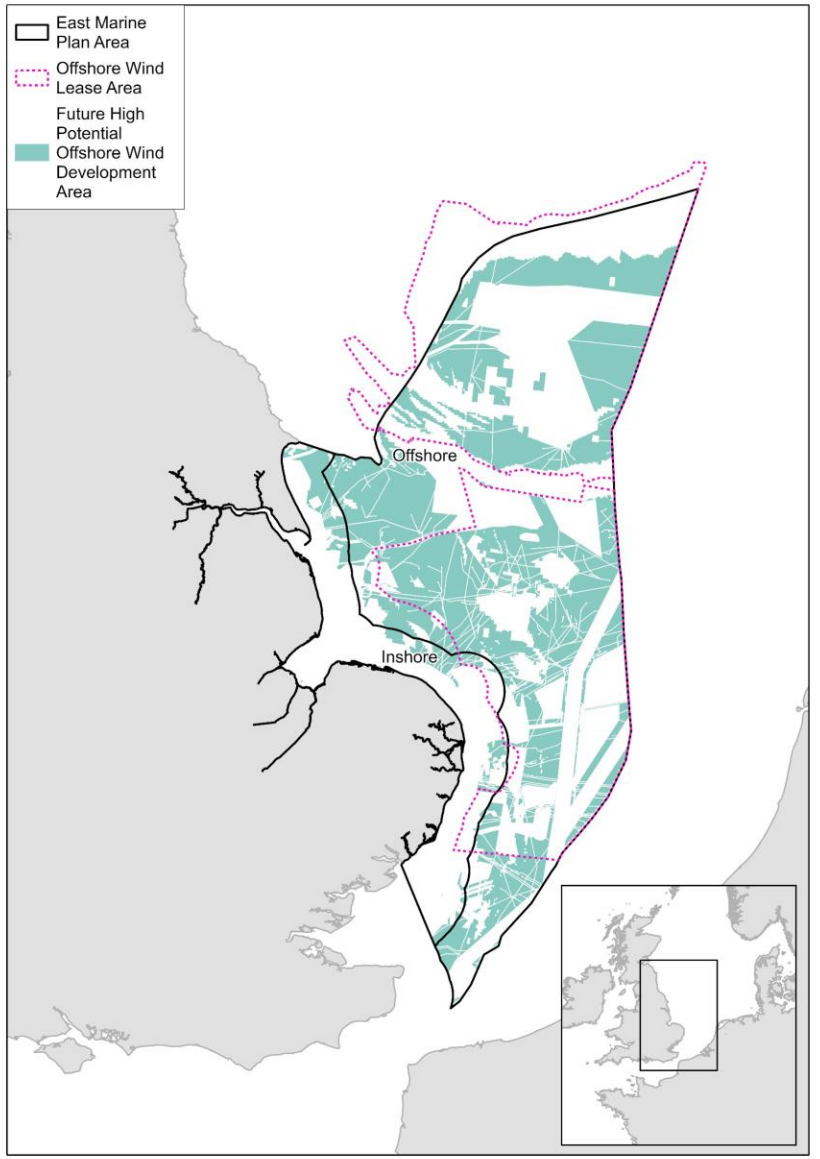

Figure 14: Renewable Energy Generation

Marine Management Organisation

Economy: Energy Generation and Infrastructure Development

Nuclear – Key baseline issues

- In 2023, nuclear power accounted for 13% of the UK's electricity generation (Economy_300).
- The following nuclear reactors are operational in the UK: Heysham 1 & 2, Hartlepool, Torness, and Sizewell B. Sizewell B power station is in the east marine plan area (Economy_110).
- Gigawatt scale nuclear power stations are generally sited in coastal locations and present specific social, environmental, and economic opportunities and challenges to the area they are situated within (Economy_273).

Nuclear – Key trend data

- Nuclear power generation has declined from a peak in the late 1990's with closure of power plants and no new reactors being built since 1995 (Sizewell B in the east marine plan area was the last). All currently operational reactors are scheduled to come offline by 2035 (Economy_411).
- The development of Sizewell C is proposed. If developed, Sizewell C will meet 7% of the UK's energy needs for at least 60 years, powering 6 million homes. The project will support 70,000 jobs across the UK and rely on over 3,000 UK-based suppliers. It will create thousands of local jobs and contribute around £4 billion to the regional economy. At the time of writing, Sizewell C is still awaiting a final investment decision.
- The government is currently in discussions with communities which could host a geological disposal facility, one of which is in the east marine plan area (Theddlethorpe) (Economy_414).
- The government has set a target for nuclear energy to contribute 24 GW of generation by 2050. It is likely that traditional gigawatt-scale technologies, as well as new small modular reactors and advanced modular reactors will contribute to achieving this target (Economy_420).

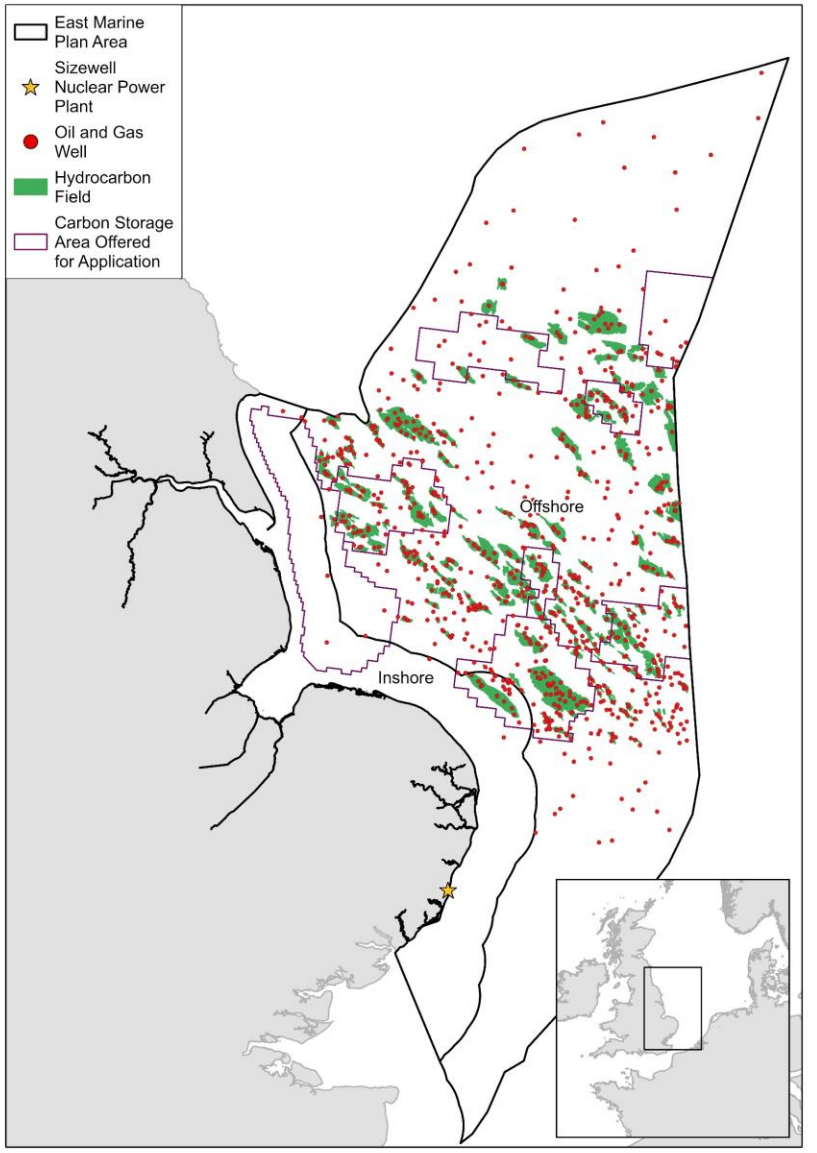

Figure 15: Fossil Fuel Energy Generation

Marine Management Organisation

Economy: Energy Generation and Infrastructure Development

Fossil Fuels – Key baseline issues

- In 2023, fossil fuels accounted for 33% of the UK's electricity generation, the lowest level since 1957 (Economy_300). In 2022, fossil fuels accounted for 79.3% of the UK's total energy generation (Economy_452).
- In 2013, there were 28 and 424 elements of oil and gas infrastructure in the east inshore and east offshore, respectively (Economy_99).
- In 2013, there were 868km2 of licenced hydrocarbon blocks in the east inshore and 23590km2 of licenced hydrocarbon blocks in the east offshore (Economy_100).
- The UK Offshore Energy SEA4 states that existing offshore oil and gas infrastructure in mature fields provide the potential for re-use as storage facilities where structure, design, life, and modifications allow. Decommissioning will also be considered where appropriate (Economy_189).

Fossil Fuels – Key trend data

- In 2022, UK port traffic (imports) included 10.174 million tonnes of coal. This has fallen significantly in the last decade; in 2012 UK port traffic included 47,040 million tonnes of coal (Economy_299).
- In 2023, 260 fixed and 20 floating oil and gas platforms existed in UK waters. Since the 1970s, the number of fixed and floating platforms has increased across the UK. The number of fixed platforms became stable from 2009-2017 and has since declined (Economy_427).
- Annual decommissioning expenditure has risen since 2020, with 2022 seeing an increase to £1.69 billion from £1.05 billion in 2020 and £1.21 billion in 2021, reflecting a higher level of decommissioning activity taking place (Economy_301).
- In 2022, oil production fell to 0.77 million barrels (bbls) per day, a decrease of 7.3% from 2021 and the lowest UK oil production rate since 2019. 0.55 bbls per day are predicted in 2028. Gas production grew by 17.4% to 0.57 million barrels of oil equivalent (boe) per day in 2022, from 0.48 million boe in 2021. 0.28 million boe per day are predicted in 2028 (Economy_302).
- In 2023, the UK exported £19.8 billion worth of crude oil and £12.0 billion worth of refined oil (Economy_425).
- The government have committed to maximising economic domestic gas production through issuing new licenses (Economy_426).

Carbon Capture and Storage – Key baseline issues

- The East Coast Cluster (ECC) has been named as one of the UK's first carbon capture, usage and storage (CCUS) clusters following a successful bid to the Department for Business, Energy & Industrial Strategy. A collaboration between Northern Endurance Partnership, Net Zero Teesside and Zero Carbon Humber, the East Coast Cluster aims to remove nearly 50% of all UK industrial cluster CO2 emissions with the aim to create and support an average of 25,000 jobs per year between 2023 and 2050 (Economy_116).
- Potential projects for CCUS in the east marine plan area include the Humber and Yorkshire CCUS project and the Bacton Energy Hub (Economy_115; Economy_453).
- The CCUS Action Plan recommends industry and government to identify North Sea and east Irish Sea oil and gas infrastructure at risk of being decommissioned in the next 5-10 years which could be maintained as "strategic assets" for CCUS use in the future (Economy_298).

Carbon Capture and Storage – Key trend data

- The availability of sites for CO2 storage is likely to increase and has the potential to exploit existing infrastructure (Economy_109).
- Twelve companies secured a total of 20 licences as part of the UK's first-ever carbon storage licensing round. Shell, Perenco and Eni have all been awarded licences off the coast of Norfolk in sites that could form part of the Bacton Energy Hub (Economy_454).
- There are further approved areas for CCUS licenses in the east off the Wash (Track 2: Viking) (Economy_419).
- Hydrogen is a fast-emerging sub-sector of CCUS that may be trialled in the east marine plan area (Economy_352). The ECC aims to use CCUS enabled low carbon H2 (Economy_116). The technology is still in development, and locations for implementation need to be agreed. The government aims to deliver 5GW of hydrogen production capacity by 2030 however (Economy_355).

Marine Management Organisation

Climate

Climate – Key baseline issues

- For the UK's marine environment, the impacts of climate change include relative sea level rise, increased seawater temperatures, ocean acidification and changes in ocean circulation (Climate_45).
- Climate change mitigation can be implemented through natural means of flood defence using ecosystem-based approaches and ensuring that that inappropriate types of development are not permitted in those areas most vulnerable to coastal change (Climate_57).
- Marine, coastal and ocean ecosystems are an important store for carbon and are referred to as blue carbon sinks. Marine habitats, such as salt marsh, seagrass, kelp and biogenic reefs can naturally sequester carbon (Carbon_141) to act as a form of climate change mitigation. Implementing nature-based solutions, such as habitat restoration, can help to increase the carbon sequestration rate within the east marine plan area (Climate_149). The restoration handbooks are a key tool for improving habitats, particularly saltmarsh and seagrass (Climate_159).
- Saltmarshes have an estimated sequestration rate of 0.24MtCO2e/yr (Climate_144). Restored saltmarshes are believed to have a lower sequestration ability than natural saltmarshes (Climate_146).
- Seagrasses have an estimated sequestration rate of 0.02MtCO2e/yr (Climate_145). Small pockets of seagrass exist on the Norfolk coast, near to Wells-next-the-Sea and Blakeney (Biodiv_560).
- Kelp has an estimated sequestration rate of 0.27 MtCO2e/yr (Climate_143). The east inshore marine plan area holds 74km2 of kelp (*Laminaria hyperborea*) (Biodiv_516).
- It is thought that biogenic reefs may also act as a carbon sink. *Sabellaria spinulosa* reef's ability to consolidate sediment means that it should be considered to have the same blue carbon potential as surrounding sediments (Climate_148). To date, in the UK, well-developed and stable *S. spinulosa* reefs are only known within the Wash and its surrounding waters (Biodiv_523).
- Climate impacts have wider environmental and social implications from inundation processes, anthropogenic action such as development of coastal defence and other coastal infrastructure (such as cable and pipe landfall and new port infrastructure), and sea-level change (Climate_52).
- As demonstrated on the National Coastal Erosion Risk Map, the majority of the preferred management options for coastal erosion from the shoreline management plans in the east marine plan area are 'hold the line', particularly at Bridlington, Hornsea and Felixstowe, while the preferred management option is managed realignment along the Norfolk coastline (eg: Cromer). Lowestoft incorporates a mixture of both management options. There are large sections of no active intervention at Hollesley Bay, and between Flamborough and Withensea (Geol_47).
- Several initiatives such as the Coastal Transition Accelerator Programme and the Flood and Coastal Resilience Innovation Programme are active in areas adjacent to the east marine plan areas and look to assist in the adaptation of communities to coasts which cannot be sustainably defended from coastal erosion (Climate_163, Climate_164).
- Green technology, such as emissions reduction technologies, alternative fuels, and 'scrubber' systems, could help to mitigate against maritime contributions to climate change, but its effectiveness could be limited by slow uptake for costly or unproven technologies (Climate_86).
- In England, 520,000 properties (including 370,000 homes) are located in areas with a 0.5% or greater annual risk from coastal flooding and 8,900 properties are located in areas at risk from coastal erosion, not taking into account coastal defences (Climate_293).
- Yorkshire and the Humber has 351km of coast, with 203km (56%) eroding, but only 156km (43%) with defences or artificial beaches (Climate_59).
- The highest number of properties at risk from coastal flooding is likely to be around Yorkshire and the Humber Estuary (Climate_27).
- It has been observed that phytoplankton and zooplankton communities (excluding larval fish) have extended distributions at remarkable rates (such as in the northeast Atlantic) with implications for marine food webs (Climate_61).

Marine Management Organisation

Climate

Climate – Key trend data

- Average UK temperatures have risen since the mid 20th century, as have average sea level and sea surface temperatures around the UK coast. There has been an approximate 14cm rise in mean sea level since the beginning of the 20th century, which has significantly increased (as much as doubled) the risk of flooding at many locations around the coast. Taking account of the vertical movement of land, this gives slightly larger sea level rise projections in the southern UK where land is subsiding, compared to the northern UK (Climate_24).
- There are likely to be effects on commercial fisheries if temperature and salinity changes in the future, as a consequence of climate change, as this will affect the range and distribution of many marine species. Research suggests that UK waters will become less suitable for species including Atlantic cod (*Gadus morhua*) and saithe (*Pollachius virens*) (Climate_150).
- In the absence of adaptation or mitigation (which may become prohibitively expensive) some beaches will narrow and habitats such as dune systems (Climate_47) and saltmarsh (Climate_62) may be lost.
- Without any further investment in flood defences, the number of properties at medium or high risk could rise from 0.75 million to 1.29 million in 50 years (Climate_90).
- There is likely to be a growing demand for marine aggregate material to support large scale coast defence schemes, and subsequently protect communities and key infrastructure (Climate_158).
- As more marine habitats such as seagrass meadows are restored, the ability to natural sequester carbon will increase (Climate_141).
- Marine Net Gain (MNG) is likely to come into legislation within the East Marine Plan period. Consultation on what MNG could include revealed that stakeholder perceived the most important ecosystems services to be those related to climate regulation, among others (Biodiv_561).

Marine Management Organisation

Pollution: Air Pollution

Air Pollution – Key baseline issues

- Shipping is a key contributor to sulphur dioxide, nitrous oxide and particulate matter 2.5. In 2021, domestic shipping (ships that start and end their journey in the UK) accounted for 12.7% of the UK's total domestic NOx emissions, 2.2% of PM2.5 and 4.9% of SO2 (Pol_35).
- International shipping (ships that go to or come from international destinations) emissions have a significant impact on air quality in the UK due to shipping lanes and engine operation while at UK ports. In 2016, it was estimated that NOx emissions from international shipping and shipping in transit were around 3 and 6 times higher respectively, than the NOx emissions from UK domestic shipping. (Pol_35).
- This hive of maritime activity witnessed in recent years has come with an environmental footprint. International shipping is responsible for 2.2% of global CO2 emissions and, unless action is taken, this figure is expected to rise (Pol_39).
- The major ports in the east inshore marine plan area include: Goole, Rivers Hull and Humber, River Trent, Hull, Felixstowe, Grimsby and Immingham. Increased shipping activity, port expansion and associated industry growth at the Port of Felixstowe could lead to increased sulphur oxides and nitrous oxides emissions at coastal locations, which in turn could contribute to the breach of national objectives for air quality (Pol_11).
- There are large differences between summer and winter. Partly, they can be ascribed to seasonal differences in the emissions, with higher shipping emissions in summer. Most of the differences in the concentrations are caused by atmospheric chemistry. As a photochemical pollutant, ozone is only increased during the summer months (Pol_20).
- There is the potential for negative cumulative ecological effects from air quality as a result of new nuclear power stations and offshore oil and gas installations, this will need to be addressed as part of the cumulative effects assessment carried out as part of the sustainability appraisal. The Environment Agency assesses that non-radioactive aerial emissions (sulphur dioxide, nitrogen oxides and volatile organic compounds) from nuclear power stations are extremely low compared to other regulated industries. However, this does not equate to no adverse effects (Pol_12).
- Ongoing challenges with air quality (from transport emissions amongst others) in air quality management areas (AQMAs) at the coast and on land could lead to eutrophication of the marine environment and acid deposition effects (Pol_15).
- There are emission control areas (ECA) in place in the North Sea for sulphur oxides and nitrogen oxides. The entire east inshore and offshore marine plan areas are within the North Sea ECA. The marine plan areas have more restrictive emissions standards and this may have transboundary effects on air pollutants (Pol_60).
- The Clean Maritime Plan was developed in 2019, requiring major ports (any port handling cargo volumes of at least one million tonnes annually) to develop air quality strategies. Within the east marine plan area, this includes Felixstowe and Grimsby and Immingham. In line with the plan's aim of a net zero maritime industry by 2050, all new vessels being ordered for use in UK waters are being designed with zero-emission propulsion capacity (Pol_47 and Pol_48).
- Within 10km of the inshore east marine plan area there are around 20 AQMAs. Felixstowe Port, Hull Port and Grimsby Port are designated AQMAs (Pol_9).
- Emissions from multiple vessels that are tied up alongside each other can have negative impacts on air quality (Pol_19).

Air Pollution – Key trend data

- There is increasing pressure upon the maritime sector to reduce its carbon and pollutant emissions. In 2020 a global 0.5% sulphur cap came into force. The International Maritime Organization agreed ambitious global targets for at least 50% carbon reduction by shipping by 2050. The need to meet new environmental targets will require the use of new, innovative technologies (Pol_40).
- Connecting ships and other vessels to on shore electricity supply at ports and marinas can help reductions in pollutant emissions through alleviating the need for on board energy generation. There are opportunities for existing development to explore the opportunities for shore-side electricity supply connections and further reduce emissions at port side (Pol_27).
- While improvements to fuel efficiency will be essential in addressing both air quality pollutants and greenhouse gas emissions, there has been research which suggests energy efficiency improvements alone will not be sufficient to achieve absolute reductions in shipping's CO2 emissions whilst transport demand increases (Pol_38).

Marine Management Organisation

Pollution: Water Pollution and Water Quality

Water Pollution and Water Quality – Key baseline issues

- Most of the areas in UK seas where there are problems from contamination with hazardous substances are local in nature. These are particularly in industrialised estuaries and coasts and generally associated with historic discharges and emissions from industry and agriculture (Pol_104).
- The UK has largely achieved its aim of good environmental status (GES) for eutrophication. A small number of eutrophication problems remain in coastal and estuarine waters, representing 0.03% of the total UK exclusive economic zone, and 0.41% of estuarine and coastal waters (Pol_174, Pol_175).
- The UK continues to achieve its aim of GES for hydrographical conditions (Pol_176).
- The UK has largely achieved its aim of GES for contaminants. Concentration of hazardous substances and their biological effects are generally meeting agreed target thresholds. Highly persistent legacy chemicals are the cause of the few failures, mainly in coastal waters close to polluted sources (Pol_177, Pol_178).
- Terrestrial coastal areas of the region are designated as nitrate vulnerable zones under the Nitrates Directive and are susceptible to eutrophication from the drainage of nitrate (Pol_76).
- The Anglian and the Humber River Basin Management Plans (RBMP) consider methods to address sediment issues, including dredging guidance and reductions in diffuse pollution and sediment-based pollutants to improve water quality to meet the objectives of the Water Framework Directive.
- The Anglian RBMP demonstrates in the coastal and estuarine waters that much of the coastline is of moderate ecological status (71.4%), with 7.8% classified as good. All water bodies failed the chemical status for surface waters. Over half of the groundwater in the coastal waters is classified as of good quantitative status (54.8%) and good chemical status (51.6%). In total between January 2016 and March 2022, 2,253km were enhanced and between April 2018 and March 2022, 308km have been protected along the Anglian River basin district (Pol_110).
- The Humber RBMP demonstrates in the coastal and estuarine waters that much of the coastline is of moderate ecological status (65.7%), with 15.2% classified as good. All water bodies failed the chemical status for surface waters. Most of the groundwater in the coastal waters is classified as of good quantitative status (80.4%) and around half of good chemical status (49.0%). In total between January 2016 and March 2022, 1,711km were enhanced and between April 2018 and March 2022, 215km have been protected along the Anglian River basin district (Pol_111).
- There are around 600 combined sewer overflows (CSOs) along the east marine plan area coastline. Large clusters exist around Norwich (121 CSOs) and Hull (96 CSOs) (Pol_195). CSOs allow sewage to enter coastal waters to reduce pressure on water systems in events of heavy rainfall, reducing the risk of flooding. This may contribute to pollution through contamination and the creation of harmful algae blooms (Pol_142).
- Developments and other activities can have adverse effects on transitional waters, coastal waters and marine waters. This includes increased demand for water, discharges to water, adverse ecological effects resulting from physical modifications to the water environment, increased risk of spills and leaks, and transmission of invasive non-native species. Movement of water offshore between catchments means that action in one catchment can impact water quality in waters at some distance away. These interactions are important in managing catchment activities (Water_44).
- The following rivers in the east marine plan area are designated as a ‘Sensitive Area (Eutrophic)’ under the Urban Waste Water Treatment Directive: River Ant; River Bure; River Wensum; River Tiffey and Yare; River Waveney/ Starston Brook and River Dove; Bottesford Beck; Woldgrift Drain; Louth Canal; and Bourne Eau/River Glen (Pol_159).
- The following water bodies in the east marine plan area are designated as a ‘Sensitive Area (Shellfish Water)’ under the Urban Waste Water Treatment Directive: Blakeney (Class A) and Southeast Wash (Class B and C) (Pol_156).
- Thirty-seven water bodies along the Humber river basin district are 'at risk' from abandoned coal mines. This is 21% of the total river basin (Pol_160).

Marine Management Organisation

Pollution: Water Pollution and Water Quality

Water Pollution and Water Quality – Key trend data

- The number of ‘Poor’ quality bathing waters has risen from 12 in 2020 to 18 in 2023. The number of ‘Excellent’ quality bathing waters has increased from 110 in 2020 to 218 in 2023 (Pol_165).
- An increase in chemical fertiliser use has increased nutrient pollution to coastal waters. It is projected that by 2030 global nitrogen input into the sea will have increased by 14% from 1995 levels (Pol_166).
- Analysis of data from 2000 to 2014 shows an overall general decrease in discharges and emissions from oil and gas industry (Pol_121, Pol_122)
- Decommissioning of oil and gas infrastructure is forecast to increase post 2020 (Pol_136). This has potential to lead to impact water quality and marine ecosystems through the emission of hydrocarbons during the decommissioning phase, particularly if not well managed (Pol_187). In the next 3 decades an estimated 500 oil and gas platforms will be decommissioned (Pol_137).